

Actuarial Review of the 2022 Accounting Disclosures for the North Carolina Office of the State Auditor

November 2022



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November 21, 2022

Mr. Jacob Taitague, CPA
Assistant State Auditor
Office of the State Auditor
2 S. Salisbury St.
20601 Mail Service Center
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Re: North Carolina Actuarial Review of 2022 Accounting Disclosures

Dear Mr. Taitague:

Gabriel, Roeder, Smith & Company (GRS) is pleased to present this report of an Actuarial Review of the 2022 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 Buck Global ("Buck") and The Segal Group ("Segal") 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 2023. 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, 2022:

- 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.

Mr. Jacob Taitague
Office of the State Auditor
November 21, 2022
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The purpose of this report is to provide the results of our actuarial review, described on the previous page, 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.

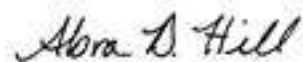
In our opinion, the assumptions and methods used in the 2022 valuations of the aforementioned plans are reasonable and comply with the Governmental Accounting Standards Board (GASB) Statement Nos. 67 and 74 and comply with practices promulgated by the Actuarial Standards. The intended audience is the OSA. The authors of this report are available to answer questions.

The signing actuaries are independent of the plan sponsor.

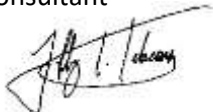
This report was prepared using our proprietary models (valuation model, capital markets model, etc.) and related software which, in our professional judgment, have the capabilities to provide results that are consistent with the purposes of the review and has no material limitations or known weaknesses. We performed tests to ensure that the models reasonably represent that which is intended to be modeled. We have also relied on the GRS actuaries and Internal Software, Training, and Processes Team who developed and maintain the model.

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,
Gabriel, Roeder, Smith & Company



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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 2022 disclosures the State will include in its Comprehensive Annual Financial Report.

This report covers the work of the first engagement. A report covering the work of the second engagement will be issued in early 2023. 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, 2022:

- 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.

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; and
- 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; and
- Comments Regarding Test Lives Review.

Section 4 – Review of the Respective GASB Reports

- Content Review; and
- Calculations Review.

Section 5 – Comments and Conclusions

- Comments;
- Prior Year’s Recommendations;
- Conclusions; and
- Recommendations for future years.

Conclusion

In our opinion, the assumptions and methods used in the December 31, 2021 valuations of the aforementioned plans are reasonable and comply with the Governmental Accounting Standards Board (GASB) Statement Nos. 67 and 74 and comply 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.

SECTION 1

EXPERIENCE STUDY REVIEW

Experience Study

The Experience Studies appear to be on a five-year cycle and assumptions have not changed since we reviewed them in our 2021 report. We are therefore incorporating our comments regarding the demographic assumptions from our 2021 report, largely unchanged. Note that the most recent Experience Study was performed by a different actuarial firm than the current firm performing the pension valuations, however the assumptions adopted from the Experience Study are still utilized in the pension valuations. This section reviews the demographic assumptions and actuarial methods, while the next section (II) contains the review of the economic assumptions.

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, 2020 through December 31, 2024. We were provided the most recently completed experience study, dated December 9, 2020, covering the period January 1, 2015 through December 31, 2019. We have 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 December 9, 2020, and covering the five-year period ending on December 31, 2019. 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 No. 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. The proposed non-mortality demographic assumptions were generally set to reflect actual experience during the study period (i.e., the ratio of actual to expected decrements based on the proposed assumptions was very close 1.0).

We find the recommended assumptions (which were in use for the December 31, 2021 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 were adjusted based on TSERS actual experience. The common industry convention 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 certain groups/statuses (or a combination thereof) were analyzed together in order to increase credibility (e.g., beneficiaries, non-safety disabled retirees, safety disabled retirees). The report demonstrates that considerations for setting mortality assumptions promulgated in ASOP 35 were followed. We noted that for some groups various scaling factors were applied based on age (similar to the previous experience study). While we believe this to be a reasonable adjustment to reflect the System's experience, not enough detail was given to see how the adjustments for each age were calculated.

We find the recommended assumptions (which were in use for the December 31, 2021 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, 2020 through December 31, 2024. We were provided the most recently completed experience study, dated December 9, 2020, covering the period January 1, 2015 through December 31, 2019. We have 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 December 9, 2020, and covering the five-year period ending on December 31, 2019. We have reviewed that report and find that the recommended assumptions are reasonable, based on LGERS actual experience (as detailed in that report). The experience study report reviewed demonstrates that these guidelines were followed in the development of the recommended assumptions. The proposed non-mortality demographic assumptions were generally set to reflect actual experience during the study period (i.e., the ratio of actual to expected decrements based on the proposed assumptions was very close 1.0).

We find the recommended assumptions (which were in use for the December 31, 2021 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 were adjusted based on LGERS actual experience. As noted under the TSERS section the report is silent as to the process used to adjust the rates for certain ages. For beneficiaries, the report indicates that beneficiaries from all the systems were combined to provide additional credibility. Non-safety disabled retirees were combined and safety disabled retirees were combined for the same reason. In general, 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, 2021 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, 2020 through December 31, 2024. We were provided the most recently completed experience study, dated December 9, 2020, covering the period January 1, 2015 through December 31, 2019. We have reviewed the demographic assumptions recommended from this study that are currently in use for the funding and GASB valuations.

The demographic experience for RODSPF is combined with the LGERS in the analysis. Therefore, 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.

The experience study report recommends updated disability and disability claim termination rates for DIPNC. The report provided to us for review showed neither the details of the current assumptions nor the actual experience. 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.

In addition, for DIPNC, the experience study recommends projecting the valuation pay to the appropriate period rather than assuming that pay does not increase from disablement.

We find the recommended assumptions (which were in use for the December 31, 2021 funding valuation) to be reasonable for use in the funding and GASB valuations.

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 Statement No. 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.

The most recent experience study proposed changes to some of the actuarial methods. The method for calculating the liability attributable to TSERS and LGERS terminated vested members is based on estimated benefits rather than 200% of each member's contribution balance. For RODSPF, the liability is based on each member's benefit provisions rather than the provisions for pre-2009 hires. In addition, the study recommends implementing direct rate smoothing over a five-year period to mitigate large contribution rate increases.

We find the methods used for the funding valuation to comply with the ASOPs and reasonable for funding. We find the methods used for the GASB valuation to be in accordance with 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 the 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 comply with the ASOPs and reasonable for funding. We find the methods used for the GASB valuation to be in accordance with 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 and actuarial methods used for the funding and GASB valuations to be reasonable.

SECTION 2

REVIEW OF ECONOMIC ASSUMPTIONS

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

Actuarial Standards of Practice No. 27, Selection of Economic Assumptions for Measuring Pension Obligations, provides guidance on the selection of economic assumptions for measuring obligations for defined benefit plans. The standard requires that the selected economic assumptions be consistent with each other. That is, the selection of the investment return assumption should be consistent with the selection of the wage inflation and price inflation assumptions.

ASOP No. 27 defines a reasonable economic assumption as an assumption that is:

1. Appropriate for the purpose of the measurement;
2. Reflects the actuary’s professional judgment;
3. Takes into account historical and current economic data that is relevant as of the measurement date;
4. Is an estimate of future experience, an observation of the data inherent in market data or a combination thereof; and
5. Has no significant bias (i.e., it is not significantly optimistic or pessimistic) except when provisions for adverse deviation or other factors included and disclosed under Section 3.5.1, or when alternative assumptions are used for the assessment of risk.

However, the standard explicitly advises an actuary not to give undue weight to recent experience.

ASOP No. 27 acknowledges that for any given economic assumption, there is a reasonable range of opinions on that assumption.

Inflation

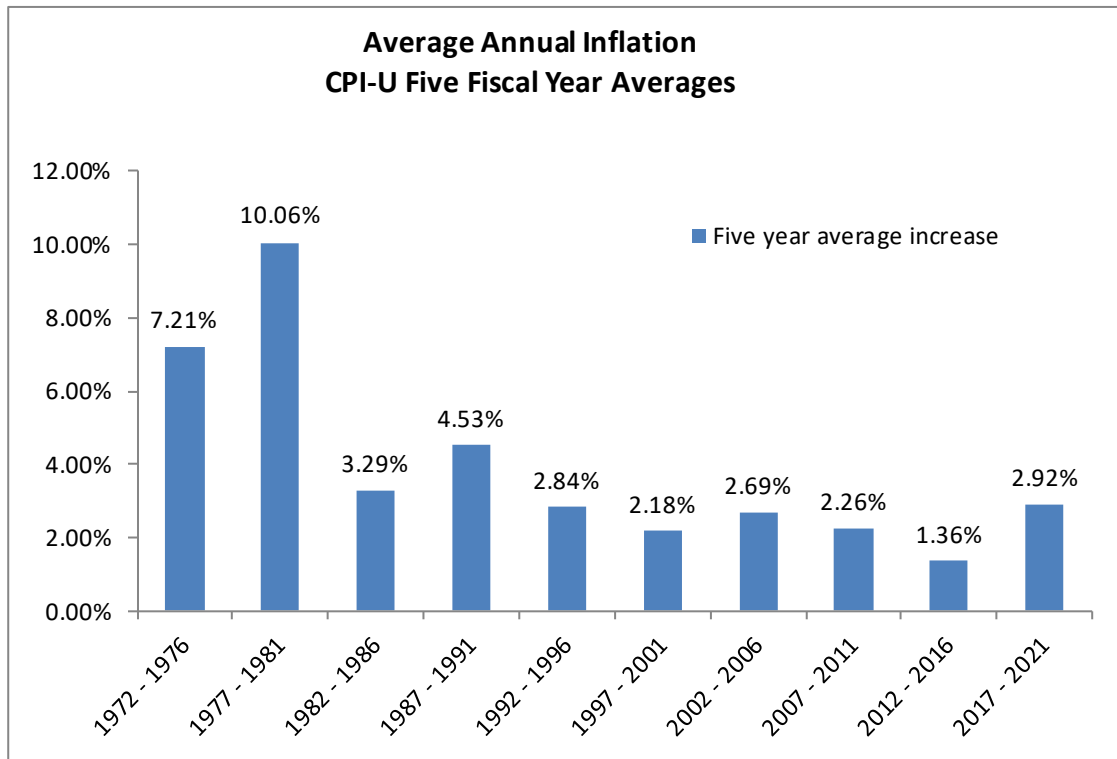
By “inflation,” we mean price inflation, as measured by annual increases in the Consumer Price Index (CPI). This inflation assumption underlies all of the other economic assumptions. It not only impacts investment return, but also salary increases and other inflation linked benefits.

Over the five-year period from 2016 through 2021, the CPI-U has increased at an average rate of 2.92%.

The table on the following page shows the average inflation over various periods ending December 31, 2021.

Fiscal Year	Annual Increase in CPI-U
2017	2.11%
2018	1.91%
2019	2.29%
2020	1.36%
2021	7.04%
3-Year Average	3.53%
5-Year Average	2.92%
10-Year Average	2.14%
20-Year Average	2.31%
25-Year Average	2.28%
30-Year Average	2.37%
40-Year Average	2.76%
50-Year Average	3.90%

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



As the above graph illustrates, recent inflation experience is much different than that of the 1970s and 1980s. The geometric average price inflation was 2.37% per year over the last 30 years, ending December 31, 2021; 2.31% over the last 20 years and 2.14% 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.

We surveyed the inflation assumption used by twelve nationally recognized firms (investment consultants, asset managers, and insurance companies) across the country. In our sample of these firms, the short-term inflation assumption ranged from 2.26% to 3.10%, with an average of 2.53%; the long-term inflation assumptions ranged from 2.20% to 3.10%, with an average of 2.49%.

Another point of reference is the Social Security Administration's (SSA) 2021 Trustees Report, in which the Office of the Chief Actuary is projecting a long-term ultimate intermediate annual inflation rate assumption of 2.4%. 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 Annual Inflation Forecasts (From Professional Experts in the Field of Forecasting Inflation)^a	
Congressional Budget Office^b 5-Year Annual Average 10-Year Annual Average	3.23% 2.81%
Federal Reserve Bank of Philadelphia^c 5-Year Annual Average 10-Year Annual Average	3.40% 2.80%
Federal Reserve Bank of Cleveland^d 10-Year Expectation 20-Year Expectation 30-Year Expectation	2.40% 2.41% 2.45%
Federal Reserve Bank of St. Louis^e 10-Year Breakeven Inflation 20-Year Breakeven Inflation 30-Year Breakeven Inflation	2.62% 2.78% 2.47%
U.S. Department of the Treasury^f 10-Year Breakeven Inflation 20-Year Breakeven Inflation 30-Year Breakeven Inflation 50-Year Breakeven Inflation 100-Year Breakeven Inflation	2.44% 2.60% 2.40% 2.50% 2.57%
Social Security Trustees^g Ultimate Intermediate Assumption	2.40%

^aEnd of the Second Quarter, 2022. Version 2022-08-09 by Gabriel, Roeder, Smith & Company

^bThe Budget and Economic Outlook: 2022 to 2032, Release Date: May 2022, Consumer Price Index (CPI-U), Percentage Change from Year to Year, 5-Year Annual Average (2022 - 2026), 10-Year Annual Average (2022 - 2031).

^cSecond Quarter 2022 Survey of Professional Forecasters, Release Date: May 13, 2022, Headline CPI, Annualized Percentage Points, 5-Year Annual Average (2022 - 2026), 10-Year Annual Average (2022 - 2031).

^dInflation Expectations, Model output date: June 1, 2022.

^eThe 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: June, 2022.

^fThe Treasury Breakeven Inflation (TBI) Curve, Monthly Average Rates, June, 2022.

^gThe 2022 Annual Report of The Board of Trustees of The Federal Old-Age And Survivors Insurance and Federal Disability Insurance Trust Funds, June 2, 2022, Long-range (75-year) assumptions, Intermediate, Consumer Price Index (CPI-W), for 2026 and later.

Taking all of this information into consideration, we believe that the 2.5% price inflation assumption currently used in the funding and GASB valuations is reasonable. We believe that a price inflation assumption in the range of 2.25% to 2.75% 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 (low) and it results in an investment rate of return that is also too high (low), the resulting valuations can be too optimistic (pessimistic) and/or contributions that may be too low (high). However, if the investment rate of return assumption is not too high, then a price inflation that is higher than future expectations may support could actually add a margin for adverse experience when measuring liabilities. In other words, 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 TSERS, LGERS, RODSPF, and DIPNC this assumption was adjusted after the 2015-2019 experience study. 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, 2021 funding valuations was 6.5%. Based on the reported asset allocation (and the target allocation shown in the Annual Comprehensive Financial Report) and a 2.50% price inflation assumption, 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. It is important to note that for both LGERS and TSERS, a large portion (approximately 25%, each) of their asset allocation (as reported in the December 31, 2021 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 uses an assumed of investment return of 3.00%. Since these funds are primarily invested in fixed income vehicles, we believe this is a reasonable assumption for funding and for the long expected rate of return for GASB, based on a 2.50% inflation assumption.

We have tested this assumption using our 2022 Capital Markets Assumption Model and the reported asset allocation in the December 31, 2021 reports. In 2022, the capital market assumptions used by the consultants who provide that information to us have continued to decrease. Based on our 2022 model, the 6.5% assumption is near the top of the range we would consider to be reasonable using the current NCRS asset allocation.

Wage inflation, Payroll Growth and Pay Increases

These items were studied as part of the most recent experience study. These respective experience studies provide enough detail to demonstrate that the recommended assumptions (which were used in the December 31, 2021 funding valuations) are reasonable.

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. We note the trend rates are consistent with the rates used in the previous valuation.

Summary

In summary, we find the economic assumptions to be reasonable for funding and GASB.

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 changed to non-active status. The active cases are shown below:

Test Case	Age	Service	Reported Pay	Sex	Valuation			
					Result	GRS	Buck	% Diff
1 Teacher	41.3267	10.5378	\$ 46,206.91	F	EAAL	\$ 76,182	\$ 81,982	-7.07%
					PVB	132,139	144,746	-8.71%
					NC	5,453	5,275	3.37%
					PVFS	496,714	551,391	-9.92%
2 Teacher	56.1107	4.5834	1,077,076.99	M	EAAL	950,211	928,349	2.35%
					PVB	2,244,150	2,107,786	6.47%
					NC	184,047	143,575	28.19%
					PVFS	7,806,033	8,920,083	-12.49%
3 General	61.1189	6.1667	99,372.00	M	EAAL	117,533	117,599	-0.06%
					PVB	195,971	200,806	-2.41%
					NC	16,152	15,252	5.90%
					PVFS	495,945	526,301	-5.77%
4 General	42.6831	19.8333	69,033.04	F	EAAL	281,664	285,375	-1.30%
					PVB	316,242	328,419	-3.71%
					NC	5,052	5,403	-6.50%
					PVFS	487,054	536,910	-9.29%
5 Other	58.7746	20.0000	48,402.13	M	EAAL	177,594	178,179	-0.33%
					PVB	206,712	206,217	0.24%
					NC	6,404	5,965	7.36%
					PVFS	229,114	224,808	1.92%
6 General	35.0821	2.9167	35,831.20	M	EAAL	15,043	13,815	8.89%
					PVB	60,541	57,215	5.81%
					NC	4,195	3,705	13.23%
					PVFS	396,148	402,158	-1.49%
7 General	54.75	12.5833	45,667.58	M	EAAL	97,799	101,819	-3.95%
					PVB	139,383	143,870	-3.12%
					NC	6,040	5,526	9.30%
					PVFS	324,914	343,418	-5.39%
8 Teacher	45.9824	22.5000	65,660.64	F	EAAL	310,803	330,709	-6.02%
					PVB	333,660	371,206	-10.11%
					NC	4,822	6,579	-26.71%
					PVFS	318,161	398,222	-20.10%
9 Teacher	53.1189	23.5000	36,777.85	M	EAAL	176,198	174,252	1.12%
					PVB	198,198	197,841	0.18%
					NC	4,357	3,998	8.98%
					PVFS	191,746	213,702	-10.27%
Total Test Cases					EAAL	2,203,027	2,212,079	-0.41%
					PVB	3,826,996	3,758,106	1.83%
					NC	236,522	195,278	21.12%
					PVFS	10,745,829	12,116,993	-11.32%

In prior reports, we valued Test Case 2 reflecting the compensation limit under 401(a)(17). Buck indicated that they did not apply any salary limits in their valuation and therefore our figures in the report do not reflect the salary limit



TSERS

Retirees

GRS requested test life information on 17 retiree cases. One retiree is no longer receiving benefits. Two cases that moved from active and terminated vested status are also included. The retiree cases are shown below:

Test Case	Age	Option Code	Current Monthly Benefit	Sex	Valuation Result	GRS	Buck	% Diff
1 - Law Enf. (beneficiary)	82.29	OPT3	\$525.90	F	EAAL/PVB	\$ 40,672	\$ 39,467	3.05%
2 - General	76.04	MAX	281.00	F	EAAL/PVB	29,475	29,244	0.79%
3 - Teacher	64.46	MAX	3,499.43	F	EAAL/PVB	509,434	511,124	-0.33%
4 - General	78.62	OPT62	718.35	F	EAAL/PVB	86,749	84,723	2.39%
5 - General	67.88	MAX	365.78	F	EAAL/PVB	48,468	48,203	0.55%
6 - General (beneficiary)	57.62	OPT62	1,621.65	F	EAAL/PVB	244,825	233,717	4.75%
7 - Other	70.38	MAX	1,476.94	M	EAAL/PVB	169,614	170,659	-0.61%
8 - Other	68.29	OPT62	1,795.69	M	EAAL/PVB	262,636	260,049	0.99%
9 - General (disabled)	61.88	OPT2	1,656.99	F	EAAL/PVB	257,418	253,428	1.57%
10 - Teacher (disabled)	69.04	OPT62	1,231.57	M	EAAL/PVB	170,331	167,602	1.63%
11 - General (disabled)	58.79	MAX	1,349.73	M	EAAL/PVB	157,104	155,594	0.97%
12 - Other	58.79	MAX	778.77	F	EAAL/PVB	120,074	119,661	0.35%
13 - General	68.96	OPT62	2,966.47	F	EAAL/PVB	538,434	525,870	2.39%
14 - General (disabled)	61.96	OPT2	970.95	F	EAAL/PVB	142,378	140,627	1.25%
15 - General (disabled)	63.46	MAX	1,913.79	M	EAAL/PVB	205,103	205,730	-0.30%
16 - Teacher (disabled)	61.62	MAX	2,079.58	F	EAAL/PVB	267,490	265,057	0.92%
17 - General (disabled)	66.04	MAX	2,049.06	M	EAAL/PVB	208,439	207,665	0.37%
18 - Other	68.21	MAX	487.05	F	EAAL/PVB	64,005	64,184	-0.28%
Total Test Cases					EAAL/PVB	3,522,649	3,482,604	1.15%

TSERS

Terminated Vested

GRS requested test life information on 13 terminated cases. One of these members retired. The terminated vested and non-vested cases, are shown below:

<u>Test Case</u>	<u>Age</u>	<u>Service</u>	<u>Accumulated Contributions</u>	<u>Sex</u>	<u>Valuation Result</u>	<u>GRS</u>	<u>Buck</u>	<u>% Diff</u>
1 - General	63.2159	14.1667	\$ 40,498.49	M	EAAL/PVB	\$ 68,366	\$ 77,649	-11.96%
2 - Teacher*	40.3470	9.7727	33,481.47	M	EAAL/PVB	33,481	33,481	0.00%
3 - General	50.1886	8.9166	41,815.36	F	EAAL/PVB	50,580	51,791	-2.34%
4 - Other	59.4906	11.5833	72,482.29	M	EAAL/PVB	116,158	114,716	1.26%
5 - Teacher	53.649	5.8636	11,870.62	F	EAAL/PVB	15,579	16,304	-4.45%
6 - General*	53.1831	16.2500	66,701.15	M	EAAL/PVB	66,701	67,576	-1.29%
7 - Other	46.5246	16.000	119,271.70	F	EAAL/PVB	123,955	164,124	-24.47%
8 - Teacher*	41.1381	11.8455	38,012.82	F	EAAL/PVB	38,013	38,013	0.00%
9 - Teacher*	40.1995	5.0122	14,897.43	F	EAAL/PVB	14,897	14,897	0.00%
10 - Other [#]	62.3157	2.2727	1,967.89	F	EAAL/PVB	1,968	1,968	0.00%
11 - Teacher [#]	33.4045	5.0000	14,410.99	F	EAAL/PVB	14,411	14,411	0.00%
12 - Teacher [#]	24.7555	3.0000	3,988.77	F	EAAL/PVB	3,989	3,989	0.00%
Total Test Cases					EAAL/PVB	548,098	598,919	-8.49%

* GRS Present Value of deferred benefits were lower than the contribution balances.

Values are equal to contribution balances.

Total TSERS

(Actives, Retirees, and Terminated Vested)

<u>Valuation Result</u>	<u>GRS</u>	<u>Buck</u>	<u>% Diff</u>
EAAL	\$6,273,774	\$6,293,602	-0.32%
PVB	7,897,743	7,839,629	0.74%



LGERS

Actives

GRS requested test life information on 10 active cases. One case changed to non-active status. The active cases are shown below:

Test Case	Age	Service	Reported Pay	Sex	Valuation			
					Result	GRS	Buck	% Diff
1 Law Enforcement	35.7132	14.4167	\$69,142.38	M	EAAL	\$ 193,106	\$ 192,668	0.23%
					PVB	273,970	286,508	-4.38%
					NC	8,326	9,001	-7.50%
					PVFS	699,158	709,128	-1.41%
2 Law Enforcement	94.1627	25.5833	48,258.56	M	EAAL	108,331	87,246	24.17%
					PVB	108,331	87,246	24.17%
					NC	0	0	
					PVFS	0	0	
3 Fire & Rescue	41.3854	15.7500	70,784.85	F	EAAL	199,164	211,325	-5.75%
					PVB	288,088	295,161	-2.40%
					NC	9,338	8,736	6.89%
					PVFS	703,385	671,317	4.78%
4 Fire & Rescue	47.4127	27.4167	74,017.88	M	EAAL	471,433	486,848	-3.17%
					PVB	493,620	516,517	-4.43%
					NC	7,315	9,208	-20.56%
					PVFS	231,185	235,123	-1.67%
5 Fire & Rescue	56.8321	22.0833	60,144.99	M	EAAL	268,667	259,397	3.57%
					PVB	305,311	296,321	3.03%
					NC	8,145	8,337	-2.30%
					PVFS	281,572	261,856	7.53%
6 Fire & Rescue	37.3799	11.6667	75,368.13	M	EAAL	140,921	152,536	-7.61%
					PVB	245,106	247,037	-0.78%
					NC	9,570	8,749	9.38%
					PVFS	860,549	805,310	6.86%
7 General	61.7187	16.4167	33,577.15	F	EAAL	111,198	105,165	5.74%
					PVB	128,352	125,343	2.40%
					NC	4,518	5,088	-11.20%
					PVFS	125,207	124,100	0.89%
8 Law Enforcement	46.2214	22.5000	79,391.68	M	EAAL	392,635	402,570	-2.47%
					PVB	462,539	460,732	0.39%
					NC	11,431	10,258	11.43%
					PVFS	506,510	446,924	13.33%
9 General	33.8415	7.4165	55,060.06	M	EAAL	43,480	60,664	-28.33%
					PVB	94,381	126,002	-25.10%
					NC	4,478	5,487	-18.39%
					PVFS	660,202	646,473	2.12%
Total Test Cases					EAAL	1,928,935	1,958,419	-1.51%
					PVB	2,399,698	2,440,867	-1.69%
					NC	63,121	64,864	-2.69%
					PVFS	4,067,768	3,900,231	4.30%

LGERS

Retirees

GRS requested test life information on 12 retiree cases. The retiree cases are shown below:

<u>Test Case</u>	<u>Age</u>	<u>Option Code</u>	<u>Current Monthly Benefit</u>	<u>Sex</u>	<u>Valuation Result</u>	<u>GRS</u>	<u>Buck</u>	<u>% Diff</u>
1 - Law Enforcement	71.59	MAX	\$1,129.62	M	EAAL/PVB	\$ 121,932	\$ 120,311	1.35%
2 - General	74.08	OPT62	2,451.86	F	EAAL/PVB	335,390	334,735	0.20%
3 - General	72.22	MAX	1,279.95	F	EAAL/PVB	152,295	153,205	-0.59%
4 - General	74.9	OPT62	861.66	F	EAAL/PVB	108,951	108,127	0.76%
5 - General	83.76	MAX	1,943.90	F	EAAL/PVB	145,472	143,548	1.34%
6 - General	68.13	MAX	360.39	F	EAAL/PVB	47,549	47,687	-0.29%
7 - Law Enforcement	60.39	OPT63	2,943.97	M	EAAL/PVB	458,564	457,501	0.23%
8 - General	71.95	MAX	1,101.97	F	EAAL/PVB	132,267	131,901	0.28%
9 - General	58.24	OPT4	3,029.60	M	EAAL/PVB	307,742	313,407	-1.81%
10 - Law Enforcement	56.14	OPT62	4,792.63	M	EAAL/PVB	814,750	810,361	0.54%
11 - Fire	75.45	OPT2	1,319.25	M	EAAL/PVB	188,502	184,192	2.34%
12 - General	76.14	MAX	1,442.55	F	EAAL/PVB	151,298	151,991	-0.46%
Total Test Cases					EAAL/PVB	2,964,713	2,956,966	0.26%

Terminated Vested

GRS requested test life information on 10 Terminated Vested cases. One of these cases changed status. The terminated vested cases are shown below:

Test Case	Age	Service	Accumulated Contributions	Sex	Valuation Result	GRS	Buck	% Diff
1 - Fire & Rescue	60.2719	18.4166	\$94,917.90	M	EAAL/PVB	\$ 209,291	\$ 220,437	-5.06%
2 - Fire & Rescue*	41.4605	7.7500	23,689.28	M	EAAL/PVB	23,689	23,689	0.00%
3 - Fire & Rescue*	38.2801	8.3333	34,013.72	M	EAAL/PVB	34,014	34,014	0.00%
4 - Fire & Rescue*	40.4127	7.4166	27,989.10	F	EAAL/PVB	27,989	27,989	0.00%
5 - Fire & Rescue	67.0411	10.5000	36,665.52	M	EAAL/PVB	55,057	64,512	-14.66%
6 - General*	44.1025	7.4167	17,610.99	F	EAAL/PVB	17,611	17,611	0.00%
7 - General	54.3799	10.3332	37,823.57	F	EAAL/PVB	53,375	60,084	-11.17%
8 - General	62.3580	8.2500	35,488.27	M	EAAL/PVB	35,488	36,980	-4.03%
9 - General	55.7351	12.0000	56,693.75	F	EAAL/PVB	81,363	96,851	-15.99%
Total Test Cases					EAAL/PVB	537,877	582,167	-7.61%

* GRS Present Value of deferred benefits were lower than the contribution balances.

Total LGERS

(Actives, Retirees, and Terminated Vested)

Valuation Result	GRS	Buck	% Diff
EAAL	\$5,431,525	\$5,497,552	-1.20%
PVB	5,902,288	5,980,000	-1.30%

RODSPF

Actives

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

Test Case	Age	Service	Reported Pay	Sex	Valuation			
					Result	GRS	Buck	% Diff
1	80.7050	35.2500	\$63,635.59	F	EAAL	\$ 155,859	\$ 155,435	0.27%
					PVB	155,859	155,435	0.27%
					NC	0	0	
					PVFS	0	0	
2	43.9659	16.9167	66,555.23	F	EAAL	97,827	60,693	61.18%
					PVB	189,805	181,466	4.60%
					NC	6,729	10,420	-35.42%
					PVFS	939,274	771,609	21.73%
3	58.3212	21.5833	91,041.60	F	EAAL	230,493	201,277	14.52%
					PVB	278,704	275,352	1.22%
					NC	12,093	15,152	-20.19%
					PVFS	370,049	442,905	-16.45%
4	52.4879	18.3333	80,851.02	F	EAAL	167,028	114,060	46.44%
					PVB	254,764	224,084	13.69%
					NC	10,446	12,003	-12.97%
					PVFS	703,858	741,191	-5.04%
5	40.0548	5.0833	51,913.76	F	EAAL	45,973	39,862	15.33%
					PVB	130,671	132,351	-1.27%
					NC	5,726	5,865	-2.37%
					PVFS	795,227	827,027	-3.85%
6	67.0329	17.0833	51,396.74	M	EAAL	91,094	100,340	-9.21%
					PVB	133,989	153,965	-12.97%
					NC	8,237	10,598	-22.28%
					PVFS	276,889	260,700	6.21%
7	64.9495	14.1667	45,646.37	F	EAAL	187,358	126,057	48.63%
					PVB	241,737	196,375	23.10%
					NC	13,772	13,496	2.05%
					PVFS	167,918	239,324	-29.84%
8	38.6831	10.4167	100,425.78	M	EAAL	95,100	87,456	8.74%
					PVB	175,738	172,685	1.77%
					NC	6,199	5,588	10.93%
					PVFS	1,351,216	1,542,406	-12.40%
9	57.6804	3.0833	67,789.60	F	EAAL	52,816	36,462	44.85%
					PVB	135,105	117,344	15.14%
					NC	9,756	9,343	4.42%
					PVFS	581,888	576,660	0.91%
10	54.1655	1.0833	135,438.34	F	EAAL	20,260	9,662	109.69%
					PVB	93,566	90,561	3.32%
					NC	8,357	8,344	0.16%
					PVFS	1,192,566	1,277,699	-6.66%
Total Test Cases					EAAL	1,143,808	931,304	22.82%
					PVB	1,789,938	1,699,618	5.31%
					NC	81,315	90,809	-10.45%
					PVFS	6,378,885	6,679,521	-4.50%



RODSPF

Retirees

GRS requested test life information on 11 retiree cases. One of the individuals was not receiving RODSPF benefits. The retiree cases are shown below:

Test Case	Age	Option Code*	Current** Monthly Benefit	Sex	Valuation Result #	GRS	Buck	% Diff
1	76.12	OPT62	\$1,903.46	F	EAAL/PVB	\$ 200,363	\$ 200,234	0.06%
2	68.29	MAX	5,145.26	M	EAAL/PVB	234,251	234,157	0.04%
3	74.46	MAX	4,499.86	F	EAAL/PVB	218,478	218,419	0.03%
4	73.54	OPT63	1,645.20	F	EAAL/PVB	218,478	218,419	0.03%
5	67.88	MAX	794.63	F	EAAL/PVB	271,536	271,600	-0.02%
6	64.62	MAX	2,811.35	F	EAAL/PVB	296,509	296,606	-0.03%
7	79.71	MAX	4,357.65	M	EAAL/PVB	132,593	131,420	0.89%
8	63.71	OPT63	3,954.55	F	EAAL/PVB	304,544	304,647	-0.03%
9	63.29	MAX	1,129.01	M	EAAL/PVB	275,780	275,845	-0.02%
10	55.12	OPT4	3,664.02	F	EAAL/PVB	369,849	369,980	-0.04%
Total Test Cases					EAAL/PVB	2,522,381	2,521,327	0.04%

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

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

Nearest integer ages used for valuation results, in accordance with the method described in Buck's report.

Terminated Vested

GRS requested test life information for two terminated vested cases. One of the cases changed status.

Test Case	Age	Service	Accumulated Contributions	Sex	Valuation Result#	GRS	Buck	% Diff
1	78.4018	10.0833	\$ 46,003.32	M	EAAL/PVB	\$ 148,350	\$ 147,803	0.37%
Total Test Cases					EAAL/PVB	148,350	147,803	0.37%

Nearest integer ages used for valuation results, in accordance with the method described in Buck's report.

Total RODSPF

(Actives, Retirees, and Terminated Vested)

Valuation Result	GRS	Buck	% Diff
EAAL	\$3,814,539	\$3,600,434	5.95%
PVB	4,460,669	4,368,748	2.10%



DIPNC

Actives

GRS requested test life information on 10 active cases. Three of these cases moved to non-active status. The active cases are shown below:

Test Case	Age	Service	Reported Pay	Sex	Valuation Result	GRS	Buck	% Diff
1	51.2159	22.3000	18,404.02	F	EAAL	80	96	-16.67%
					PVB	383	364	5.22%
					NC	42	46	-8.70%
					PVFS	135,357	128,507	5.33%
2	55.3157	16.5556	37,705.71	F	EAAL	(66)	254	-125.98%
					PVB	1,133	930	21.83%
					NC	137	112	22.32%
					PVFS	340,488	288,142	18.17%
3	37.7406	12.8484	56,728.35	F	EAAL	755	555	36.04%
					PVB	1,656	1,336	23.95%
					NC	77	61	26.23%
					PVFS	685,257	793,873	-13.68%
4	26.5465	4.2727	44,076.65	F	EAAL	250	139	79.86%
					PVB	655	479	36.74%
					NC	38	26	46.15%
					PVFS	478,010	586,039	-18.43%
5	49.9550	19.4545	70,729.93	M	EAAL	410	400	2.50%
					PVB	1,510	1,486	1.62%
					NC	110	140	-21.43%
					PVFS	731,858	727,300	0.63%
6	69.2433	11.9167	29,496.79	M	EAAL	(13)	0	
					PVB	0	0	
					NC	4	0	
					PVFS	87,664	87,288	0.43%
7	41.3267	10.5378	46,206.91	F	EAAL	880	714	23.25%
					PVB	2,484	2,059	20.64%
					NC	121	97	24.74%
					PVFS	640,740	692,552	-7.48%
Total Test Cases					EAAL	2,296	2,158	6.39%
					PVB	7,821	6,654	17.54%
					NC	529	482	9.75%
					PVFS	3,099,374	3,303,701	-6.18%

DIPNC

Retirees

GRS requested test life information on 15 retiree cases (of which not all were receiving disability benefits). The retiree cases currently receiving benefits are shown below:

<u>Test Case</u>	<u>Age</u>	<u>Disability Start Date</u>	<u>Current Monthly Benefit</u>	<u>Sex</u>	<u>Valuation Result</u>	<u>GRS</u>	<u>Buck</u>	<u>% Diff</u>
1	53.35	11/2012	1,840.77	F	EAAL/PVB	\$ 42,424	\$ 42,732	-0.72%
2	69.54	4/1981	702.90	F	EAAL/PVB	2,396	2,108	13.66%
3	54.54	1/2011	3,172.86	F	EAAL/PVB	110,643	110,033	0.55%
4	61.27	6/2007	1,197.37	F	EAAL/PVB	7,787	7,107	9.56%
5	54.10	11/1999	1,970.44	M	EAAL/PVB	6,598	3,540	86.38%
6	64.51	7/2013	2,374.77	F	EAAL/PVB	6,307	6,209	1.57%
7	42.26	3/2018	2,421.70	M	EAAL/PVB	149,063	147,360	1.16%
Total Test Cases					EAAL/PVB	325,217	319,089	1.92%

Terminated Vested

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

Total DIPNC

(Actives and Retirees)

<u>Valuation Result</u>	<u>GRS</u>	<u>Buck</u>	<u>% Diff</u>
EAAL	\$327,513	\$321,247	1.95%
PVB	333,038	325,743	2.24%

RHB

GRS requested test life information on 10 active, 12 retiree and 11 terminated vested cases. Some of the requested cases changed status and were not included. Segal previously 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 when we first began reviewing these reports (in 2018). Each test record in the following table actually represents a group of members.

Actives

Test Case	Age	Service	Reported Pay	Sex	Valuation			
					Result	GRS	Segal	% Diff
1 Teachers	41.32	10.54	\$ 46,207	F	EAAL	\$ 42,289	\$ 47,369	-10.72%
					PVB	124,487	132,196	-5.83%
					NC	6,491	5,840	11.15%
					PVFS	596,598	671,198	-11.11%
2 Teachers	56.17	15.37	\$ 34,179	F	EAAL	36,422	36,370	0.14%
					PVB	63,073	62,176	1.44%
					NC	4,169	3,363	23.97%
					PVFS	222,446	262,296	-15.19%
3 General	56.69	16.00	\$ 32,198	M	EAAL	38,245	39,631	-3.50%
					PVB	64,655	63,671	1.55%
					NC	3,846	3,280	17.26%
					PVFS	224,407	235,969	-4.90%
4 General	37.39	16.90	\$ 49,117	M	EAAL	100,500	132,138	-23.94%
					PVB	204,535	230,301	-11.19%
					NC	8,519	9,208	-7.48%
					PVFS	603,685	523,646	15.28%
5 General	35.08	2.92	\$ 35,831	M	EAAL	16,058	15,877	1.14%
					PVB	76,619	75,087	2.04%
					NC	4,119	3,983	3.41%
					PVFS	521,126	532,606	-2.16%
6 Other	57.26	18.30	\$ 15,661	F	EAAL	41,476	40,064	3.52%
					PVB	63,525	64,014	-0.76%
					NC	3,886	3,435	13.13%
					PVFS	90,825	109,188	-16.82%
7 Other	51.99	6.04	\$ 30,429	F	EAAL	15,786	14,969	5.46%
					PVB	39,966	36,586	9.24%
					NC	2,182	1,864	17.06%
					PVFS	348,627	352,982	-1.23%
8 Other	35.68	11.25	\$ 64,020	F	EAAL	90,531	87,779	3.14%
					PVB	146,276	143,336	2.05%
					NC	4,490	4,152	8.14%
					PVFS	803,081	856,652	-6.25%
Total Test Cases					EAAL	381,307	414,197	-7.94%
					PVB	783,136	807,367	-3.00%
					NC	37,702	35,125	7.34%
					PVFS	3,410,795	3,544,539	-3.77%

RHB

Retirees

Test Case	Age	Sex	Valuation Result	GRS	Segal	% Diff
1 General	92.59	F	EAAL/PVB	\$ 4,270	\$ 4,553	-6.22%
2 General	85.02	F	EAAL/PVB	8,435	8,973	-6.00%
3 General	77.76	M	EAAL/PVB	16,509	16,827	-1.89%
4 General	73.04	F	EAAL/PVB	20,757	21,440	-3.19%
5 General	73.29	M	EAAL/PVB	22,154	23,227	-4.62%
6 General	68.77	M	EAAL/PVB	28,524	28,837	-1.09%
7 General (disabled)	68.09	F	EAAL/PVB	22,129	22,849	-3.15%
8 General	69.54	F	EAAL/PVB	1,335	460	190.22%
9 General	60.46	F	EAAL/PVB	91,272	98,172	-7.03%
10 General (disabled)	62.26	M	EAAL/PVB	74,936	79,632	-5.90%
11 Teachers/Other	64.01	M	EAAL/PVB	22,971	23,840	-3.65%
12 General	75.20	M	EAAL/PVB	21,328	22,296	-4.34%
Total Test Cases			EAAL/PVB	334,620	351,106	-4.70%

Terminated Vested

Test Case	Age	Service	Sex	Valuation Result	GRS	Segal	% Diff
1 Teacher	48.61	18.4	F	EAAL/PVB	\$ 74,583	\$ 76,258	-2.20%
2 Teacher	52.81	7.9	F	EAAL/PVB	8,616	11,569	-25.52%
3 Teacher	37.17	7.6	F	EAAL/PVB	9,709	13,414	-27.62%
4 Teacher	43.27	8.0	F	EAAL/PVB	80,819	83,523	-3.24%
5 Law Enforcement	47.70	18.4	M	EAAL/PVB	81,667	84,964	-3.88%
6 General	64.61	6.2	F	EAAL/PVB	36,711	32,271	13.76%
Total Test Cases				EAAL/PVB	369,869	373,599	-1.00%

Total RHB

(Actives, Retirees, and Terminated Vested)

Valuation Result	GRS	Segal	% Diff
EAAL	\$1,085,796	\$1,138,902	-4.66%
PVB	1,487,625	1,532,072	-2.90%

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, differences 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 fifth year performing this analysis. As such, we attempted to request some of the same test life cases this year as we did in previous years, so we could review how the results changed from year-to-year. The results of our test life comparisons are generally consistent with the analysis performed in past years.

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

- Several of the terminated vested test cases showed greater discrepancies than others. GRS was not provided with the estimated benefits for the vested terminated members and therefore attempted to estimate the members' benefits using methods and assumptions described in the Buck reports. It may be that test cases where the difference is greater is attributable to using actual available data versus an estimation. In addition, we could not locate an assumption detailing when a terminated vested member would commence benefits. We assumed these members would commence receipt of benefits at earliest eligibility for reduced retirement benefits.
- We continue to recommend a description concerning how RODSPF service is determined and/or maintained (see comment below).
- In prior reports, we noted that there were retired DIPNC members who, based on the raw data provided to us, should have ceased receiving benefits prior the valuation date. Retired DIPNC test case 2 had a large decrease in liability since the prior report. We believe this may be due to a difference in valuation methods or assumptions between Buck and the prior actuary, since nothing in the data indicated a change in benefits. Due to the age of the member, it is reasonable to expect the member would be eligible for retirement benefits and ceasing receiving disability benefits.
- We recommend Segal review the disability rates used in their actuarial valuation for consistency with the rates disclosed by Buck in the DIPNC valuation. Buck notes that the rates disclosed in the prior valuation (performed by Cavanaugh Macdonald Consulting) were incorrectly disclosed.

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 Buck 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.
- As discussed previously, provide the estimated benefits for terminated vested members to the auditor.

SECTION 4

A REVIEW OF THE RESPECTIVE GASB REPORTS

Content Review

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

For the reports prepared by Buck, 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 Statement Nos. 67 and 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 the GASB Statement No. 74 results contained the underlying valuation results as of December 31, 2021. We believe that the Segal GASB Statement No. 74 report contains all the actuarial schedules and disclosures required by GASB Statement No. 74.

Calculations Review

While our review affirmed the December 31, 2021 calculations of liabilities, the following chart shows our attempt at replicating the roll forward to June 30, 2022. Since the exact calculations were not provided and certain elements had to be estimated, we did not expect to exactly reproduce the June 30, 2022 numbers. As the schedules show, our estimates were extremely close.

Data	TSERS	LGERS	RODSPF	DIPNC	RHB
1 December 31, 2021 AAL	\$92,356,225,906	\$34,884,123,410	\$33,768,153	\$320,183,088	\$25,815,387,000
2 Employee Contribs during 12 months, ending 6/30/22	1,030,635,000	477,001,000	-	-	-
3 Employer Normal Cost Rate (Excl Admin Exp) as of 1/1/22	6.23%	6.79%	17.04%	22,246,000	1,279,519,000
4 Payroll as of 12/31/21	15,312,224,584	6,898,855,515	7,414,958		
5 Benefits Paid during 12 months ending 6/30/22	5,324,253,000	1,732,564,000	1,844,000	40,381,000	1,044,121,000
GRS' approximation of numbers needed for roll forward					
Change in Benefit Terms or Assumptions (not already					
6 included in 12/31/2021 AAL)	-	-	-	(5,241,000)	-
7 Service Cost from 12/31/21 to 6/30/22: (3)*(4)/2	476,975,796	234,175,469	631,632	11,123,000	639,759,500
8 Benefit Payments from 12/31/21 to 6/30/22: (5)/2	2,662,126,500	866,282,000	922,000	20,190,500	522,060,500
GRS' approximation of 6/30/22 TPL/OBEP Liab (roll forward)					
9 12/31/21 TPL: (1)+(6)	92,356,225,906	34,884,123,410	33,768,153	314,942,088	25,815,387,000
10 Service Cost: (2)/2 + (7)	992,293,296	472,675,969.45	631,632	11,123,000	639,759,500
11 Benefit Payments	2,662,126,500	866,282,000	922,000	20,190,500	522,060,500
12 Interest: (1)* i/2 + [(10)-(11)]* i/4 [#]	2,974,442,552	1,127,337,913	504,345	4,780,288	457,973,986
13 TPL/OBEP Liab 6/30/22: (9) + (10) - (11) + (12)	93,660,835,254	35,617,855,292	33,982,129	310,654,876	26,391,059,986
14 TPL/OBEP Liab 6/30/22 developed by Buck/Segal	93,572,242,000	35,578,561,000	33,918,000	307,964,000	26,557,121,000
15 Ratio of GRS approximation to Buck/Segal Calculation	100.1%	100.1%	100.2%	100.9%	99.4%

[#] i = 6.50% for TSERS and LGERS; 3.00% for RODSPF; 3.08% for DIPNC, and 3.54% for RHB.



SECTION 5

COMMENTS AND CONCLUSIONS

Comments

We would like to thank Segal and Buck for their cooperation in the completion of this review.

We have indicated we believe the assumed rate of return of 6.50% was reasonable for TSERS and LGERS (based on the information provided for this review). However, capital market expectations have shown a pattern of decreasing in the last few years- although we are beginning to see a reversal in this trend in the most recent capital market expectations (from late 2022). If the decreasing trend continues, it is possible this assumption may need to be lowered for future valuations (assuming no change in the asset allocation).

Prior Year's Recommendations

We have reviewed the reports with regard to our recommendations from last year (and the prior years) and have found implementation of most of our recommendations.

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.

Recommendations for Future Years

We have the following recommendations for future valuations:

- We recommend the North Carolina Retirement Systems continue working to provide their actuary with more complete information regarding terminated vested members.
- We recommend that Buck increase the documentation regarding their data processing. Specifically, we suggest that documentation/commentary include:
 - How RODSPF service is determined/maintained
- We recommend Buck and/or Segal review their calculations, assumptions, and/or disclosures with regard to the following:
 - Assumed commencement age for vested terminated members (pension valuations)
 - Disability rates (RHB/DIPNC)
- Providing additional data used in the valuation to the actuarial auditor:
 - RODSPF service for active members
 - Estimated benefits for terminated vested members