# Commonwealth of Virginia Joint Legislative Audit and Review Commission

## 2018 Quadrennial Actuarial Audit of the Virginia Retirement System

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# TRANSMITTAL LETTER

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May 24, 2018

Mr. Hal Greer
Director
Commonwealth of Virginia
Joint Legislative Audit and Review Commission
201 North Ninth Street, Suite 1100
General Assembly Building, Capitol Square
Richmond, Virginia 23219

**Re: 2018 Quadrennial Actuarial Audit of the Virginia Retirement System**

Dear Mr. Greer:

Presented in this report are the results of the 2018 Quadrennial Actuarial Audit of the Virginia Retirement System ("VRS"). This report has been prepared in order for the Joint Legislative Audit and Review Commission, herein referred to as JLARC, to meet its statutory responsibility, mandated by the Virginia Retirement System Oversight Act (§30-78 – §30-84 of the Code of Virginia), for publishing an actuarial report concerning the VRS. This 2018 Quadrennial Actuarial Audit is intended to provide the General Assembly with comprehensive overview of the actuarial soundness of the VRS. Although the term "actuarial soundness" is not specifically defined, the primary purpose of the 2018 Quadrennial Actuarial Audit of VRS is to evaluate the financial status of the VRS as of June 30, 2017.

This 2018 Quadrennial Actuarial Audit consists of a non-replication actuarial audit of the assumptions, methods, procedures and conclusions used in the June 30, 2017, actuarial valuations prepared by VRS' consulting actuary, Cavanaugh Macdonald Consulting, LLC ("CMC").

The results of the audit are presented in the following format:

I. Executive Summary
II. General Audit Approach
III. Reasonableness of Actuarial Assumptions
IV. Reasonableness of Actuarial Methods and Funding Policy
V. Application of Actuarial Assumptions, Methods and Plan Provisions
VI. Actuarial Report Content, Detail, Format and Clarity
VII. Review of Contribution Rates and Funded Ratios
VIII. Actuarial Principles and Practices Employed by the Actuary
IX. Comments and Considerations from the 2014 Quadrennial Audit
X. Virginia Retirement System Response

This study was performed at the request of the JLARC and may be shared with other interested parties only with the permission of the JLARC. If shared with other parties, it should be shared in its entirety.

We would like to thank the staff at the VRS as well as CMC for their cooperation and assistance in providing the requested information as well as their thoughtful responses to our questions and inquiries.

Please understand that the primary purpose of our recommendations provided throughout this audit report is to improve the actuarial valuation process. We trust that CMC and VRS will find these recommendations to be helpful.

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

This audit was performed by actuaries experienced with public sector retirement systems. The actuaries signing this report, Lance J. Weiss and Amy Williams, are Members of the American Academy of Actuaries and meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinion contained herein.

GRS is independent of VRS, JLARC and CMC.

If you have any questions on this report or need additional information, please feel free to contact us.

Respectfully submitted,

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Senior Consultant and Team Leader

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Consultant

# SECTION I.

## EXECUTIVE SUMMARY

# Executive Summary

In accordance with the Virginia Retirement System Oversight Act (§30-78 – §30-84 of the Code of Virginia), Gabriel, Roeder, Smith & Company ("GRS") was hired by the Joint Legislative Audit and Review Commission ("JLARC") to conduct the 2018 Quadrennial Actuarial Audit of the Virginia Retirement System ("VRS").

The purpose of this audit is to provide the General Assembly with comprehensive overview of the actuarial soundness of the VRS. This audit consisted of a non-replication actuarial audit of the actuarial assumptions, methods and procedures used in, and the resulting conclusions from, the June 30, 2017, actuarial valuations prepared by VRS' consulting actuary, Cavanaugh Macdonald Consulting, LLC ("CMC").

Note that a full replication of the June 30, 2017, actuarial valuation results was not covered under the scope of this engagement. The actuarial audit consisted of a review of the key components in the actuarial valuations as well as a review of 94 test life cases in order to opine on the correct application of the actuarial assumptions, methods and benefit plan provisions (including the calculation of the normal cost and actuarial accrued liability).

The actuarial audit of the VRS included a review of the following VRS programs:

- VRS State Plans covering the following divisions: State Employees, Teachers, State Police (SPORS), Judges and Virginia Law Officers (VaLORS);
- Seven select political subdivisions participating in the VRS;
- Health Insurance Credit Program ("HIC");
- Group Life Insurance Program ("GLI");
- Virginia Sickness and Disability Program ("VSDP"); and
- Virginia Local Disability Program ("VLDP").

Based on the results of our audit, we believe that:

- VRS is actuarially sound;
- The actuarial assumptions used for the June 30, 2017, actuarial valuations of all plans are generally reasonable;
- The funding ratio of the VRS plans are generally improving and moving towards a 100 percent funded ratio goal; and
- The actuarial valuations prepared by Cavanaugh Macdonald Consulting, LLC, VRS' Consulting Actuary, are reasonable and generally comply with the Actuarial Standards of Practice.

**This audit report contains a number of recommendations resulting from our review. However, we do not consider these recommendations to be the result of material deficiencies; rather, these recommendations are intended to improve the measurement and communication of future actuarial valuations.**

# Executive Summary

Below is a **high level** summary of the areas addressed in the audit and our associated findings and recommendations:

- Actuarial Assumptions
  - Findings
    - We believe the actuarial assumptions used in the actuarial valuations for all the defined benefit plans, including the economic assumptions (inflation, investment return, wage inflation, payroll growth, salary increases) and the demographic assumptions (retirement, withdrawal, disability, mortality) are generally reasonable. The assumptions for the Other Postemployment Benefit (OPEB) programs are generally reasonable as well.
  - Recommendations
    - In order to improve the measurement of the actuarial valuation results, we have included a number of recommendations related to several of the actuarial assumptions which we believe VRS and CMC should implement when the actuarial assumptions are next reviewed. (Note that GRS is not recommending that any changes in assumptions need to be made prior to the next scheduled assumption review.) These include, among other recommendations, (1) continue to review the investment return assumption giving due consideration to both short term and long term investment horizons, (2) include information in the next experience study report documenting the weighting of the short term and long-term investment horizons and (3) continue to review the payroll growth assumption giving due consideration to both actual historical plan experience between 2008 and the time of the next experience study, and future expectations. (Pages 26-27)
- Actuarial Cost Method and Actuarial Asset Valuation Method
  - Findings
    - The actuarial cost method and actuarial asset valuation method are reasonable for the actuarial valuation of the benefit plans. The entry age normal cost method and the 5-year asset smoothing method are appropriate and key components to satisfying VRS' financing objectives.
  - Recommendations
    - None
- Actuarial Funding Policy
  - Findings
    - We believe that the VRS funding policy represents an appropriate balance between cost stability and the goal of maintain intergenerational equity. In addition, this funding policy is consistent with the model practices represented by the Conference of Consulting Actuaries White Paper as well as by the Government Finance Officers Association.
  - Recommendations
    - To better meet the plan's funding policy objectives, we recommend that CMC provide more details in the VRS funding actuarial report including (1) the definition of an "effective amortization period," (2) a description of the implications of having separate unfunded liability amortization bases and an effective amortization period in excess of 26 years (the number of years remaining until VRS is expected to be fully funded) and (3) the magnitude of the expected change in future contribution rates as a result of the

separate amortization bases. Also, if the prospect of expected large increases in contribution rates is adverse to VRS, we recommend that VRS consider a change to the funding policy which may include aggregating the outstanding unfunded liability bases such that the effective amortization period is less than a fixed number of years (such as 25 or 30) which would result in a smaller near term contribution increase instead of a larger contribution increase in the future. (Page 31)

- Application of Actuarial Assumptions, Methods and Benefit Plan Provisions
  - Findings
    - Based on our review of the individual test lives, we conclude that CMC appears to be consistently applying the actuarial assumptions, methods and plan provisions with the assumptions, methods and plan provisions as stated in the actuarial valuation reports. We have also reviewed CMC's calculation of the present value of future benefits, normal cost and employer contribution rates and believe they are reasonable.
  - Recommendations
    - We recommend that CMC use the same assumption for current terminated vested members as is used for future terminated vested members which is to assume that the more valuable of a return of contributions and a deferred annuity is elected. (Page 35)
- Actuarial Report Content, Detail, Format and Clarity
  - Findings
    - We have reviewed the actuarial valuation reports prepared by CMC for all the VRS benefit plans, including actuarial valuation reports provided to a select number of political subdivisions, and find them to generally be in compliance with the Actuarial Standards of Practice with regard to content, detail, format and clarity. The gain/loss analysis disclosed in the actuarial valuation report for the VRS State Plans is useful in explaining the change in the unfunded actuarial accrued liability.
  - Recommendations
    - We recommend including the funded ratio in future actuarial valuation reports, since it is a fundamental measure of the funding condition of a plan. (Page 39)
    - In order to ensure that another actuary qualified in the same practice area could make an objective appraisal of the reasonableness of the CMC's work as presented in the VRS actuarial reports, we have included a number of other recommendations regarding enhanced disclosures in future actuarial valuation reports. (Page 39)
- Contribution Rates and Funded Ratios
  - Findings
    - We believe that the employer contribution rates are reasonable.
    - We believe that the funding ratios of the VRS plans are generally improving and moving towards a 100 percent funded ratio goal.
  - Recommendations
    - We recommend continued analysis be performed for the Health Insurance Credit Program in order to evaluate the adequacy of the contribution policy. (Page 46)
    - We recommend providing more details in the actuarial report describing the reasons why the VSDP is so well funded. (Page 46)

The following sections of this report provide a more detailed discussion of our review of CMC's actuarial work for VRS, including additional findings and recommendations.

# SECTION II.

## GENERAL AUDIT APPROACH

# General Audit Approach

In accordance with the Virginia Retirement System Oversight Act (§30-78 – §30-84 of the Code of Virginia), Gabriel, Roeder, Smith & Company ("GRS") was hired by the Joint Legislative Audit and Review Commission ("JLARC") to conduct the 2018 Quadrennial Actuarial Audit of the Virginia Retirement System ("VRS").

The purpose of this audit is to provide the General Assembly with comprehensive overview of the actuarial soundness of the VRS. This audit consisted of a non-replication actuarial audit of the actuarial assumptions, methods and procedures used in, and the resulting conclusions from, the June 30, 2017, actuarial valuations prepared by VRS' consulting actuary, Cavanaugh Macdonald Consulting, LLC ("CMC").

In accordance with the Statement of Needs agreed to between GRS and JLARC, this actuarial audit addresses the following areas:

- Reasonableness of Actuarial Assumptions;
- Reasonableness of Actuarial Methods and Funding Policy;
- Application of Actuarial Assumptions and Benefit Plan Provisions;
- Actuarial Report Content, Detail, Format and Clarity;
- Review of Contribution Rates and Funded Ratios; and
- Actuarial Principles and Practices Employed by the Actuary.

Plans included in the scope of this audit include the following VRS programs:

- VRS State Plans covering the following divisions: State Employees, Teachers, State Police (SPORS), Judges and Virginia Law Officers (VaLORS);
- Seven select political subdivisions participating in the VRS;
- Health Insurance Credit Program ("HIC");
- Group Life Insurance Program ("GLI");
- Virginia Sickness and Disability Program ("VSDP");
- Virginia Local Disability Program ("VLDP"); and
- Seven political subdivision plans (selected by JLARC and referred to as Plans A through G in this report).

In performing our review, we:

- Reviewed the VRS benefit handbooks and applicable statutes to understand the benefits provided by VRS;
- Reviewed the appropriateness of the actuarial assumptions;
- Reviewed the actuarial valuation reports; and
- Reviewed the detailed liability calculation of the sample lives to ensure that the calculations were consistent with the stated plan provisions, actuarial methods and assumptions.

The audit findings, which follow, are based on our review of this information and subsequent correspondence with VRS and the retained actuary for clarification and further documentation.

# General Audit Approach

The following table presents a summary of the approach and steps GRS completed on behalf of the 2018 Quadrennial Actuarial Audit of the VRS:

| TASK DESCRIPTION | | RESPONSIBILITY | | | |
|---|---|---|---|---|---|
| | | GRS | JLARC | VRS AND/OR CavMac | DUE DATE |
| PROJECT PLANNING | **1 Project Planning with Client and Team** | | | | |
| | a.) Confirm project plan with JLARC | X | X | | 12/22/2017 |
| DATA | **2 Census Data, Financial Data, Actuarial Reports and Assumption Tables** | | | | |
| | a.) Send information request to CavMac and VRS | X | | | 01/19/2018 |
| | b.) Entrance conference call with JLARC, VRS and CavMac | X | X | X | 01/26/2018 |
| | c.) Provide GRS with certain plan data and information | | | | |
| | - Valuation ready data used by CavMac to prepare the 2017 valuation | | | X | 02/07/2018 |
| | - Electronic copy of complete assumption tables | | | | |
| | - VRS investment policy | | | | |
| | d.) Copy of the June 30, 2017 actuarial valuation report(s) (all plans) | | | X | 02/12/2018 |
| | e.) Request test lives data | X | | | 02/16/2018 |
| | f.) Complete review of the valuation ready data files utilized by CavMac | X | | | 02/23/2018 |
| | g.) Scheduled status call with GRS and JLARC | X | X | | 03/02/2018 |
| ASSUMPTIONS AND METHODS | **3 Actuarial Assumptions and Methods** | | | | |
| | a.) Complete review of the economic actuarial assumptions | X | | | 03/16/2018 |
| | b.) Complete review of the actuarial valuation methods | X | | | 03/23/2018 |
| | c.) Complete review of the demographic actuarial assumptions | X | | | 03/30/2018 |
| ACTUARIAL LIABILITIES | **4 Actuarial Liabilities** | | | | |
| | a.) CavMac provides test lives data (request made on Feb 16) | | | X | 03/02/2018 |
| | c.) Complete test live review | X | | | 03/30/2018 |
| | b.) Scheduled status call with GRS and JLARC | X | X | | 03/30/2018 |
| ACTUARIAL VALUATION AND REPORT | **5 Actuarial Valuation and Report** | | | | |
| | a.) Review CavMac actuarial report | | | | |
| | - Review for content, clarity, and accuracy | | | | |
| | - Compliance with relevant Actuarial Standards of Practice (ASOPs) | | | | |
| | - Reasonableness and completeness of results | X | | | 04/20/2018 |
| | - Examination of funded ratios | | | | |
| | - Reasonableness of contribution rates | | | | |
| | - Review local plan actuarial valuations | | | | |
| | b.) Scheduled status call with GRS and JLARC | X | X | | 04/27/2018 |
| REPORT AND BRIEFINGS | **6 Deliverable Schedule** | | | | |
| | a.) Draft report to JLARC | X | | | 04/30/2018 |
| | b.) First Exit Conference Call | X | X | | 05/04/2018 |
| | c.) Receive comments from JLARC | | X | | 05/09/2018 |
| | d.) Second draft report to JLARC (copies provided to VRS and CavMac) | X | | | 05/23/2018 |
| | e. Second Exit Conference (by phone or in-person) | X | X | X | 05/29/2018 |
| | f.) Receive commnents from VRS and CavMac | | | X | 06/08/2018 |
| | g.) Draft of briefing slides to JLARC | X | | | 06/19/2018 |
| | h.) Receive comments from JLARC | | X | | 06/22/2018 |
| | i.) Final report copies to JLARC | X | | | 06/27/2018 |
| | j.) Final briefing packets | X | | | 06/28/2018 |
| | k.) Briefing to JLARC | X | X | X | 07/09/2018 |

*Source: GRS Work Product*

# SECTION III.

## REASONABLENESS OF ACTUARIAL ASSUMPTIONS

# Reasonableness of Actuarial Assumptions

## Overview

For any pension plan, actuarial assumptions are selected that are intended to provide reasonable estimates of future expected events, such as Fund investment returns, interest crediting, and patterns of retirement, turnover and mortality. These assumptions, along with an actuarial cost method, an asset valuation method, the employee census data and the plan's provisions are used to determine the actuarial liabilities and overall actuarially determined funding requirements for the plan.

A single set of assumptions is typically not expected to be suitable forever. As the actual experience unfolds or the future expectations change, the assumptions should be reviewed and adjusted accordingly. Use of outdated or inappropriate assumptions can result in understated costs which will lead to higher future contribution requirements or perhaps an inability to pay benefits when due; or, on the other hand, produce overstated costs which place an unnecessarily large burden on the current generation of members, employers, and taxpayers.

The purpose of an experience study is to evaluate the continued appropriateness of the actuarial assumptions used in the annual actuarial valuation by comparing actual experience to expected experience. Understanding that recent prior experience tends to be a good indicator of future experience, we generally recommend an experience study be performed every three to five years, or sooner, if warranted.

The Code of Virginia sets forth requirements under which VRS is administered. In particular § 51.1 – 124.22(A)(4) requires an experience study once every four years. The retained actuary completed an analysis of the experience of the system from July 1, 2012, to June 30, 2016, covering the following divisions of VRS:

- State Employees;
- Teachers;
- State Police;
- Virginia Law Officers;
- Judicial;
- Political Subdivisions;
- Group Life Insurance Program (GLI);
- Line of Duty Act Fund (LODA Fund);
- Health Insurance Credit Program (HIC);
- Virginia Sickness and Disability Program (VSDP); and
- Virginia Local Disability Program (VLDP).

We have reviewed CMC's experience study report dated February 21, 2018, in detail in order to assess the reasonableness of the assumptions used in the actuarial valuation.

It is important to understand the nature of the retirement plan and the plan sponsor when assessing the reasonableness of the actuarial assumptions. No projection of future events can be labeled as "correct" or "incorrect." Setting actuarial assumptions involves professional judgment that is both an art and a science.

# Reasonableness of Actuarial Assumptions

The Actuarial Standards Board (ASB) promulgates actuarial standards of practice (ASOPs) for use by actuaries when rendering actuarial services in the United States. The ASB is vested by the U.S.-based actuarial organizations with the responsibility for promulgating ASOPs for actuaries rendering actuarial services in the United States. Each of these organizations requires its members, through its Code of Professional Conduct, to satisfy applicable ASOPs when rendering actuarial services in the United States. The primary ASOPs applicable to the development and selection of actuarial assumptions are as follows:

- ASOP No. 27, *Selection of Economic Assumptions for Measuring Pension Obligations*; and
- ASOP No. 35, *Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations*.

In accordance with these ASOPs, each assumption has a "range of reasonableness." We evaluated each individual actuarial assumption as follows:

- Whether or not they fall within the range of reasonableness; and
- If they fall within that range, whether they are reasonable for the actuarial valuation of the plan.

Actuarial assumptions for the valuation of retirement plans are generally classified within two major categories: (i) economic assumptions (the money assumptions), and (ii) demographic assumptions (the people assumptions). We have assessed the reasonableness of both categories of actuarial assumptions as part of this actuarial audit.

Please note that the ASB recently released exposures drafts of proposed revisions to both ASOP No. 27 and ASOP No. 35 in March of 2018.

## *Economic Assumptions*

These assumptions simulate the impact of economic forces on the amounts and values of future benefits. Key economic assumptions include inflation, investment return, and rates of future salary increases.

### Inflation

Inflation refers to price inflation as measured by annual increases in the Consumer Price Index (CPI). This assumption underlies and is the building block for most of the other economic assumptions, including the investment return assumption and assumed rate of salary increases.

Also, because VRS provides retirees a cost of living adjustment (COLA) that is based on the annual increase in CPI, future increases in CPI have a direct result on the actuarial valuation and future benefit payments.

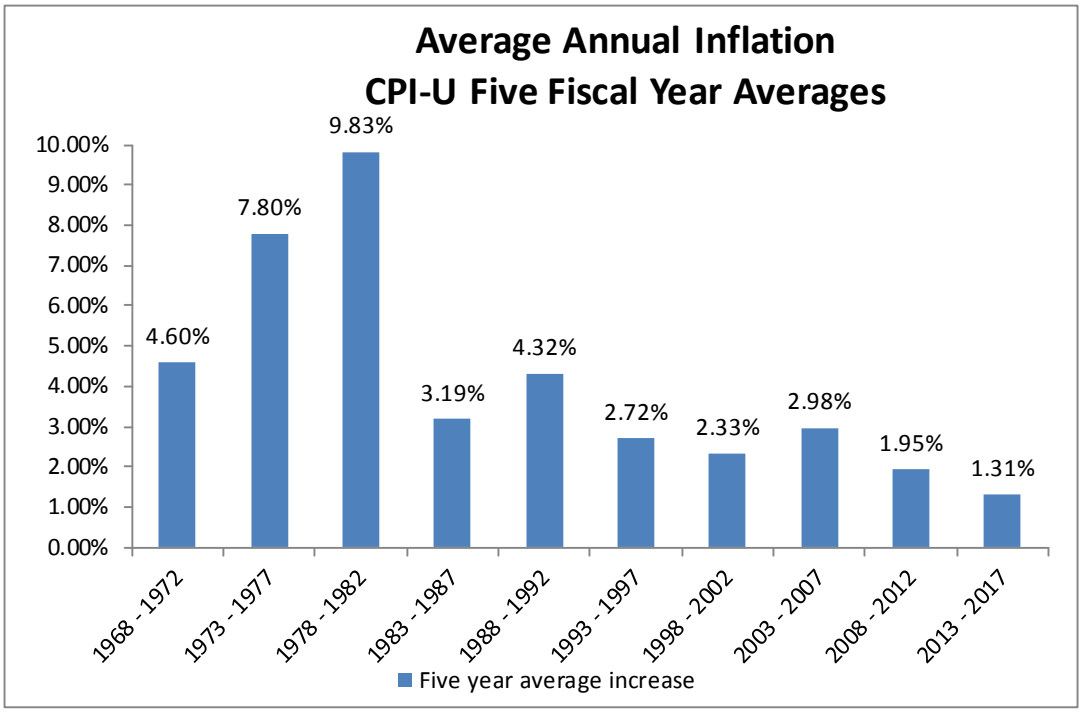
The current inflation assumption is 2.50 percent. Over the five-year period from June 2012 through June 2017, the CPI-U has increased at an average rate of 1.31 percent.

The table on the following page shows the average inflation over various periods, ending June 2017.

| Fiscal Year | Annual Increase in CPI-U |
|---|---|
| 2012-13 | 1.75% |
| 2013-14 | 2.07% |
| 2014-15 | 0.12% |
| 2015-16 | 1.00% |
| 2016-17 | 1.63% |
| | |
| 3-Year Average | 0.92% |
| 5-Year Average | 1.31% |
| 10-Year Average | 1.63% |
| 20-Year Average | 2.14% |
| 25-Year Average | 2.26% |
| 30-Year Average | 2.60% |
| 40-Year Average | 3.55% |
| 50-Year Average | 4.07% |

*Source: U.S. Bureau of Labor Statistics*

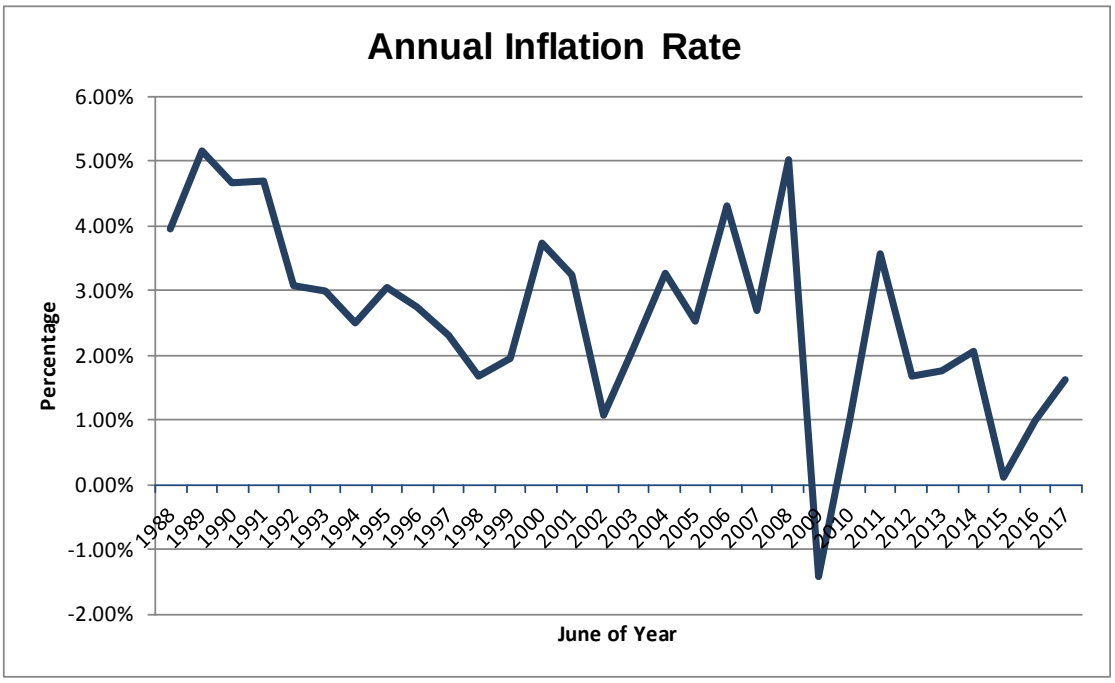
The following chart shows the average annual inflation, as measured by the increase in CPI-U, in each of the 10 consecutive 5-year periods over the last 50 years.




*Source: U.S. Bureau of Labor Statistics*

As the above chart illustrates, the high inflation of the 1970s and 1980s is well in the past.

The following graph illustrates the rate of inflation on a year by year basis over the last 30 years.




*Source: U.S. Bureau of Labor Statistics*

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 as well.

One source of information about future, expected inflation is the market for US Treasury bonds. Simplistically, the difference in yield between non-indexed and indexed treasury bonds should be a reasonable estimate of what the bond market expects on a forward looking basis for inflation. As of the end of June 2017, the difference between non-indexed and indexed 20-year bonds implies that inflation over the next 20 years would average 1.77 percent. The difference in yield for 30-year bonds implies that inflation over the next 30 years would average 1.85 percent.

However, this analysis is not perfect as it ignores (1) the inflation risk premium that buyers of US Treasury bonds often demand, as well as (2) possible differences in liquidity between US Treasury bonds and Treasury Inflation-Protected Securities (TIPS). These factors may drive up the difference in yield between non-indexed and indexed treasury bonds.

Based on a GRS survey of the inflation assumptions used by well-known investment consulting firms across the country, the inflation assumption ranged from 2.00 percent to 2.75 percent, with an average of 2.25 percent.

Another point of reference is the Social Security Administration's (SSA) 2017 Trustees Report, in which the Office of the Chief Actuary is projecting a long-term average ultimate annual inflation rate of 2.0 percent in the high cost projection scenario, 2.6 percent under the intermediate cost projection scenario and 3.2 percent in the low cost projection scenario. 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.

# Reasonableness of Actuarial Assumptions

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

| Forward-looking Annual Inflation Forecasts | |
|---|---|
| **Federal Reserve Board's Federal Open Market Committee** | |
| Current Long-run Price Inflation Objective (Since Jan 2012; Personal Consumer Expenditures) | 2.00% |
| **Congressional Budget Office: *The Budget and Economic Outlook*** | |
| Overall Consumer Price Index (June 2017; Ultimate) | 2.40% |
| Overall Consumer Price Index (June 2017; 11 Years) | 2.36% |
| Personal Consumer Expenditures (June 2017; Ultimate) | 2.00% |
| Personal Consumer Expenditures (June 2017; 11 Years) | 1.98% |
| **2017 Social Security Trustees Report** | |
| CPI-W 15-Year Intermediate Assumption | 2.60% |
| CPI-W 30-Year Intermediate Assumption | 2.60% |
| GDP Deflator 15-Year Intermediate Assumption | 2.20% |
| GDP Deflator 30-Year Intermediate Assumption | 2.20% |
| **Quarterly Survey of Professional Forecasters** | |
| 1Q2018 Federal Reserve Bank of Philadelphia 10-Year Forecast | 2.25% |
| **Federal Reserve Bank of Cleveland** | |
| 30-Year Expectation on January 1, 2018 | 2.21% |
| 20-Year Expectation on January 1, 2018 | 2.10% |
| 10-Year Expectation on January 1, 2018 | 1.92% |
| **Bond Investors (Excess Yield of Non-indexed Treasuries Over Indexed Treasuries)** | |
| 30-Year Expectation on June 30, 2017 | 1.85% |
| Median 30-year Expectation over 6/30/12 - 6/30/17 | 2.09% |
| 20-Year Expectation on June 30, 2017 | 1.77% |
| Median 20-year Expectation over 6/30/12 - 6/30/17 | 2.02% |
| 10-Year Expectation on June 30, 2017 | 1.73% |
| Median 10-year Expectation over 6/30/12 - 6/30/17 | 1.96% |
| **Investment Consultants and Forecasters** | |
| 2017 GRS Survey major national investment forecasters and consultants | |
| Median expectation among 8 firms (averaging 9.4 years) | 2.25% |
| Median expectation among 4 firms (averaging 26.3 years) | 2.21% |
| 2017 HAS* Survey of 12 investment advisors: Median (10 years) | 2.32% |
| 2017 HAS* Survey of 12 investment advisors: Median (20 years) | 2.44% |

**Horizon Actuarial Services 2017 Survey of Capital Market Assumptions*
*Source: GRS analysis of professional experts' inflation forecasts*

As previously stated, VRS provides retirees a cost of living adjustment (COLA) that is based on the annual increase in CPI. Therefore future increases in CPI have a direct result on the actuarial valuation and future benefit payments. However, there is a risk of setting the inflation assumption too low such that plan benefits and cost will increase faster than expected if actual inflation is higher than assumed. (However, this risk has been somewhat mitigated with the COLA design. Specifically, Plan 1 retirees receive a COLA equal to the first 3 percent increase in CPI, plus 50 percent of any additional increase (up to an additional 4 percent of the increase in CPI), for a maximum annual COLA of 5 percent. Retirees in Plan 2 and the Hybrid Plan receive a slightly smaller COLA that is equal to the first 2 percent increase in CPI plus 50 percent of any additional increase (up to an additional 2 percent of the increase in CPI), for a maximum annual COLA of 3 percent.)

Taking this information into consideration, including the COLA design, **we believe the current 2.50 percent price inflation assumption is reasonable.**

## Investment Return

The investment return assumption (also referred to as the actuarial 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.

It is important to note that an actuarial investment return assumption based on expected future experience is a single estimate for all years and therefore implicitly assumes that returns above and below expectations will "average out" over time. In other words, the expected risk premium is reflected in the assumed rate of investment return in advance of being earned, while investment gains/losses are not reflected until actual experience emerges with each actuarial valuation.

## CMC Analysis Using VRS Assumptions

CMC states the following on pages 19 and 20 of their experience study report:

*Many investment firms and investment consulting firms produce estimates of future asset returns. While it might seem desirable to directly compare these estimates, asset class expectations are dependent on the construction of the portfolio. Other investment consultants may have in mind a different blend of large versus small stocks or growth versus value equities. There are also comparison challenges in certain asset classes such as international stock (emerging or developed markets), bonds (duration and credit quality), and alternatives (a very broadly interpreted category). For this reason, we believe trying to compare the expected return developed by VRS with the assumptions of another group of investment professionals may lead to an invalid comparison. Since VRS has qualified professionals on its staff and is in the best position to understand its own portfolio and the reasonable expectations given their investment style, we prefer to rely heavily on their analysis.*

Based on 10-year forward returns from VRS investment staff and adjusting for an inflation assumption of 2.50 percent, the CMC experience study report estimates the 50$^{th}$ percentile return to be 6.83 percent. This compares to VRS' long term rate of return assumption of 7.00 percent.

## GRS Analysis

In order to assess the reasonability of the current VRS investment return assumptions, we have performed an independent analysis which considers forward-looking measures of likely investment return outcomes for the asset classes in the current VRS investment policy. For purposes of this analysis, we have analyzed the VRS investment policy in conjunction with the capital market assumptions from 10 nationally recognized investment consultants. We do recognize that there are shortcomings in this analysis (as explained by CMC in their experience study report) and we also agree with the CMC suggestion to rely more heavily on the analysis of the VRS investment staff (or a System's own investment consultant).

Our analysis is based on the GRS Capital Market Assumption Modeler (CMAM). Because GRS is a benefits consulting firm and does not develop or maintain our own capital market expectations, we request and monitor forward-looking capital market expectations developed by a number of well-known major investment consulting firms. We update our CMAM on an annual basis. The capital market assumptions in the 2017 CMAM are from the following investment consultants (in alphabetical order) Aon Hewitt, BNY Mellon, JPMorgan, Marquette Associates, Mercer, NEPC, Principal, PCA, RVK and Voya. However, not all of these investment consultants provide us with forward-looking capital market expectations for all asset classes. In addition, there are differences in investment horizons, price inflation, treatment of investment expenses, excess manager performance (i.e., alpha), geometric vs. arithmetic averages and other technical issues with the information we receive from these investment consultants. We have attempted to align the various assumption sets from the different investment consultants to be as consistent as possible.

To the best of our ability, we have utilized the 10 investment consultants' capital market assumptions adjusting these assumptions to fit the VRS investment policy (i.e., target asset allocation). In the following charts, all returns are net of investment expenses and do not consider excess manager performance (alpha). The information in this report is not intended to be construed as investment advice.

## Real Return

The allocation of assets within the universe of investment options will significantly impact the overall performance. Therefore, it is meaningful to identify the range of expected returns based on each fund's targeted allocation of investments and an overall set of capital market assumptions.

Our analysis was based on the target asset allocation from the Strategic Asset Allocation Implementation Schedule and Allowable Ranges document, which was approved by the VRS Board of Trustees on June 7, 2016, as disclosed on page 103 of the June 30, 2017, Comprehensive Financial Annual Report. VRS' forward looking investment policy is summarized in the table on the following page:

| Asset Class | Target Allocation |
|---|---|
| Public Equity | 40% |
| Fixed Income | 15% |
| Credit Strategies | 15% |
| Real Assets | 15% |
| Private Equity | 15% |
| Total | 100% |

*Source: 2017 VRS CAFR*

The capital market assumptions in the 2017 GRS CMAM from the 10 nationally recognized investment consultants are for varying time horizons. Eight investment consulting firms provided capital market expectations for shorter time horizons (10 years or less). Two of the investment consulting firms that provided capital market expectations for shorter time horizons also provided capital market expectations for longer time horizons (20 to 30 years) and two investment consulting firms provided capital market expectations for longer time horizons only.

Given VRS' current target asset allocation and the capital market assumptions from the investment consultants, the development of the average nominal return, net of investment expenses, is provided in the following tables. The experience study indicates that the current assumption is comprised of a 2.50 percent price inflation, plus a 4.50 percent real net rate of return, for an assumed nominal rate of return of 7.00 percent that is net of investment expenses.

**Short-term Investment Horizon (10 years or less)**

| Investment Consultant | Investment Consultant Expected Nominal Return | Investment Consultant Inflation Assumption | Expected Real Return (2)–(3) | Actuary Inflation Assumption | Expected Nominal Return Net of Expenses (4)+(5) | | Standard Deviation of Expected Return (1-Year) |
|---|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) | | (7) |
| 1 | 6.25% | 2.20% | 4.05% | 2.50% | 6.55% | | 12.08% |
| 2 | 6.69% | 2.50% | 4.19% | 2.50% | 6.69% | | 11.87% |
| 3 | 6.22% | 2.00% | 4.22% | 2.50% | 6.72% | | 10.11% |
| 4 | 6.88% | 2.50% | 4.38% | 2.50% | 6.88% | | 12.14% |
| 5 | 6.80% | 2.26% | 4.54% | 2.50% | 7.04% | | 10.40% |
| 6 | 6.80% | 2.25% | 4.55% | 2.50% | 7.05% | | 12.04% |
| 7 | 7.27% | 2.21% | 5.05% | 2.50% | 7.55% | | 13.06% |
| 8 | 7.66% | 2.25% | 5.41% | 2.50% | 7.91% | | 9.52% |
| **Average** | **6.82%** | **2.27%** | **4.55%** | **2.50%** | **7.05%** | | **11.40%** |

*Source: GRS Analysis*

Based on each investment consulting firm's capital market assumptions, we estimated the expected real return of VRS' portfolio (col. (4)). As the immediately preceding table shows, the average one-year nominal return (net of expenses) of the firms with short-term investment horizons is 7.05 percent, which is 0.05 percentage points higher than the current assumption of 7.00 percent.

**Long-term Investment Horizon (20 to 30 years)**

| Investment Consultant | Investment Consultant Expected Nominal Return | Investment Consultant Inflation Assumption | Expected Real Return (2)–(3) | Actuary Inflation Assumption | Expected Nominal Return Net of Expenses (4)+(5) | | Standard Deviation of Expected Return (1-Year) |
|---|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (8) | | (9) |
| 1 | 6.59% | 2.00% | 4.59% | 2.50% | 7.09% | | 10.10% |
| 2 | 7.32% | 2.21% | 5.11% | 2.50% | 7.61% | | 11.92% |
| 3 | 8.23% | 2.75% | 5.48% | 2.50% | 7.98% | | 12.14% |
| 4 | 7.86% | 2.20% | 5.66% | 2.50% | 8.16% | | 13.06% |
| **Average** | **7.50%** | **2.29%** | **5.21%** | **2.50%** | **7.71%** | | **11.81%** |

*Source: GRS Analysis*

As the immediately preceding table shows, the average one-year nominal return (net of expenses) of the firms with long-term investment horizons is 7.71 percent.

Since future returns can vary considerably, it is extremely important to quantify the effect of anticipated volatility of the investment returns on the accumulation of assets and understand the range of long- term net return that could be expected to be produced by the investment portfolio.

The tables on the following page provide the 40$^{th}$, 50$^{th}$ and 60$^{th}$ percentiles of the 10-year geometric average of the expected nominal return, net of expenses based on the inflation assumption of 2.50 percent. (I.e., 40 percent of the results are below the 40$^{th}$ percentile results and 40 percent of the results are above the 60$^{th}$ percentile results.)

The table also shows the probability of exceeding the current 7.00 percent assumption, and alternate assumptions of 6.75 percent and 6.50 percent.

**Short-term Investment Horizon (10 years or less)**

| Investment Consultant | Distribution of 10-Year Average Geometric Net Nominal Return | | | Probability of exceeding 7.00% | Probability of exceeding 6.75% | Probability of exceeding 6.50% |
|---|---|---|---|---|---|---|
| | 40th | 50th | 60th | | | |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1 | 4.91% | 5.87% | 6.83% | 38.30% | 40.82% | 43.39% |
| 2 | 5.10% | 6.04% | 6.99% | 39.85% | 42.45% | 45.08% |
| 3 | 5.44% | 6.25% | 7.05% | 40.64% | 43.70% | 46.81% |
| 4 | 5.24% | 6.20% | 7.16% | 41.65% | 44.21% | 46.81% |
| 5 | 5.71% | 6.54% | 7.37% | 44.36% | 47.38% | 50.43% |
| 6 | 5.43% | 6.38% | 7.34% | 43.52% | 46.13% | 48.76% |
| 7 | 5.74% | 6.77% | 7.81% | 47.74% | 50.18% | 52.62% |
| 8 | 6.74% | 7.50% | 8.26% | 56.59% | 59.87% | 63.09% |
| **Average** | **5.54%** | **6.44%** | **7.35%** | **44.08%** | **46.84%** | **49.62%** |

*Source: GRS Analysis*

The average results of the eight firms with short-term investment horizons indicate there is about a 44 percent chance that the System will produce an average return that exceeds 7.00 percent over the next 10 years (based on an inflation assumption of 2.50 percent). A rate of 6.50 percent would have about a 50 percent chance of being exceeded over the next 10 years.

**Long-term Investment Horizon (20 to 30 years)**

| Investment Consultant | Distribution of 10-Year Average Geometric Net Nominal Return | | | Probability of exceeding 7.00% | Probability of exceeding 6.75% | Probability of exceeding 6.50% |
|---|---|---|---|---|---|---|
| | 40th | 50th | 60th | | | |
| (1) | (2) | (3) | (4) | (5) | (6) | (6) |
| 1 | 5.81% | 6.61% | 7.42% | 45.15% | 48.27% | 51.42% |
| 2 | 6.02% | 6.96% | 7.91% | 49.56% | 52.24% | 54.90% |
| 3 | 6.34% | 7.30% | 8.27% | 53.15% | 55.76% | 58.36% |
| 4 | 6.35% | 7.38% | 8.42% | 53.74% | 56.17% | 58.58% |
| **Average** | **6.13%** | **7.06%** | **8.00%** | **50.40%** | **53.11%** | **55.82%** |

*Source: GRS Analysis*

The average results of the four firms with long-term investment horizons indicate there is about a 50 percent chance that the System will produce an average return that exceeds 7.00 percent over the next 10 years (based on an inflation assumption of 2.50 percent).

An important fact to consider when deciding what weight to put on shorter term results or longer term results is the amount of benefits for current members that are projected to be paid over the shorter term (for example, the next 10 years). As shown in the solvency test on page 26 of the actuarial valuation report, over 50 percent of the actuarial accrued liability as of June 30, 2017, is attributable to benefits for current retired and inactive members (and a large percentage of these benefits are likely payable over the shorter term). Therefore, it is important to consider shorter-term expectations in addition to longer-term expectations in setting the economic assumptions.

**We believe that the current 7.00 percent investment return assumption is reasonable for the June 30, 2017, funding actuarial valuation.**

Based on the GRS analysis, there is approximately a 50 percent probability that VRS will produce an average return that exceeds 7.00 percent when considering a longer term investment horizon. However, when considering a shorter term investment horizon, there is less than a 50 percent probability (44 percent) that VRS will produce an average return that exceeds 7.00 percent.

In recommending a 7.00 percent assumption, CMC in the experience study report, indicates that "…. we believe we must be careful not to let recent experience or the short-term expectations impact our judgement regarding the appropriateness of the current assumption over the long term."

We believe, however, that it is important to consider shorter-term expectations in addition to longer-term expectations in setting the investment return assumption since over 50 percent of the VRS actuarial accrued liability as of June 30, 2017, is attributable to benefits for current retired and inactive members (and a large percentage of these benefits are likely payable over the shorter term).

**Therefore, during the next experience study review (or if sooner, the next review of the investment return assumption), we recommend that VRS/CMC continue to review the investment return assumption giving due consideration to both short term and long term investment horizons, and document the weightings in the experience study report.**

Reducing/increasing the investment return assumption will reduce/increase the funded ratio and increase/decrease the contribution requirements.

## Wage Inflation Assumption

The wage inflation assumption is 3.50 percent for all employee groups, comprised of 2.50 percent for price inflation and 1.00 percent for assumed economic productivity increases. The apparent real wage inflation shown on page 27 of the experience study report covering July 1, 2012, to June 30, 2106, experience was about 2.00 percent for State Employees, Teachers and VaLORS (2.82 percent for SPORS). In the prior experience study covering the period July 1, 2008, through June 30, 2012, the apparent increase was much lower (0.17 percent for Teachers, 0.67 percent for State Employees, 0.53 percent for VaLORS and 0.91 percent for SPORS).

**Given the national statistics and VRS statistics presented in the experience study report, GRS believes the current wage inflation assumption of 3.50 percent is reasonable for all employee groups.**

## Payroll Growth Assumption

The assumed rate of total payroll growth is used in the calculation of the amortization of the unfunded actuarial accrued liability as a level percentage of payroll. The current assumption is 3.00 percent for all divisions.

If total payroll increases by less than the payroll growth assumption, the System will receive less contributions to finance the unfunded liability which will result in an increase in the actuarial determined contribution rate in future years in order to finance the unfunded liability over the same time period. Following is a summary of the average annualized increase in total payroll for State Employees, Teachers, SPORS, VaLORS and JRS. The total payroll increases were calculated based on history included on pages 114 and 115 of the June 30, 2017, VRS CAFR.

| | Average Annualized Increases in Total Payroll for 9 Years (Through 2017) | Average Inflation | Average Annualized Increases in Total Payroll in Excess of Inflation | Average Annualized Increases in Total Payroll for 5 Years (Through 2017) | Average Inflation | Average Annualized Increases in Total Payroll in Excess of Inflation |
|---|---|---|---|---|---|---|
| | 9 Years | 9 Years | 9 Years | 5 Years | 5 Years | 5 Years |
| State | 1.36% | 1.26% | 0.10% | 1.88% | 1.31% | 0.57% |
| Teachers | 1.57% | 1.26% | 0.31% | 2.43% | 1.31% | 1.12% |
| SPORS | 1.08% | 1.26% | -0.18% | 1.64% | 1.31% | 0.33% |
| VaLORS | -0.26% | 1.26% | -1.52% | -0.16% | 1.31% | -1.47% |
| JRS | 1.41% | 1.26% | 0.15% | 2.50% | 1.31% | 1.19% |

*Source: GRS Analysis*

Total payroll has increased on average by less than the current assumption of 3.00 percent for the nine-year period from 2008-2017 and for the five-year period from 2012-2017. Based on the exhibit on page 8 of the June 30, 2017, actuarial valuation report, the number of active members has increased from 340,032 in 2013 to 343,559 in 2017. The increase in active members is likely one reason why the increase over the last five years was higher than the increase over the last nine years.

**During the next experience study review (or if sooner, the next review of the payroll growth assumption), we recommend that VRS/CMC continue to review the payroll growth assumptions giving due consideration to both actual historical plan experience between 2008 and the time of the next experience study, and future expectations.**

A decrease/increase in the payroll growth assumption will increase/decrease the contribution requirements which will result in a higher/lower funded ratio over time.

## Salary Increase Assumptions

Generally, assumed rates of pay increase are constructed as the total of two main components:

- Wage Inflation – currently 3.50 percent (comprised of 2.50 percent for price inflation and 1.00 percent for real wage increases)

- Merit, Promotion and Longevity – This portion of the salary increase assumption reflects components such as promotional increases as well as "step" increases and longevity pay. This portion of the assumption is not related to inflation.

In the context of a typical employer pay scale, pay levels are set for various employment grades, or "steps." In general, this pay scale is adjusted as follows:

- The inflation and economic productivity assumptions, collectively referred to as wage inflation, reflect the overall increases of the entire pay scale; and
- The Merit, Promotion and Longevity increase assumption reflects movement of members through the pay scale.

The experience study reports provide documentation of the salary increase experience for State Employees, Teachers, State Police, Judges, Virginia Law Officers (VaLORS)and Law Enforcement Officer (LEO) and Non-LEO employees of the political subdivisions (separately for employees in hazardous duty and non-hazardous duty occupations).

Although actual inflation during the experience study period was lower than the assumption of 2.50 percent, actual rates of salary increase for employees with 20 or more years of service (for whom no Merit, Promotion and Longevity increase in excess of inflation is assumed) were close to the expected salary increase rates of 3.50 percent (except for Judges). However, actual rates of salary increase for employees with less than 20 years of service were lower than assumed for State Employees, Teachers and VaLORS. Despite the differences between actual and expected increases for employees with less than 20 years of service, CMC kept both the step-rate assumption and the wage inflation assumption for all the employee groups unchanged from the prior experience study. The only commentary/justification provided in the report was that "Experience was reasonably close to expected."

Based on the actual salary experience compared with the current assumptions, it appears that adjustments to the Merit, Promotion and Longevity increases would be appropriate. Although the current assumptions reflect higher increases earlier in an employee's career and lower increases at the end of an employee's career, the salary experience in the most recent experience study indicates:

- For Teachers, higher increases earlier in their careers than the current assumptions, with increases leveling off after about five to 10 years of service. The salary experience does not show a significant difference in the level of pay increases for employees once they have 20 years of service (as is currently assumed).
- For State Employees, there is not as high of a difference in the rates of salary increase for employees earlier in their careers compared with those later in their careers (as is currently assumed).

The table on the following page summarizes the assumed increases and the differences in salary increase rates earlier and later in employees' careers for State employees and Teachers. Pages 193, 195, 197, 199, 200, 202, 204, 206 and 208 of the experience study report have graphs of the salary increase experience and expected rates for each group which also illustrate these points.

| | Sample Assumed Rates of Salary Increase | |
|---|---|---|
| Years of Service | State | Teachers |
| 1 | 5.35% | 5.95% |
| 10 | 4.00% | 4.85% |
| 19 | 3.65% | 4.45% |
| 20+ | 3.50% | 3.50% |
| Difference in Increase in Highest Year* and 20+ Years | | |
| Assumed | 1.85% | 2.45% |
| Estimated Actual | 1.00% | 4%-5% |
| Difference in Increase in 19 and 20+ Years | | |
| Assumed | 0.15% | 0.95% |
| Estimated Actual | 0.00%-0.25% | 0.00%-0.25% |

*The highest annual salary increase is assumed to occur in the first year.

*Source: GRS Analysis*

**During the next experience study:**

- **We recommend that VRS continue to review the step-rate increases for State Employees, Teachers and VaLORS and consider assumptions that more closely follow the pattern of salary increase experience based on years of service.**
- Actual rates of salary increase for Judges were significantly lower than the assumed rate (even after adjusting for differences between actual and assumed inflation). **We recommend that VRS continue to review whether an increase assumption of 4.50 percent (2.00 percent in excess of price inflation and 1.00 percent in excess of wage inflation) is appropriate for the Judges.**
- Although the salary increase assumption is the same for males and females for all groups, the salary experience was presented separately for males and females. **We recommend showing salary increase experience on a combined basis for males and females in the experience study report (consistent with the assumption**).

## *Demographic Assumptions*

ASOP 35, Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations, applies to actuaries when they are selecting demographic and all other assumptions not covered by ASOP No. 27 to measure obligations under any defined benefit pension plan that is not a social insurance program as described in section 1.2, Scope, of ASOP No. 32, Social Insurance.

In accordance with ASOP 35, an actuary should identify the types of demographic assumptions to use for a specific measurement. In doing so, the actuary should determine the following:

(a) The purpose and nature of the measurement;
(b) The plan provisions or benefits and factors that will affect the timing and value of any potential benefit payments;
(c) The characteristics of the obligation to be measured (such as measurement period, pattern of plan payments over time, open or closed group, and volatility);
(d) The contingencies that give rise to benefits or result in loss of benefits;
(e) The significance of each assumption; and

(f) The characteristics of the covered group.

Not every contingency requires a separate assumption. For example, for a plan that is expected to provide benefits of equal value to employees who voluntarily terminate employment or become disabled, retire, or die, the actuary may use an assumption that reflects some or all of the above contingencies in combination rather than selecting a separate assumption for each.

## Retirement

The retirement assumption is used to model the likelihood that a member retires from employment and immediately commences their VRS retirement benefit. CMC uses different retirement assumptions based on age, gender, employee type, plan and whether the employee is eligible for a reduced or unreduced retirement benefit. Utilizing different retirement assumptions like this is common for performing actuarial valuations for large retirement systems.

The number of members who actually retired during the observation period was less than expected. VRS' retirement experience during the observation period is similar to what we have observed with other statewide retirement systems. Generally, members have been working to later ages before retiring.

As a result, CMC recommended adjustments to the retirement assumption in the Experience Study for the Period July 1, 2012 to June 30, 2016, to better match actual experience. In addition, CMC recommended the age at which 100 percent retirement is assumed be increased from age 70 to age 75 State Employees, Teachers and non-hazardous duty locals. A comparison of the actual experience, current rates and proposed rates was easiest to review in the graphs in the Experience Study for each of the groups. The proposed rates were generally between the actual and current rates, which suggests that CMC gave the actual experience during the experience study period partial credibility.

**We believe the retirement assumptions documented in the experience study are reasonable. We recommend including the number of actual, expected and proposed number of retirements and ratio of actual to expected/proposed retirements in the same table for ease of comparison in the next experience study report.**

## Withdrawal

Not all active members of VRS are expected to continue employment with a participating employer of VRS during their entire career and make it to retirement. The purpose of the withdrawal assumption is to model the likelihood that an active member will continue to work for the employer to their retirement. Employee turnover behavior can be influenced by many factors, including external effects such as the economy. Therefore, it is important for the actuary to consider these factors when determining how much credibility to assign the experience when adjusting the current assumption to better model expected future experience.

CMC uses withdrawal rate assumptions based on age, gender, service and employee type. For the first 10 years, the rates vary by both age and service, and once a member attains 10 years of service, the rates vary solely by age.

**We believe the withdrawal assumptions recommended in the experience study report are reasonable.** However, it is difficult to determine from the details in the experience study report whether the current complex structure of rates is needed or if it could be simplified (for example, to rates that are service-based only for a certain number of years and then age-based only). **We recommend including additional detail in the next experience analysis report to determine whether the current complex structure of withdrawal rates is needed or if it could be simplified.**

## Disability Incidence

The disability incidence assumption models the number of members who will become disabled each year. Disabilities can occur due to service related or non-service related incidences.

CMC recommended changes in the disability rates in the Experience Study for the Period July 1, 2012, to June 30, 2016, such that the ratio of actual disabilities to the expected number of disabilities under the proposed assumptions was 1.00. Given the smaller sizes of some plans and the significant differences between actual and expected experience under the old assumptions, we would recommend setting rates giving partial credibility to the experience. The experience study report indicates "We recommend proposed disability rates that partially reflect disability experience over the study period." However, it appears that the proposed rates fully reflected disability experience over the study period. (For example, the number of Top 10, Female Non LEO disabilities was 136, the expected number was about 85 and the number under the proposed assumptions was 136.)

We do not believe that modifying disability rates between experience studies would significantly change the actuarial valuation results. **Therefore, we recommend reviewing the process for recommending disability rates based on partial or full credibility, during the next experience study.**

## Mortality

The post-retirement mortality assumption is one of the most important demographic assumptions used in the actuarial valuation of a pension plan because it models how long benefit payments are expected to be paid to retirees. The longer retirees live, the larger VRS' liability, thus requiring more contributions to fund VRS.

Pre-retirement mortality and disabled mortality have a less significant impact on the actuarial valuation.

Because of potential differences in expected mortality experience, it is common to use different mortality assumptions for disabled and non-disabled retirees. It is also common to use gender distinct assumptions and different assumptions for certain membership groups that are expected to have different mortality patterns, such as teachers.

The mortality assumptions used in the actuarial valuation of the VRS plans (before and after the assumption changes recommended in the Experience Study for the period July 1, 2012, to June 30, 2016) are based on standard mortality tables published by the Society of Actuaries, adjusted using various techniques to provide a better fit to the expected mortality for the retirees covered by the benefit plan and to reflect expected future mortality improvements.

CMC has reflected expectations for future mortality improvements by using mortality assumptions that expect fewer deaths than actually occurred in order to provide a margin for future mortality improvements. The margin was 9 to 14 percent for post-retirement mortality and 2 to 20 percent for pre-retirement and disabled mortality. GRS' preferred approach (which we also believe at this point is currently more common) is to use a generational mortality assumption which means that the probability of a 60-year-old retired male dying in any particular year is lower for a 60-year old born in 1994 than a 60-year old born in 1954. The use of generational mortality tables is based on the assumption that life expectancy increases from generation to generation. Simply put, this means that the life expectancy of someone born in 1994 is greater than that of someone born in 1954.

Following is an illustration of expected life expectancies based on the RP-2014 White Collar Healthy Annuitant mortality table with rates projected back to 2006 using the MP-2014 projection scale and projected forward using the MP-2017 projection scale. A male retiree who is age 65 in the year 2022 is expected to have a life expectancy that is about 0.36 years longer than a male retiree who is 65 in the year 2017.

| | Post-retirement Future Life Expectancy (years) | | | | | | Increase in Life Expectancy | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2017 | | 2022 | | 2027 | | 2017 to 2022 | | 2022 to 2027 | |
| Age | Male | Female | Male | Female | Male | Female | Male | Female | Male | Female |
| 50 | 36.34 | 38.14 | 36.80 | 38.58 | 37.25 | 39.02 | 0.46 | 0.44 | 0.45 | 0.44 |
| 55 | 31.44 | 33.13 | 31.88 | 33.56 | 32.32 | 33.99 | 0.45 | 0.43 | 0.44 | 0.43 |
| 60 | 26.68 | 28.26 | 27.09 | 28.65 | 27.51 | 29.07 | 0.41 | 0.39 | 0.42 | 0.41 |
| 65 | 22.11 | 23.60 | 22.47 | 23.95 | 22.86 | 24.34 | 0.36 | 0.36 | 0.39 | 0.38 |
| 70 | 17.75 | 19.13 | 18.08 | 19.48 | 18.43 | 19.83 | 0.32 | 0.35 | 0.35 | 0.35 |
| 75 | 13.71 | 14.94 | 14.01 | 15.26 | 14.32 | 15.59 | 0.30 | 0.33 | 0.31 | 0.32 |
| 80 | 10.10 | 11.16 | 10.37 | 11.44 | 10.64 | 11.72 | 0.27 | 0.27 | 0.27 | 0.29 |
| 85 | 7.08 | 7.96 | 7.29 | 8.16 | 7.51 | 8.39 | 0.21 | 0.20 | 0.22 | 0.23 |
| 90 | 4.80 | 5.47 | 4.94 | 5.61 | 5.11 | 5.77 | 0.15 | 0.14 | 0.16 | 0.17 |

*Source: GRS Analysis*

The table on the following page is an illustration of expected life expectancies using the current post-retirement mortality assumptions used in the actuarial valuation as of June 30, 2017, and a comparison to the life expectancies calculated based on the previous mortality assumptions as shown in the 2014 GRS Quadrennial Audit report. For the larger plans, the mortality assumptions were updated, and based on the new assumptions, there were increases in life expectancies (similar to what is reflected when using a generational mortality assumption). The new assumptions resulted in a decrease in the life expectancies for SPORS/VaLORS. However, due to the smaller size of the plans and the limited number of deaths, we do not believe that full credibility should be given to the experience in assumption setting for these plans.

**Future Life Expectancy (years) based on CMC assumptions**

| | State | | Teachers | | SPORS/VaLORS | | Subdivision Non LEO | |
|---|---|---|---|---|---|---|---|---|
| Age | Male | Female | Male | Female | Male | Female | Male | Female |
| 50 | 32.3 | 35.5 | 34.4 | 37.6 | 31.6 | 33.0 | 30.5 | 34.9 |
| 55 | 28.0 | 30.9 | 29.9 | 32.8 | 27.3 | 28.6 | 26.3 | 30.4 |
| 60 | 23.9 | 26.5 | 25.5 | 28.2 | 23.1 | 24.2 | 22.3 | 25.9 |
| 65 | 19.9 | 22.1 | 21.2 | 23.7 | 19.1 | 20.1 | 18.3 | 21.6 |
| 70 | 16.0 | 17.9 | 17.0 | 19.3 | 15.2 | 16.1 | 14.6 | 17.5 |
| 75 | 12.5 | 14.0 | 13.1 | 15.1 | 11.6 | 12.6 | 11.2 | 13.7 |
| 80 | 9.3 | 10.5 | 9.6 | 11.4 | 8.4 | 9.4 | 8.2 | 10.2 |
| 85 | 6.6 | 7.6 | 6.6 | 8.1 | 5.8 | 6.7 | 5.7 | 7.2 |
| 90 | 4.5 | 5.2 | 4.3 | 5.4 | 3.8 | 4.6 | 3.9 | 4.9 |
| **Future Life Expectancy (years) based on CMC assumptions from prior quadrennial audit** | | | | | | | | |
| 65 | 19.2 | 21.8 | 20.8 | 23.6 | 19.2 | 21.8 | 18.3 | 21.0 |
| **Change in Future Life Expectancy (years) based on CMC assumptions** | | | | | | | | |
| 65 | 0.7 | 0.3 | 0.4 | 0.1 | -0.1 | -1.7 | 0.0 | 0.6 |

*Source: GRS Analysis*

CMC reviewed mortality experience based on the number of deaths during the experience study period. Post-retirement mortality experience can also be reviewed on a benefits-weighted basis or a liability weighted basis which will recognize differences in life expectancies based on the amount of the members' benefits (or pays).

In addition, CMC made a number of adjustments to the standard base mortality tables for each of the plans for pre-retirement, post-retirement and disabled mortality. In some cases, it does not appear that there were enough deaths in the plan's experience or within the adjusted age band for the experience to be fully credible.

Please note that the Retirement Plans Experience Committee (RPEC) of the Society of Actuaries (SOA) is currently working on a public pension plan mortality study. The purpose of this mortality study is to analyze mortality experience specific to public sector retirement systems and to issue standard mortality tables that reflect public sector mortality experience as compared to only private sector mortality experience.

**We believe the current mortality assumptions are reasonable. However, we have the following recommendations when the next experience study is prepared (which we expect will be after the release of the latest SOA standard public sector mortality tables):**

1. **Continue to consider if a generational mortality improvement assumption is appropriate**
2. **Analyze mortality experience on a benefits weighted or liability weighted basis**
3. **Review the credibility of the experience in adjusting the standard base mortality tables (especially for smaller plans such as SPORS/VaLORS and pre-retirement and disabled mortality)**

## Other Assumptions

The normal form of payment for retirement benefits is a life annuity, with a cash refund feature that guarantees that if a member dies before receiving benefits paid at least equal to contributions plus interest at retirement, the balance will be paid as a lump sum to the member's beneficiary. CMC has indicated that they are valuing benefits for future retirees as a life annuity. **We recommend that CMC either explicitly value the cash refund feature or value the cash refund feature by assuming a certain period and also clearly disclose the assumption for the assumed form of payment for benefits in the actuarial report.**

CMC assumes that decrements (retirements, terminations, deaths and disabilities) occur at the beginning of the valuation year (July 1). For teachers' plans, retirements and terminations typically occur either at the beginning of the year (if the valuation data as of June 30 does not already reflect the retirements and terminations at the end of the most recent school year) and at the end of the year if retirements and terminations from the most recent school year have already been reflected in the valuation data. For non-teachers' plans and for deaths and disabilities, we usually see these terminations occurring throughout the year and make an assumption that these occur in the middle of the year. **We recommend that VRS continue to review the timing of members leaving active membership (for retirements, terminations, deaths and disabilities), from each plan during the next experience study and update the timing assumptions if needed.**

## Assumptions Specific for OPEB Plans

Because there is significant overlap in the employee group covered by the pension and OPEB plans (i.e., Health Insurance Credit (HIC) Program, Group Life Insurance Program and the Virginia Sickness and Disability Program (VSDP)), the actuarial valuation of the OPEB plans utilize many of the same assumptions used in the actuarial valuation of the pension plan, including rates of termination, retirement and mortality.

The actuarial valuation of the HIC Program includes assumptions regarding participation rates and benefit utilization.

As part of the Experience Study for the Period July 1, 2012, to June 30, 2016, CMC reviewed the following assumptions for the HIC program:

1) Benefit election rates;
2) Benefit Utilization rates;
3) Assumed benefit commencement ages for terminated vested members; and
4) Percentage of terminated vested members electing to withdraw from VRS.

CMC recommended a change to the benefit utilization rates for members who elect HIC but do not receive the maximum benefit amount. CMC recommended that all other rates remain unchanged. The experience study document did not include a comparison of the proposed assumption to the plan's actual experience for some of the rates, so we are unable to provide an opinion with certainty that the recommended assumptions are reasonable. However, they do appear reasonable. For the percentage of

members who are assumed to utilize HIC but are not expected to receive the maximum benefit amount, CMC appeared to give full credibility to the experience for SPORS/VaLORS in the recommended rate, but only limited credibility to the experience for the Political Subdivisions in the recommended rate. It is not clear why the recommended rate was only 10 percent; however, a lower rate is more conservative (because a higher percentage of members are assumed to receive the maximum benefit). The following table illustrates these rates.

| System | Actual Rate | Current Assumption | Proposed Assumption |
|---|---|---|---|
| SPORS/VaLORS | 20% | 10% | 20% |
| Political Subdivisions | 22% | 5% | 10% |

**We believe the other OPEB assumptions are generally reasonable. We recommend that sufficient documentation be included in the next experience study report comparing the OPEB proposed assumptions to the plan's actual experience in order to assess the reasonability of the assumptions.**

## Actuarial Experience Review Report

**We recommend including the number of actual, expected and proposed number of decrements and the ratio of actual to expected/proposed decrements in the same table for ease of comparison.** The graphs that were included in the report were useful in illustrating the comparison between the actual experience and expected and proposed rates.

## Summary of Recommendations on Actuarial Assumptions

**When the next experience study is conducted**, (which based on § 51.1–124.22(A)(4) would cover experience for the four year period July 1, 2016, to June 30, 2020), GRS recommends that CMC and VRS give consideration to the following:

- We recommend VRS continue to review the investment return assumption giving due consideration to both short term and long term investment horizons. (Page 17)
- We recommend CMC include additional information in the next experience analysis report documenting the weighting of the short term and long term investment horizons. (Page 17)
- We recommend VRS continue to review the payroll growth assumption giving due consideration to both actual historical plan experience between 2008 and the time of the next experience study, and future expectations. (Page 18)
- We recommend VRS continue to review the step-rate increases for State Employees, Teachers and VaLORS and consider assumptions that more closely follow the pattern of salary increase experience based on years of service. (Page 20)
- We recommend VRS continue to review whether an increase assumption of 4.50 percent (2.00 percent in excess of price inflation and 1.00 percent in excess of wage inflation) is appropriate for the Judges. (Page 20)
- We recommend showing salary increase experience on a combined basis for males and females in the experience study report (consistent with the assumption). (Page 20)

- We recommend including the number of actual, expected and proposed number of retirements and ratio of actual to expected/proposed retirements in the same table for ease of comparison in the next experience study report. (Page 21)
- We recommend including additional detail in the next experience analysis report to determine whether the current complex structure of withdrawal rates is needed or if it could be simplified. (Page 22)
- We recommend reviewing the process for recommending disability rates based on partial or full credibility, during the next experience study. (Page 22)
- We have the following recommendations when the mortality assumptions are next reviewed: (Page 24)
    - Continue to consider if a generational mortality improvement assumption (to reflect future expected mortality improvements) is appropriate
    - Analyze mortality experience on a benefits weighted or liability weighted basis
    - Review the credibility of the experience in adjusting the standard base mortality tables (especially for smaller plans such as SPORS/VaLORS and pre-retirement and disabled mortality)
- We recommend that CMC either explicitly value the cash refund feature or value the cash refund feature by assuming a certain period and also clearly disclose the assumption for the assumed form of payment for benefits in the actuarial report. (Page 25)
- We recommend that CMC continue to review the timing of members leaving active membership (for retirements, terminations, deaths and disabilities) from each plan during the next experience study. (Page 25)
- We recommend that sufficient documentation be included in the next experience study report comparing the OPEB proposed assumptions to the plan's actual experience in order to assess the reasonability of the assumptions. (Page 26)
- We recommend including the number of actual, expected and proposed number of decrements and the ratio of actual to expected/proposed decrements in the same table for ease of comparison in future actuarial experience study reports. (Page 26)

Based on past history, revised actuarial assumptions based on the results of the next experience study (covering the four year period July 1, 2016, to June 30, 2020) will likely first be reflected in the June 30, 2021 actuarial valuation. As such, they will first affect employer contribution rates for fiscal years ending 2023 and 2024.

# SECTION IV.

## REASONABLENESS OF ACTUARIAL METHODS AND FUNDING POLICY

## Actuarial Cost Methods

The ultimate cost of VRS is equal to the actual benefits paid plus the expenses related to operating the plans. This cost is pre-funded through annual contributions to VRS plus the investment return on accumulated contributions. The projected level and timing of the contributions needed to fund the ultimate cost are determined by the actuarial assumptions, plan provisions, participant characteristics, investment and demographic experience and the actuarial cost method.

An actuarial cost method is a mathematical process for allocating the dollar amount of the total present value of plan benefits (TPV) between future normal costs and actuarial accrued liability (AAL). According to the VRS Funding Policy Statement updated as of November 15, 2017, the VRS Board has adopted the Entry Age Normal cost method for all defined benefit and OPEB plans. Accordingly, this is the actuarial cost method used by CMC.

The Entry Age Normal actuarial cost method is characterized by:

(1) Normal Cost – the level percent of payroll contribution, paid from each participant's date of hire to date of retirement, which will accumulate enough assets at retirement to fund the participant's projected benefits from retirement to death.

(2) Actuarial Accrued Liability – the assets which would have accumulated to date had contributions been made at the level of the normal cost since the date of the first benefit accrual, if all actuarial assumptions had been exactly realized, and there had been no benefit changes.

**The Entry Age Normal actuarial cost method is the most common funding method in the public sector. We believe that it is appropriate for the public sector because it produces costs that remain stable as a percentage of payroll over time, resulting in intergenerational equity for taxpayers. It is also the cost method required to be used by GASB for financial reporting.**

**We have reviewed CMC's application of the Entry Age Normal actuarial cost method by comparing the test life results calculated by GRS and provided by CMC, and we believe that the method is applied correctly.**

## Asset Valuation Method

Market value of assets can experience significant short-term swings, which can cause large fluctuations in the development of the actuarially determined contributions required to fund retirement systems. As a result, many public pension systems use an asset valuation method which dampens these short-term volatilities and therefore achieves more stability in the employer contribution.

ASOP No. 44, Selection and Use of Asset Valuation Methods for Pension Valuations, provides a framework for the determination of the actuarial value of assets (AVA), emphasizing that the method should: (1) bear a reasonable relationship to the market value of assets (MVA), (2) recognize investment gains and losses over an appropriate time period and (3) avoid systematic bias that would overstate or understate the AVA in comparison to MVA.

# Reasonableness of Actuarial Methods and Funding Policy

In accordance with the VRS Funding Policy Statement, the asset valuation method used by the systems in VRS, including the OPEB plans, is a five-year smoothing method that recognizes the difference between the actual return (net of investment and administrative expenses) and the expected return based on the market asset value for each fiscal year at the rate of 20 percent each year. This method is the most common asset valuation method used by other large public employee retirement systems and **we believe it is appropriate to use for all the plans in VRS.**

VRS also applies a 20 percent corridor around the MVA that restricts the degree which the AVA can vary from the MVA. **We believe the use of a corridor is also reasonable**.

**We also verified the calculation of the actuarial value of assets as of June 30, 2017, for each benefit plan.**

## VRS Funding Policy

The VRS Funding Policy Statement addresses the following general policy objectives:

- Ensure funding of plans is based on actuarially determined contributions;
- Build funding discipline into the policy to ensure promised benefits can be paid;
- Maintain intergenerational equity so the cost of employee benefits is financed by the generation of taxpayers who receives services;
- Make employer costs a consistent percentage of payroll; and
- Require clear reporting to show how and when pension plans will be adequately funded.

VRS operates the same target funding level for all the benefit plans with the intent of ultimately attaining a 100 percent funded ratio.

The VRS Board has elected to calculate the actuarially determined contribution using the Entry Age Normal cost method (as a level percentage of payroll), a five-year asset smoothing method with a 20 percent corridor, and amortization rates that, with exception of recognition of the deferred contributions from the 2010-2012 biennium, are determined as a level percentage of payroll. The following components of the unfunded liability will be amortized as follows:

- The deferred contributions of the 2010-2012 biennium will be amortized as a level dollar amount over a closed, 10-year period beginning June 30, 2011. These deferred contributions, as defined under the 2011 Appropriations Act, Item 469(I)(6), have been paid off, except for the Teachers Plan which is to be amortized using a level dollar, closed 10-year period beginning June 30, 2011. As of June 30, 2017, there are four years remaining in the amortization period for the Teachers.
- The legacy unfunded liability as of June 30, 2013, that is not attributable to the deferred contributions of the 2010-2012 biennium will be amortized as a level percentage of payroll over a closed 30-year period beginning June 30, 2013.
- All new sources of unfunded liability incurred in future years will be separately amortized as a level percentage of payroll over individual closed 20-year periods.

If the participating employers of VRS, including the State, adhere to this funding policy, then the funded ratio is expected to gradually improve and eventually attain a 100 percent funded ratio within a reasonable period.

The Conference of Consulting Actuaries ("CCA") Public Plans Community in October 2014 issued a White Paper entitled *Actuarial Funding Policies and Practices for Public Pension Plans.* This CCA White Paper provides the following model practice for amortization periods and components:

- Layered fixed period amortization by source of UAAL;
- Level percent of pay amortization; and
- Amortization periods.

| Source | Period |
|---|---|
| Active Plan Amendments | Lesser of active demographics, or 15 years |
| Inactive Plan Amendments | Lesser of inactive demographics, or 10 years |
| Experience Gain/Loss | 15 to 20 years |
| Assumption or Method Changes | 15 to 25 years |
| Early Retirement Incentives | 5 years or less |

*Source: CCA White Paper*

The Government Finance Officers Association (GFOA) has recommended that every state and local government that offers defined benefit pensions formally adopt a funding policy that provides reasonable assurance that the cost of those benefits will be funded in an equitable and sustainable manner. In particular, the GFOA recommends that amortization of the unfunded actuarial accrued liability should:

1) Use fixed (closed) periods that:
   - Are selected so as to balance the twin goals of demographic matching (equitable allocation of cost among generations) and volatility management (funding at a level percentage of payroll)
   - Never exceed 25 years, but ideally fall in the 15-20 year range
2) Use a layered approach for the various components to be amortized (that is, an approach that separately tracks the different components to be amortized); and emerge as a level percentage of member compensation or as a level dollar amount

**In general, we believe that the VRS funding policy represents an appropriate balance between cost stability and the goal of maintaining intergenerational equity.** In addition, this funding policy is consistent with the model practices recommended by CCA White Paper, as well as by the GFOA.

Based on the current interest rate and payroll growth assumptions, the total unfunded liability will decrease as long as the effective amortization period is less than approximately 22 years. The remaining amortization period as of June 30, 2017, for the outstanding balance of the unfunded liability as of June 30, 2013, is 26 years and new sources of unfunded liability are amortized over separate 20-year closed periods each year. However, because gains subsequent to June 30, 2013, are being amortized over shorter periods than the remaining unfunded liability from June 30, 2013, the effective amortization period for all plans except the Teachers Plan is longer than 26 years. The effective amortization period for each plan is shown on pages 1 through 6 of the June 30, 2017, VRS actuarial valuation report. The impact of having an effective amortization period in excess of 26 years is that as annual gains (amortized over 20 years) are fully amortized before the end of the 26 year period for the outstanding balance of the unfunded liability as of June 30, 2013, annual contribution requirements may increase significantly. Therefore, considering that the effective amortization period for all of the plans is in excess of 28 years (with the exception of the Teachers Plan at 26 years), **we recommend that CMC provide more details in the VRS funding actuarial report including (1) the definition of an "effective amortization period", (2) a description of the implications of having separate unfunded liability amortization bases and an effective amortization period in excess of 26 years (the number of years remaining until VRS is expected to be fully funded) and (3) the magnitude of the expected change in future contribution rates as a result of the separate amortization bases. Also, if the prospect of expected large increases in contribution rates is adverse to VRS, we recommend that VRS consider a change to the funding policy which may include aggregating the outstanding unfunded liability bases such that the effective amortization period is less than a fixed number of years (such as 25 or 30) which would result in a smaller near term contribution increase instead of a larger contribution increase in the future.**

## VRS Funding Policy for At-Risk Local Plans

According to the VRS funding policy, CMC identified several potential at-risk local plans with funding ratios below 50 percent. Therefore, the VRS Board approved an amendment, effective November 14, 2013, to the VRS funding policy to address potential at-risk plans, including, but not limited to, those with 50 percent or lower funding. The amendment allows the Board to certify alternative contribution rates that would maintain a plan's solvency while also meeting the other objectives as stated in the Board's funding policy.

We reviewed the June 30, 2017, actuarial report prepared by CMC for Plan G which was provided to us by JLARC and VRS as representing an at-risk political subdivision plan. However, there is no specific information in this actuarial report that gives any indication that it is an at-risk plan. In fact, the funded ratio of this plan as of June 30, 2017, is about 86 percent. The only comment in this actuarial report related to any alternative contributions is that "The unfunded liability may also include an additional funding contribution rate to maintain plan solvency."

Therefore, we inquired why this plan was identified as an at risk plan. We were informed by VRS on April 3, 2018, that the basis of the additional funding charge for at-risk plans is the cross-over calculation that is used in deriving the discount rate for Governmental Accounting Standards Board ("GASB ") Statement No. 68. In effect, VRS is using the cross over calculation to identify at-risk plans. In an effort to avoid having a blended rate for any of the political subdivision plans, CMC runs a closed group cross-over projection for each of the political subdivision plans. If these closed group projections show a cross-over date (meaning

that current contributions are insufficient to pay benefits for current members), an additional contribution is developed that prevents the plans' assets from dropping below zero.

Under GASB Statement No. 68, the single discount rate used to determine the Total Pension Liability ("TPL") and the Pension Expense is a blended rate that reflects (1) a long-term expected rate of return on pension plan investments (to the extent that the plan's fiduciary net position is projected to be sufficient to pay benefits) and (2) a tax-exempt municipal bond rate based on an index of 20-year mixed maturity general obligation bonds with an average Standard & Poor's Corp.'s AA credit rating (which is published by the Bond Buyer Index) as of the measurement date (to the extent that the contributions for use with the long-term expected rate of return are not met). The result of using a blended rate that is less than the investment return assumption used for the funding actuarial valuation is an increase in the unfunded liability which is reflected on the financial statement balance sheet.

We have reviewed the cross-over calculation provided to us for Plan G. In our opinion it is a reasonable approach to identifying and developing the additional contribution for at-risk plans. However, the purpose and amount of this additional funding contribution should be fully disclosed in accordance with the ASOPs.

**Therefore, we recommend adding additional information to the actuarial valuation reports for at-risk political subdivision plans, including:**

- **A description of the purpose of the additional funding charge for at-risk plans**
- **A description of how the additional funding charge for at-risk plans is calculated**
- **The specific amount of the additional funding charge**
- **The amortization charge as a percentage of payroll excluding the additional funding charge (based on the amortization schedule shown in the report)**
- **The effective amortization period and additional discussion of the implications of the funding policy (similar to the recommendation for the main VRS actuarial valuation report)**

## Summary of Recommendations on Reasonableness of Actuarial Methods and Funding Policy

- We recommend that CMC provide more details in the VRS funding actuarial report including (1) the definition of an "effective amortization period", (2) a description of the implications of having separate unfunded liability amortization bases and an effective amortization period in excess of 26 years (the number of years remaining until VRS is expected to be fully funded) and (3) the magnitude of the expected change in future contribution rates as a result of the separate amortization bases. (Page 31)
- Also, if the prospect of volatile annual contribution requirements is adverse to VRS, we recommend that VRS consider aggregating the outstanding unfunded liability bases such that the effective amortization period is less than a fixed number of years (such as 25 or 30). (Page 31)
- We recommend adding additional information to the actuarial valuation reports for at-risk political subdivision plans, including: (Pages 32-33)
    - A description of the purpose of the additional funding charge for at-risk plans
    - A description of how the additional funding charge for at-risk plans is calculated

- The specific amount of the additional funding charge
- The amortization charge as a percentage of payroll excluding the additional funding charge (based on the amortization schedule shown in the report)
- The effective amortization period and additional discussion of the implications of the funding policy (similar to the recommendation for the main VRS actuarial valuation report)

# SECTION V.

## APPLICATION OF ACTUARIAL ASSUMPTIONS, METHODS AND PLAN PROVISIONS

# Application of Actuarial Assumptions, Methods and Plan Provisions

## Review of Test Life Calculations for Accuracy

In order to determine if the June 30, 2017, actuarial valuations completed by CMC for the VRS plans (1) are calculated based on the benefit provisions specified in Title 51.1 of State Code and (2) use the actuarial assumptions and actuarial methods disclosed in the experience study and the June 30, 2017, actuarial valuation reports, GRS requested sample participant calculations (i.e., test lives) from the retained actuary.

GRS requested that CMC provide sample participant calculations for the sample lives requested. For each active member sample life, CMC provided the following by decrement (retirement, termination, disability, death): present value of future benefits (PVB), present value of future salaries (PVFS), actuarial accrued liability (AAL) and normal cost (NC). The test life detail provided to us for the 2018 quadrennial audit was more limited than the information provided for the 2014 audit and does not show probabilities of decrement by age, estimated pay and benefits by age or decrement, or present value of benefits by age for each decrement. Therefore, while we were able to compare the final results that GRS independently calculated against the results provided by CMC, we could not verify whether there were issues or inconsistencies in the calculations or application of assumptions for an individual age or year of service or if the differences were due to nuances in the valuation software programming. **However, since the results calculated by GRS are close to those calculated by CMC (generally within 3 percent-5 percent), we conclude that any inconsistencies that may be present in the CMC calculations are not material to the actuarial results.**

***Calculation of the Actuarial Liability Information for Active Members*:**

Following are our comments based on calculating results for the 46 active member VRS pension test lives:

1) For 45 of the 46 test lives, the present value of future salaries (PVFS) calculated by GRS was within 3 percent of the amount calculated by CMC. However, in most of the cases, the amounts calculated by GRS were lower than those calculated by CMC. **Based on these results, we conclude that CMC seems to be applying the pay increase assumptions and the other decrement assumptions in a manner that is consistent with the stated actuarial assumptions.**
   a. It is not clear why in most of the test lives, the PVFS amounts calculated by GRS were lower than those calculated by CMC. In the 2014 Audit, GRS had recommended that CMC change the methodology used to calculate PVFS that would decrease the calculated PVFS for each member and better align the calculation with the assumptions for decrement timing and pay increase timing. However, CMC has indicated that this change was made.
2) For 41 of the 46 test lives, the present value of future benefits (PVFB) calculated by GRS was within 5 percent of the amount calculated by CMC (and more than half were within 3 percent). However, in most of the cases, the amounts calculated by GRS were lower than those calculated by CMC and the combined PVFB for the 46 test lives was about 1.3 percent lower. **Based on these results, we conclude that CMC seems to be applying the assumptions and benefit provisions in a manner that is consistent with the stated assumptions and benefit provisions in the actuarial report.**
   a. For Plan 2 and Hybrid Plan members, there is an actuarial reduction for early retirement. (Compared to a set percentage reduction for each year that retirement precedes normal

retirement for Plan 1.) We were not provided the early retirement reduction factors used in the administration of Plan 2 and the Hybrid Plan or details on how CMC was calculating/applying the early retirement reductions. Therefore, there are likely differences in the application of the early retirement reductions between GRS and CMC that may be contributing to the differences.

**3)** The normal cost (NC) calculation is based on a normal cost rate (based on a calculation of PVFB and PVFS at the member's entry age) and the member's expected pay in the upcoming year. The actuarial accrued liability (AAL) calculation is based on the PVFB and PVFS at the member's current age and the normal cost rate. Because there are more calculations performed for the AAL and NC than for the PVFS and PVFB, there is more room for differences in calculation methodologies between the two firms. Therefore, there were larger differences in the actuarial accrued liability (AAL) and normal cost calculated by GRS and CMC than for the PVFS and PVFB for the 46 individual test lives. **However, the combined AAL and NC calculation by GRS for the 46 test lives was less than 0.50 percent lower for AAL and less than 2.00 percent lower for NC, which we believe is a reasonable difference.**

   a. We further reviewed the difference in AAL and NC for the third State active member test life where there was a 30 percent difference in the AAL and 19 percent difference in the NC. This member had a 45 percent decrease in pay from fiscal year 2016 to 2017 based on the data provided to GRS. We expect that the large difference in the AAL and NC calculated by GRS and CMC is due to differences in the pay each firm assumed from the member's entry age to her age at the valuation, which was then used in the calculation of the normal cost rate. However, the expected PVFB to be paid by VRS that was calculated by both firms was within 1.0 percent, which means that although the recognition of costs over the member's career differs significantly, the ultimate cost to VRS does not.

***Calculation of the Actuarial Liability Information for Inactive and Retired Members*:**

For each inactive/retired member sample life, CMC provided the actuarial accrued liability (which is equal to the present value of future benefits for inactive/retired members).

**Based on calculating results for the 48 terminated and retired member VRS pension test lives, GRS can closely match the actuarial accrued liabilities.** However, for the terminated vested members under age 50, the member contribution balance is significantly higher than the present value of the deferred annuity payable at normal retirement age. **We recommend that CMC use the same assumption for current terminated vested members as is used for future terminated vested members which is to assume that the more valuable of a return of contributions and a deferred annuity is elected**.

## Detailed Test Live Results

Tables 1 and 2 in the Appendix present results for the 46 active and 48 inactive (retired and terminated) members for whom we received test life results.

## Summary of Recommendations on Application of Actuarial Assumptions, Methods and Plan Provisions

- We recommend that CMC use the same assumption for current terminated vested members as is used for future terminated vested members which is to assume that the more valuable of a return of contributions and a deferred annuity is elected. (Page 35)

# SECTION VI.

## ACTUARIAL REPORT CONTENT, DETAIL, FORMAT AND CLARITY

# Actuarial Report Content, Detail, Format and Clarity

## Actuarial Standards of Practice

The Actuarial Standards Board (ASB) promulgates actuarial standards of practice (ASOPs) for use by actuaries when rendering actuarial services in the United States. A summary of the specific ASOPs that provide guidance with respect to report content and clarity (ASOP Nos. 4 and 41) can be found in the Appendix.

## Findings and Recommendations

Our review of the June 30, 2017, actuarial valuation reports includes the following plans:

- Virginia Retirement System (i.e., actuarial valuation of the State Employees, Teachers, State Police, VaLORS and JRS);
- Seven political subdivision plans participating in the VRS; and
- OPEB programs (i.e., the Group Life Insurance Program, Health Insurance Credit Program, the Virginia Sickness and Disability Program and the Virginia Local Disability Program).

**In general, we believe that the actuarial reports we reviewed are in compliance with the applicable ASOPs regarding report content, detail, format and clarity. However, we have several recommendations regarding enhanced disclosures in future actuarial valuation reports. The purpose of these additional disclosures is to ensure that another actuary qualified in the same practice area could make an objective appraisal of the reasonableness of the actuary's work as presented in the actuarial report.**

We noted an apparent inconsistency between the sources of gains and losses on pages 18 and 19 in the June 30, 2017, VRS Actuarial Valuation Report and the new sources of unfunded liability arising from the 2017 actuarial valuation as shown in the amortization schedules on pages 42 through 46 of the actuarial valuation report. Based on follow up with CMC, they identified adjustments to the development of gains and losses which would result in consistency between the gains and losses on pages 18 and 19 and the new sources of unfunded liability from the 2017 actuarial valuation as shown on pages 42 through 46. **We recommend that CMC incorporate these adjustments in future actuarial valuation reports.**

In the plan provision section of the June 30, 2017, VRS Actuarial Valuation Report, the early retirement benefit summary and a portion of the disability retirement summary appear to be missing from between pages 84 and 85 of the report. **We recommend that CMC check the actuarial report plan provision sections.**

**We recommend that the actuarial reports for the political subdivisions plans participating in the VRS include more detail on the provisions of the Hybrid Plan. For example, it is not clear what the level of employer match is for contributions made to the DC plan by employers.**

**We also recommend that the actuarial reports for the political subdivisions plans participating in the VRS include more detail on the sources of actuarial gains and losses occurring during the year.** For example, in the June 30, 2017, actuarial report for Plan E, the only comment made with regard to experience is as follows "Most employers have experienced a gain for the year ending June 30, 2017,

primarily due to strong asset returns that were slightly offset by the change in assumptions." In fact, Plan E experienced a loss. It would be very useful if CMC broke down the actual 2017 experience into individual components including asset experience, changes in assumptions, salary experience, demographic changes of the covered group, etc. We do acknowledge the additional time, resources and fees necessary to provide individual gain/loss analyses given that VRS has nearly 600 separate political subdivisions.

In the individual political subdivision plan actuarial reports there is no development of the actuarial value of assets. In fact, there is no statement of assets or reconciliation of assets for individual plans at all, with the exception of a reported figure that represents the Market Value of Assets ("MVA") and the Actuarial Value of Assets ("AVA") for each plan. Therefore, we asked VRS and CMC about the development of the AVA for the political subdivision plans and received the following response on April 4, 2018, "The aggregate actuarial value of assets is first determined in aggregate based on the aggregate market value of assets. The aggregate market value of assets is the sum of the market value of assets as provided by VRS across all political subdivisions. The actuarial value of assets is then allocated to each political subdivision based on the market value of that political subdivision. What that means is that if a political subdivision has 2 percent of the total market value of assets of the total political subdivision plan, that political subdivision will be allocated 2 percent of the total actuarial value of assets." **We recommend that CMC include a similar explanation in the actuarial reports for the political subdivisions plans participating in the VRS regarding how the AVA is developed.**

**We also recommend that the actuarial reports for the political subdivisions plans identified as at-risk plans include:**

- **A description of the purpose of the additional funding charge for at-risk plans**
- **A description of how the additional funding charge for at-risk plans is calculated**
- **The specific amount of the additional funding charge** (For the Plan G actuarial report that was identified to us by VRS as representing an at-risk plan, the additional funding contribution is included in the UAAL Amortization Rate with no breakout.)
- **The amortization charge as a percentage of payroll excluding the additional funding charge (based on the amortization schedule shown in the report)**

There is a statement in the actuarial reports for the political subdivisions plans in the *Summary of Principal Results* section indicating that "The valuation reflects a contribution timing adjustment based on feedback from the 2014 quadrennial actuarial audit of the Virginia Retirement System by JLARC." **We recommend that the details of this adjustment be clearly identified in the actuarial reports for the political subdivisions plans. It appears that this same adjustment was made to the actuarial valuation of the VRS; therefore, we recommend that the details of this adjustment be clearly identified in the VRS actuarial reports as well.**

Finally, it is interesting to note that the annual funding actuarial valuation reports prepared by CMC for VRS do not include the funded ratio (i.e., the ratio of assets to accrued liability). The funded ratio is the primary metric for evaluating the financial status of a pension or OPEB plan and for evaluating trends of the financial status over time. If the funded ratio is not increasing over time, this may be an indication that a change in the funding policy or the actuarial assumptions is needed. Although the unfunded

actuarial accrued liability (which is included in the funding reports) also provides information on the funded status of the plan, it needs to be evaluated in conjunction with the actuarial accrued liability. We asked VRS about this practice and they replied that when GASB 67/68 became effective, VRS staff decided to take funded ratio information out of the funding actuarial reports and only include it in the GASB reports so as to minimize confusion between the accounting and funding measures. Funded ratio information is, however, included in CMC presentations to the VRS Board.

**We recommend that funded ratio be included in future annual funding actuarial valuation reports, with additional discussion, as necessary, to explain differences in funding and accounting results, since it is a fundamental measure of the funding condition of a plan.**

## Summary of Recommendations for Actuarial Report Content, Detail, Format and Clarity

Following is a summary of the recommendations discussed in this section of the report:

- Update the gain/loss analysis to have consistency between the gain/loss schedules and the new unfunded liability arising from the 2017 actuarial valuation, as shown in the amortization schedules (Page 37)
- Check the plan provision sections of the June 30, 2017, VRS Actuarial Valuation Report for completeness (Page 37)
- For the actuarial valuation reports for the political subdivisions:
    - Clarify the level of employer match for contributions made to the DC plan (Page 37)
    - Provide details on the sources of actuarial gains and losses (Pages 37-38)
    - Provide an explanation of the development of the actuarial value of assets (Page 38)
    - Include for political subdivisions plans identified as at-risk plans: (Page 38)
        - A description of the purpose of the additional funding charge for at-risk plans
        - A description of how the additional funding charge for at-risk plans is calculated
        - The specific amount of the additional funding charge
        - The amortization charge as a percentage of payroll excluding the additional funding charge (based on the amortization schedule shown in the report)
    - Provide more information on the contribution timing adjustment (Page 38)
- Provide more information on the contribution timing adjustment in the June 30, 2017, VRS Actuarial Valuation Report (Page 38)
- Include funded ratio in the funding valuation reports with additional discussion, as necessary, to explain differences in funding and accounting results (Pages 38-39)

# SECTION VII.

## REVIEW OF CONTRIBUTION RATES AND FUNDED RATIOS

## Calculation of the Employer Contribution Rate

The employer contribution rate is comprised of two components, an employer normal cost rate and an amortization percentage. The normal cost rate is the theoretical percentage of pay that would be required to fund the member's benefits if this amount had been contributed from each member's entry date and if the fund's experience exactly followed the actuarial assumptions. For VRS, the normal cost will gradually decrease in future years as the number of active members earning the relatively more valuable Plan 1 benefits decrease and the number of members in Plan 2 and the new Hybrid plan (for applicable employee groups) increase.

The unfunded actuarial accrued liability amortization payment percentage is the cost of financing the difference between the actuarial accrued liability and the actuarial value of assets. The methods for determining the amortization percentage, such as the funding period, are dictated by the Board's funding policy.

Following are the components of the unfunded liability and the method for amortizing those components of the unfunded liability:

- The deferred contributions of the 2010-2012 biennium will be amortized as a level dollar amount over a closed, 10-year period beginning June 30, 2011. These deferred contributions, as defined under the 2011 Appropriations Act, Item 469(I)(6), have been paid off, except for the Teachers Plan which is to be amortized using a level dollar, closed 10-year period beginning June 30, 2011. As of June 30, 2017, there are four years remaining in the amortization period for the Teachers.
- The legacy unfunded liability as of June 30, 2013, that is not attributable to the deferred contributions of the 2010-2012 biennium will be amortized as a level percentage of payroll over a closed 30-year period beginning June 30, 2013.
- All new sources of unfunded liability incurred in future years will be separately amortized as a level percentage of payroll over individual closed 20-year periods.

In the 2014 audit performed by GRS, GRS had recommended that for each of the separate amortization bases, the original amortization base, the current outstanding balance and current year's amortization cost be documented. This information (which includes an amortization dollar payment calculated as of the beginning of the year) is documented on pages 42 through 46 of the VRS actuarial valuation report. In addition, GRS had recommended CMC update the amortization methodology to better simulate the timing of the actual contribution receipts and expected investment earnings thereon. The CMC reports indicate that a change was made in order to recognize the timing of actual contributions.

The employer contribution rates as a percentage of payroll are shown on pages 1 through 5 of the VRS actuarial valuation report. Based on the payroll figures shown on these pages and the amortization payments shown on pages 42 through 46, the table on the following page presents a comparison of a calculated unfunded liability contribution rate and the rate in the report. (The Teachers' rate also includes the rate for amortization of deferred contributions.) **We recommend that the adjusted amortization payment and payroll figures used to determine the unfunded liability rates be shown in the report along with a description of the adjustments made.**

| Division | BOY Amortization Payment (a) | Annual Covered Payroll (b) | Calculated Rate (a)/(b) | Unfunded Liability Rate |
|---|---|---|---|---|
| State | $318,547 | $4,037,072 | 7.89% | 8.04% |
| Teachers | $735,254 | $7,919,450 | 9.28% | 9.02% |
| SPORS | $13,246 | $110,625 | 11.97% | 12.24% |
| VaLORS | $36,860 | $339,150 | 10.87% | 11.08% |
| JRS | $6,046 | $66,288 | 9.12% | 9.30% |

*Source: GRS Analysis*

**Based on the information provided in the actuarial valuation report, we believe that the employer contribution rates are reasonable.**

## Review of VRS' Funded Ratio

The table below provides the schedule of funding progress for all systems on a combined basis.

**Schedule of Funding Progress (All Systems Combined) (Dollars in Millions)**

| 30-Jun Year End | Actuarial Value of Assets | Actuarial Accrued Liability | Unfunded Actuarial Accrued Liability | VRS Total Funded Ratio |
|---|---|---|---|---|
| 2006 | $ 44,166 | $ 55,072 | $ 10,906 | 80.2% |
| 2007 | $ 49,516 | $ 60,530 | $ 11,014 | 81.8% |
| 2008 | $ 54,441 | $ 65,174 | $ 10,733 | 83.5% |
| 2009 | $ 55,123 | $ 69,135 | $ 14,012 | 79.7% |
| 2010 | $ 54,660 | $ 75,889 | $ 21,229 | 72.0% |
| 2011 | $ 54,473 | $ 78,423 | $ 23,950 | 69.5% |
| 2012 | $ 53,069 | $ 81,207 | $ 28,138 | 65.4% |
| 2013 | $ 54,027 | $ 82,407 | $ 28,380 | 65.6% |
| 2014 | $ 59,271 | $ 85,541 | $ 26,270 | 69.3% |
| 2015 | $ 64,392 | $ 88,269 | $ 23,877 | 72.9% |
| 2016 | $ 67,660 | $ 90,793 | $ 23,133 | 74.5% |
| 2017 | $ 71,834 | $ 93,501 | $ 21,667 | 76.8% |

*Source: June 30, 2017, actuarial valuation report issued by CMC and the 2017 VRS Comprehensive Annual Financial Report.*

The following table illustrates the funded ratio for individual plans as of June 30, 2017.

| System | Funded Ratio* |
|---|---|
| State | 75.3% |
| Teachers | 72.6% |
| SPORS | 75.5% |
| VaLORS | 67.2% |
| JRS | 80.1% |
| HIC | 7.5% |
| VLDP | 45.0% |
| VSDP | 193.1% |
| Group Life | 46.6% |

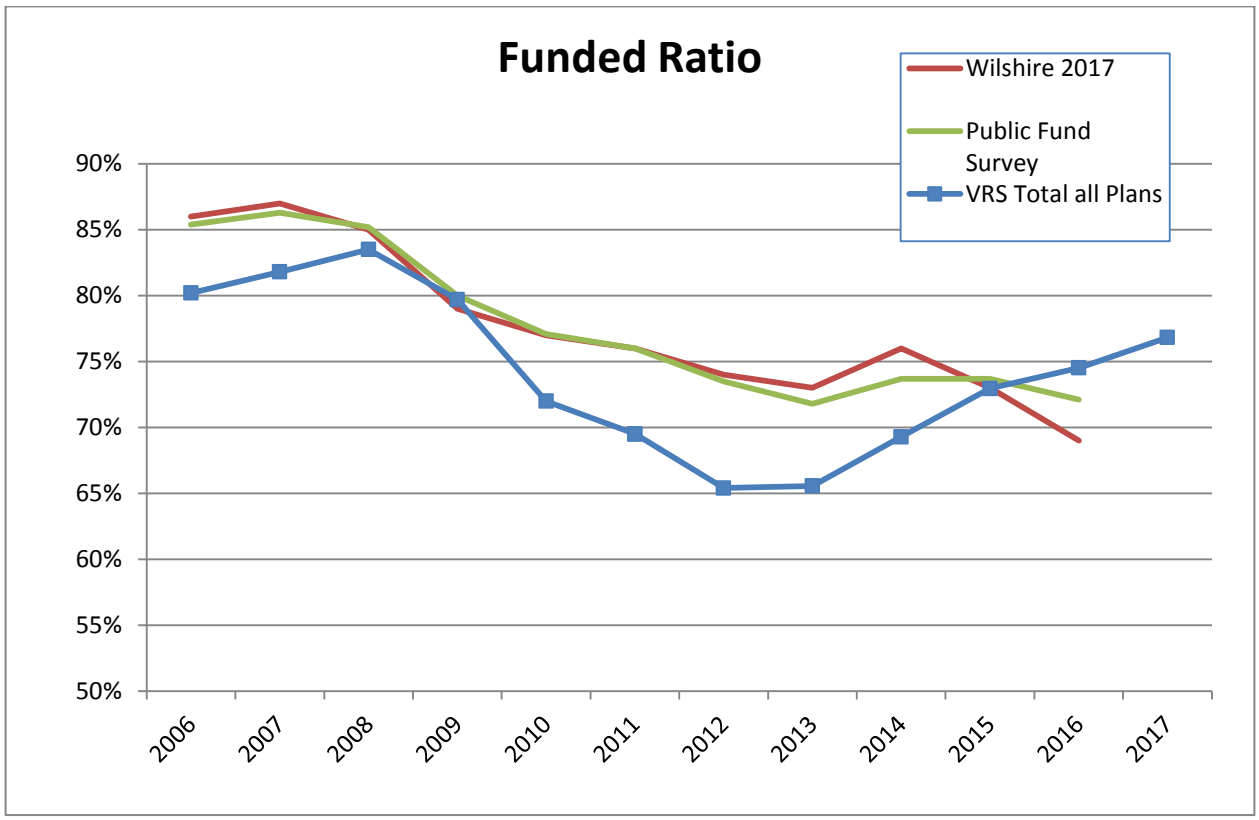
**Funded ratio based on actuarial value of assets as of June 30, 2017*

*Source: CMC PowerPoint Presentation Deck dated October 18, 2017 and CMC OPEB Plan Actuarial Report as of June 30, 2017*

VRS' funding ratio of 74.5 percent for FY2016 ranks 58 out of 120 large public retirement systems based on the Public Fund Survey. The Public Fund Survey, which is sponsored by the National Association of State Retirement Administrators, is an online compendium of key characteristics of most of the nation's largest public retirement systems. Of the 120 systems reported in the latest survey, the funding ratio ranges from a high of 110.8 percent to a low of 18.9 percent.

VRS' ranking is somewhat misleading because other systems use different actuarial assumptions for determining their actuarial accrued liability. Most notably, many other statewide retirement systems use a rate of return assumption that is higher than the 7.00 percent assumption used by VRS. If these other retirement systems calculated their liability, and corresponding funded ratio, using a 7.00 percent discount rate, then VRS would compare much more favorably to other statewide retirement systems.

The table on the following page compares historical funding ratios among VRS, the Public Find survey and the Wilshire Consulting 2017 Report on State Retirement Systems Funding Levels.




*Wilshire Consulting 2017 Report on State Retirement Systems: Funding Levels and Asset Allocation*
*Public Fund Survey Summary of Finding for FY2016 Dated November 2017 (sponsored by the National Association of State Retirement Administrators)*

The VRS funded ratio was about equal to the average from the Public Fund Survey and Wilshire Consulting report in 2009, was significantly lower until 2015 and is higher in 2016 (and likely 2017). In addition, the assumptions used by VRS, specifically the investment return assumption, are reasonable, whereas some plans included in the Public Fund Survey and the Wilshire Report may be using more aggressive assumptions (for example, an investment return assumption with a low probability of being achieved).

## Review of Political Subdivision Plans

Following is a summary table (prepared by GRS) for the seven political subdivisions plans that we reviewed:

| Political Subdivision Plan | Plan A | Plan B | Plan C | Plan D | Plan E | Plan F | Plan G |
|---|---|---|---|---|---|---|---|
| Actuarial Accrued Liability | $ 112,746,837 | $ 24,697,713 | $ 190,298,327 | $ 52,404,726 | $ 285,787,272 | $ 76,404,633 | $ 38,440,560 |
| Actuarial Value of Assets | $ 96,734,410 | $ 21,397,228 | $ 167,206,301 | $ 45,205,377 | $ 242,285,563 | $ 73,285,851 | $ 30,708,762 |
| Unfunded Actuarial Accrued Liability | $ 16,012,427 | $ 3,300,485 | $ 23,092,026 | $ 7,199,349 | $ 43,501,709 | $ 3,118,782 | $ 7,731,798 |
| Funded Ratio | 85.80% | 86.64% | 87.87% | 86.26% | 84.78% | 95.92% | 79.89% |

*Source: GRS Analysis of Select Political Subdivision Plan Actuarial Reports*

With the exception of Plan F which is 80 percent funded, all of the other plans are at, or over, 85 percent funded. These funded ratios compare to an average funding ratio of 69 percent according to the *Wilshire 2017 Report on City & County Retirement Systems: Funding Levels and Asset Allocation.* The average funded ratio for all of the Political Subdivisions plans with no enhanced hazardous duty is 95.7 percent and the average funded ratio for all plans with enhanced hazardous duty is 86.1 percent.

As previously indicated, Plan G is the only one of the seven plans that we reviewed that was identified as a plan that requires an additional contribution in order to avoid needing a GASB blended discount rate. According to the CMC November 16, 2017, PowerPoint Presentation, there are 54 out of a total of 589 plans that require an average 1.04 percent of pay additional contribution. This is down from 80 out of a total of 585 plans impacted in the 2016 actuarial valuations.

## OPEB Plans Funding

The funding policy for the OPEB plans is to contribute normal cost plus amortization of the unfunded liability. The unfunded liability as of June 30, 2013 (legacy unfunded liability) is amortized over a 30-year closed period as a level percentage of payroll subsequent gains and losses arising from future actuarial valuations are amortized over separate 20-year closed periods as a level percentage of payroll.

By way of background, prior to 2007, the OPEB plans were previously funded on a "pay-as-you-go" basis. In addition, the contribution rates were not fully funded until 2017 for the state wide plans. **We recommend that background on the historical funding of the OPEB plans be added to the actuarial valuation report.**

Group Life Insurance Program

The VRS Report on the Actuarial Valuation of Other Postemployment Benefits ("VRS OPEB Report") includes the following chart showing a progression of the funded status for the Group Life Insurance Program from 2012 to 2017.

Group Life Insurance Program

| Actuarial Valuation Date | Actuarial Value of Assets ( a ) | Actuarial Accrued Liability (AAL) ( b ) | Unfunded AAL (UAAL) ( b - a ) | Funded Ratio ( a / b ) | Covered Payroll ( c ) | UAAL as a Percentage of Covered Payroll ( ( b - a ) / c ) |
|---|---|---|---|---|---|---|
| 6/30/2012 | $755,889 | $2,458,310 | $1,702,421 | 30.75% | $16,696,961 | 10.20% |
| 6/30/2013 | 836,547 | 2,571,691 | 1,735,144 | 32.53 | 17,132,176 | 10.13 |
| 6/30/2014 | 992,221 | 2,701,509 | 1,709,288 | 36.73 | 17,559,285 | 9.73 |
| 6/30/2015 | 1,128,876 | 2,829,104 | 1,700,228 | 39.90 | 17,813,570 | 9.54 |
| 6/30/2016 | 1,247,564 | 2,974,468 | 1,726,904 | 41.94 | 18,321,880 | 9.43 |
| 6/30/2017 | 1,410,087 | 3,024,718 | 1,614,631 | 46.62 | 19,222,759 | 8.40 |

*Source: June 30, 2017, actuarial valuation report issued by CMC and the 2017 VRS Comprehensive Annual Financial Report.*

- The funded ratio has increased from 31 percent at 2012 to 47 percent at 2017. This implies that the plan sponsor is making progress towards the financing of unfunded liabilities.
- The VRS CAFR includes a comparison of the historical actuarially determined contribution to actual contributions. In general, over the past five years the plan sponsor has made contributions that are approximately 95 percent of the targeted annual required contributions.
- Based on the growth in funded ratio and the historical contribution patterns, if the plan sponsor continues to contribute 95 percent to 100 percent of the ARC, the funded ratio is expected to increase in the future.

Health Insurance Credit Program

The VRS OPEB Report includes the following chart showing a progression of the funded status for the Health Insurance Credit Program from 2012 to 2017.

Health Insurance Credit Program

| Historical Funded Status for FYE 6/30 | State Employees | Teachers | Political Subdivisions | Constitutional Officers | Social Service Employees | Registrars |
|---|---|---|---|---|---|---|
| 2012 | 6% | 5% | | | | |
| 2013 | 6% | 5% | | | | |
| 2014 | 6% | 6% | | | | |
| 2015 | 7% | 6% | 52% | 4% | 7% | 1% |
| 2016 | 7% | 6% | 51% | 5% | 6% | 2% |
| 2017 | 8% | 7% | 56% | 8% | 8% | 7% |

*Source: June 30, 2017, actuarial valuation report issued by CMC and the 2017 VRS Comprehensive Annual Financial Report.*

- The preceding table shows very slow growth in the funded ratio. This is an indicator that the funding policy may need to be strengthened.

The OPEB Report includes a reconciliation of assets during 2017, which is summarized below:

Health Insurance Credit Program

| Market of Assets ($ in thousands) | State Employees | Teachers | Political Subdivisions | Constitutional Officers | Social Service Employees | Registrars |
|---|---|---|---|---|---|---|
| Assets 6/30/2016 | $68,685 | $82,854 | 19,337 | 1,479 | 861 | 11 |
| Contributions | 75,058 | 87,613 | 2,165 | 2,320 | 1,069 | 47 |
| Benefits/Expense | (71,387) | (83,631) | (1,720) | (1,572) | (930) | (27) |
| Investment Income | 7,160 | 9,254 | 2,385 | 200 | 91 | 3 |
| Assets at 6/30/2017 | 79,516 | 96,090 | 22,167 | 2,427 | 1,091 | 34 |
| Liquidity Ratio | 0.96 | 0.99 | 11.24 | 0.94 | 0.93 | 0.41 |

*Source: June 30, 2017, actuarial valuation report issued by CMC and the 2017 VRS Comprehensive Annual Financial Report.*

- The preceding table shows that ratio of assets to benefits and expenses, or liquidity ratio, is less than 1.00 for most plans. This is another indicator that the funding policy may not adequately finance plan benefits.

**Based on these facts, we recommend continued analysis be performed for the Health Insurance Credit Program in order to evaluate the adequacy of the contribution policy.**

**Virginia Sickness and Disability Program (VSDP) and Virginia Local Disability Program (VLDP)**

The VRS OPEB Report includes two charts showing a progression of the funded status from 2012 to 2017 for the VSDP and VLDP, which is summarized below:

**Virginia Sickness and Disability Program (VSDP) and Virginia Local Disability Program (VLDP)**

| Historical Funded Status for FYE 6/30 | VSDP State Employees | VLDP Teachers | VLDP Political Subdivisions |
|---|---|---|---|
| 2012 | 117% | | |
| 2013 | 171% | | |
| 2014 | 173% | 0% | 0% |
| 2015 | 169% | 27% | 22% |
| 2016 | 173% | 13% | 14% |
| 2017 | 193% | 40% | 50% |

*Source: June 30, 2017, actuarial valuation report issued by CMC*

- The preceding table shows that the VSDP program is very well funded. The VLDP program is experiencing reasonable growth in the funded ratio.

**We recommend providing more details in the actuarial report describing the reasons why the VSDP is so well funded.**

## Funded Ratio Conclusions

VRS is actuarially sound. The funding ratio of the VRS plans are generally improving and moving towards a 100 percent funded ratio goal.

- The funded ratio for the main VRS system has increased from about 65 percent in 2012 to 77 percent in 2017.
- The funded ratios for the political subdivision plans are generally over 85 percent funded.
- The funded ratio for the Group Life Insurance Program is increasing and if the plan sponsor continues to contribution 95 percent to 100 percent of the ARC, the funded ratio is expected to increase in the future.

## Summary of Recommendations for Review of Contributions Rates and Funded Ratios

- We recommend that the adjusted amortization payment and payroll figures used to determine the unfunded liability rates be shown in the actuarial valuation report along with a description of the adjustments made. (Page 40)
- We recommend that background information on the historical funding of the OPEB plans be added to the actuarial valuation report. (Page 44)
- We recommend continued analysis be performed for the Health Insurance Credit Program in order to evaluate the adequacy of the contribution policy. (Page 46)
- We recommend providing more details in the actuarial report describing the reasons why the VSDP is so well funded. (Page 46)

# SECTION VIII.

## ACTUARIAL PRINCIPLES AND PRACTICES EMPLOYED BY THE ACTUARY

# Actuarial Principles and Practices Employed by the Actuary

## Actuarial Standards of Practice

The Actuarial Standards Board (ASB) promulgates actuarial standards of practice (ASOPs) for use by actuaries when rendering actuarial services in the United States. Although the Board of VRS is the ultimate decision-making body with regard to approval of the actuarial assumptions used in the annual actuarial valuations, CMC must still comply with the Actuarial Standards of Practice when providing advice or recommendations to the Board on the selection of actuarial assumptions.

The following Actuarial Standards of Practice are applicable to the retirement and OPEB plans sponsored by VRS:

- ASOP No. 4, *Measuring Pension Obligations and Determining Pension Plan Costs or Contributions;*
- ASOP No. 6, *Measuring Retiree Group Benefits Obligations and Determining Retiree Group Benefits Program Periodic Costs or Actuarially Determined Contributions;*
- ASOP No. 27, *Selection of Economic Assumptions for Measuring Pension Obligations*;
- ASOP No. 35, *Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations*;
- ASOP No. 41, *Actuarial Communications;*
- ASOP No. 44, *Selection and Use of Asset Valuation Methods for Pension Valuations*; and
- ASOP No. 51, *Assessment and Disclosure of Risk Associated with Measuring Pension Obligations and Determining Pension Plan Contributions (Effective for any actuarial work product with a measurement date on or after November 1, 2018).*

**In general, we find that CMC followed the appropriate ASOPs.**

## Summary of Recommendations for Actuarial Principles and Practices Employed by the Actuary

**We have made several recommendations listed in Section VI -- Actuarial Report Content, Detail, Format and Clarity. These recommendations are for more disclosures in the various actuarial reports.** The purpose of these additional recommended disclosures is to ensure that another actuary qualified in the same practice area could make an objective appraisal of the reasonableness of the actuary's work as presented in the actuarial report.

# SECTION IX.

## COMMENTS AND CONSIDERATIONS FROM THE 2014 QUADRENNIAL AUDIT

# Comments and Considerations from GRS from the 2014 Audit

The 2014 Quadrennial Actuarial Audit of the Virginia Retirement System conducted by Gabriel, Roeder, Smith & Company included a number of recommendations. Note that these recommendations were not intended to correct any material deficiencies but rather to improve the quality of future actuarial valuations.

## Conclusions

CMC provided a response to our recommendations in a letter addressed to Ms. Cynthia Comer dated June 27, 2014. To the best of our knowledge, based on the responses in this letter and information and test life detail received from CMC and VRS for this year's audit, **we believe that these recommendations were considered and appropriately reflected.**

# SECTION X.

## VIRGINIA RETIREMENT SYSTEM RESPONSE

Virginia Retirement System

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Patricia S. Bishop
*Director*

June 25, 2018

Mr. Hal E. Greer
Director Joint Legislative Audit and Review Commission
919 East Main Street
Suite 2101
Richmond, Virginia 23219

Dear Hal:

Thank you for the opportunity to review the exposure draft of the 2018 Quadrennial Actuarial Audit of the Virginia Retirement System ("VRS"). We appreciate the thorough approach and attention to detail that Gabriel, Roeder, Smith & Company ("GRS") exhibited during the audit process and will incorporate the elements contained in their recommendations in forthcoming experience studies and valuations. We also appreciated the chance to discuss the report's findings in the meeting between our respective actuaries on June 14, 2018, during which the actuaries reached substantial agreement on the report's major findings. Further, we appreciate the efforts of the JLARC staff in coordinating and overseeing this review.

We are pleased that GRS found no material deficiencies and found the work of Cavanaugh MacDonald Consulting, LLC ("CMC") to be performed according to generally accepted actuarial standards and principles using reasonable assumptions and methods. While we generally concur with the report's findings and recommendations, we wanted to provide some additional clarification and context for several of GRS' findings.

Assumptions - Investment Return

In recognition that the investment return is one of the most sensitive assumptions in the valuation process, VRS has long been at the forefront of the public pension plan community in using a 7 percent discount rate, and has done so since 2010. In establishing this key assumption, long-term return expectations are the primary consideration due to the long-term nature of the plan benefits and the plan's status as an open pension plan. That stated, VRS along with its actuary, CMC, as a matter of course not only review and consider long-term expectations, but also include shorter term return expectations in the various analyses conducted, such as asset liability studies,

stress testing and sensitivity analyses, experience studies and valuations. As part of its ongoing review, VRS investment staff collaborates with its external investment managers to assess their views of forward returns. In addition, VRS recently engaged Pension Consulting Alliance to work with the Investment Policy Committee and the Investment Advisory Committee to undertake an exhaustive review of the Fund's asset allocation and return assumptions.

With that backdrop in mind and as VRS completes a thorough review of the assumed rate of return, we will provide additional documentation to the experience study report on the weighting and consideration given to short-term expectations in the development of the investment return assumption.

Report Content – Political Subdivisions

GRS recommended that the actuarial reports for the political subdivision plans participating in the VRS include more detail on the sources of actuarial gains and losses occurring during the year. We appreciate that GRS acknowledges the additional time, resources, and fees necessary to include a separate analysis and descriptions of the gains and losses for each of the nearly 600 political subdivisions in a valuation report. Historically, VRS has provided this type of more detailed plan-level analysis to employers upon request. As VRS understands that this analysis provides useful information, VRS will evaluate whether to either modify the general information related to gains and losses for each valuation report or internally develop a separate gain/loss analysis for each political subdivision and provide this information to employers outside of the formal valuation report.

CMC has submitted its own letter that provides more detailed comments on a number of the issues raised by the GRS report.

Conclusion

We would again like to express our appreciation to the actuaries of GRS and to the JLARC staff for the professional, courteous and cooperative manner in which this actuarial audit was conducted. Actuarial valuations and experience studies are critical in the rate setting process, including valuing and documenting the plan's assets and liabilities. Accordingly VRS remains keenly focused on adhering to highest standards of professional and actuarial practice as well as other industry best practices related to this essential duty. VRS and its actuaries from CMC concur with the report's findings and find

the Quadrennial Audit conducted by JLARC and its actuary to be a valuable tool for validating and fine tuning VRS' valuation and rate setting processes.

Sincerely,

Patricia S. Bishop
Director

Cavanaugh Macdonald
CONSULTING, LLC
*The experience and dedication you deserve*

June 25, 2018

Ms. Cynthia D. Wilkinson
Policy, Planning and Compliance Director
Virginia Retirement System
1200 E. Main Street
Richmond, VA 23219

RE: ACTUARIAL REVIEW RESULTS

Dear Ms. Wilkinson:

We have received a copy of the exposure draft of the 2018 Quadrennial Actuarial Audit of the Virginia Retirement System which was produced by Gabriel, Roeder, Smith & Company (GRS) to detail their findings of the review of our June 30, 2017 valuations, as well as our latest experience study report.

We are, of course, pleased that GRS's overall findings conclude that the actuarial valuations we prepared and the actuarial assumptions upon which they are based are reasonable and comply with Actuarial Standards of Practice.

While there were no material findings, GRS has detailed a number of items that will allow us to fine-tune future valuations and experience studies. We have reviewed each of these recommendations and, as appropriate, provided our comments below. We did not comment on minor items, but will explore minor items with VRS.

We want to thank GRS and the JLARC staff for the professional and courteous manner in which they conducted their review.

Sincerely,

Larry Langer, ASA, FCA, EA, MAAA
Principal and Consulting Actuary

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**Reasonableness of Actuarial Assumptions**

*GRS comment:* We recommend VRS continue to review the investment return assumption giving due consideration to both short term and long term investment horizons. We recommend CMC include additional information in the next experience analysis report documenting the weighting of the short term and long term investment horizons. (Page 17)

*Cavanaugh Macdonald comment:* For the next experience review, we will add additional documentation related to the consideration given to both long and short term expectations in reviewing the investment return assumption. Our focus will continue to be longer term given the time horizon of VRS and given that the development of longer term expectations include short term expectations as well.

*GRS comment:* We have the following recommendations when the mortality assumptions are next reviewed: (Page 24)

1. Continue to consider if a generational mortality improvement assumption (to reflect future expected mortality improvements) is appropriate
2. Analyze mortality experience on a benefits weighted or liability weighted basis
3. Review the credibility of the experience in adjusting the standard base mortality tables (especially for smaller plans such as SPORS/VaLORS and pre-retirement and disabled mortality)

*Cavanaugh Macdonald comment:* CMC will continue to review the evolving information concerning mortality data and improvements. To illustrate, the Retirement Plans Experience Committee (RPEC) of the Society of Actuaries is expected to release mortality tables specific to the Public Sector by early next year. The release of these tables will further shape our analysis. The RPEC intends to publish tables based on income, which may replace analysis based on a liability weighted basis. Finally, the RPEC intends to publish tables for public safety which will impact our recommendations for SPORS/VaLORS.

In addition, Actuarial Standard of Practice No. 35 does not prescribe that generational mortality be incorporated to reflect future expected mortality improvements, and clearly identifies the use of margins as an acceptable practice. As discussed in the report, we will review this assumption in the next experience study and either recommend movement to the full generational mortality table or adjustments in margin.

*GRS comment:* We recommend that CMC either explicitly value the cash refund feature or value the cash refund feature by assuming a certain period and also clearly disclose the assumption for the assumed form of payment for benefits in the actuarial report. (Page 25)

*Cavanaugh Macdonald comment:* We agree with GRS's comment and will incorporate this change in the next valuation. The impact of this change will be immaterial to the fund.

**Reasonableness of Actuarial Methods and Funding Policy**

*GRS comment:* We recommend that CMC provide more details in the VRS funding actuarial report including (1) the definition of an "effective amortization period," (2) a description of the implications of having separate unfunded liability amortization bases and an effective amortization period in excess of 26 years (the number of years remaining until VRS is expected to be fully funded) and (3) the magnitude of the expected change in future contribution rates as a result of the separate amortization bases. Also, if the prospect of volatile annual contribution requirements is adverse to VRS, we recommend that VRS consider aggregating the outstanding unfunded liability bases such that the effective amortization period is less than a fixed number of years (such as 25 or 30). (Page 31)

*Cavanaugh Macdonald comment:* The effective amortization metric, no longer required under GASB, is not a true indication of when the UAAL is projected to be paid off. In light of the recommendation, CMC will work with VRS to explore additional methods for adjusting the amortization of the legacy unfunded liabilities without having to aggregate bases. The primary purpose of implementing layered amortization is to establish a policy which does not require periodic resetting such as those needed under a single amortization period. Resetting an amortization period introduces the risk of contributions being lowered when higher contributions may be desirable. For example, using a 30 year period as recommended by GRS increases the number of years until the UAAL is paid off under the current policy. We will continue to monitor the funding policy with VRS in a holistic manner.



*GRS comment:* We recommend adding additional information to the actuarial valuation reports for at-risk political subdivision plans, including: (Pages 32-33)

- A description of the purpose of the additional funding charge for at-risk plans
- A description of how the additional funding charge for at-risk plans is calculated
- The specific amount of the additional funding charge
- The amortization charge as a percentage of payroll excluding the additional funding charge (based on the amortization schedule shown in the report)
- The effective amortization period and additional discussion of the implications of the funding policy (similar to the recommendation for the main VRS actuarial valuation report)

*Cavanaugh Macdonald comment:* We will work with VRS to disclose more information related to at-risk political subdivisions.

**Application of Actuarial Assumptions, Methods and Benefit Plan Provisions**

*GRS comment:* We recommend that CMC use the same assumption for current terminated vested members as is used for future terminated vested members which is to assume that the more valuable of a return of contributions and a deferred annuity is elected. (Page 35)

*Cavanaugh Macdonald comment:* We do believe it is appropriate to assume the more valuable of a return of contributions and a deferred annuity for future terminated vested members, although a refinement could be made by making an assumption (based on observed experience) regarding the percent electing to receive a return of contributions. That being said, current terminated vested members who have not requested a return of contributions are more likely to have a reason they wish to keep their contributions on deposit and elect to receive a deferred annuity, as evidenced by the fact that they have not chosen a refund. We will continue to monitor this for the next experience review study.



**Actuarial Report Content, Detail, Format and Clarity**

GRS provided various comments related to documentation provided in valuation reports and the need for additional detail and clarity.

*Cavanaugh Macdonald comment:* CMC will consider these comments and will work with VRS to present this information in a manner that is more useful to VRS, its Board and the political subdivisions, and other stakeholders. In addition, we have submitted an updated valuation report to include the missing plan provision you noted in your review.

*GRS comment:* Include funded ratio in the funding valuation reports with additional discussion, as necessary, to explain differences in funding and accounting results. (Pages 38-39)

*Cavanaugh Macdonald comment:* CMC and VRS have discussed this and will include the funded ratios using both an actuarial value and market value of assets in the funding valuation reports. VRS will continue to provide the funded ratio based on accounting standards in the VRS CAFR. VRS will also include additional disclosures in the funding valuations to clarify the meaning of the various funding measures.

# APPENDIX

# Appendix
# Table 1: VRS Pension Plan Active Member Test Cases

| Active Members | | | | | | GRS | | | CMC | | | % Difference - GRS to CMC | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| System | Plan | Age | Salary | Vest Svc | Sex | PVFB | AL | NC | PVFB | AL | NC | PVFS | PVFB | AL | NC |
| State | 1_Plan1 | 58.46 | 42,537 | 26.33 | F | 93,752 | 54,833 | 7,210 | 95,531 | 55,769 | 7,134 | -1.93% | -1.86% | -1.68% | 1.06% |
| State | 1_Plan1 | 64.46 | 80,548 | 37.42 | M | 555,336 | 533,322 | 6,428 | 564,349 | 540,386 | 6,764 | -1.71% | -1.60% | -1.31% | -4.97% |
| State | 1_Plan1 | 37.12 | 37,500 | 7.33 | F | 74,724 | 38,376 | 3,192 | 75,435 | 29,298 | 3,928 | -1.83% | -0.94% | 30.99% | -18.74% |
| State | 2_Plan2 | 50.29 | 34,926 | 23.92 | M | 71,102 | 29,362 | 4,503 | 72,002 | 29,802 | 4,435 | -1.35% | -1.25% | -1.48% | 1.53% |
| State | 2_Plan2 | 38.62 | 62,231 | 7.00 | M | 95,106 | 40,867 | 4,500 | 97,038 | 43,263 | 4,326 | -1.83% | -1.99% | -5.54% | 4.03% |
| State | 2_Plan2 | 61.46 | 31,136 | 6.92 | F | 47,861 | 29,974 | 4,119 | 51,232 | 32,048 | 4,291 | -1.66% | -6.58% | -6.47% | -4.00% |
| State | 2_Plan2 | 27.46 | 31,416 | 4.25 | F | 28,852 | 10,895 | 1,997 | 29,641 | 10,146 | 2,101 | -1.92% | -2.66% | 7.38% | -4.95% |
| State | 3_Plan1 Non-Vested | 64.29 | 32,944 | 7.83 | M | 53,321 | 39,055 | 4,110 | 54,833 | 39,546 | 4,276 | -1.63% | -2.76% | -1.24% | -3.89% |
| State | 3_Plan1 Non-Vested | 31.29 | 33,666 | 7.50 | F | 42,021 | 20,439 | 1,988 | 42,890 | 19,920 | 2,053 | -1.77% | -2.03% | 2.60% | -3.15% |
| State | 4_Hybrid | 35.12 | 34,574 | 5.75 | F | 21,683 | 205 | 1,917 | 22,143 | 0 | 1,920 | -2.08% | -2.08% | | -0.17% |
| State | 4_Hybrid | 28.54 | 28,250 | 0.75 | M | 10,090 | 608 | 1,133 | 10,050 | 0 | 1,178 | -1.16% | 0.40% | | -3.80% |
| Teachers | 0: Plan1 Vested | 64.12 | 52,441 | 23.75 | F | 245,204 | 225,059 | 7,185 | 251,974 | 229,759 | 7,660 | 0.00% | -2.69% | -2.05% | -6.20% |
| Teachers | 0: Plan1 Vested | 63.71 | 91,664 | 30.75 | M | 580,394 | 562,628 | 6,843 | 592,711 | 574,252 | 6,873 | 0.00% | -2.08% | -2.02% | -0.44% |
| Teachers | 2: Plan 2 | 38.29 | 60,895 | 6.33 | F | 124,962 | 46,698 | 5,946 | 130,143 | 48,146 | 5,970 | -0.87% | -3.98% | -3.01% | -0.40% |
| Teachers | 2: Plan 2 | 33.04 | 49,300 | 6.00 | M | 92,782 | 32,297 | 4,250 | 96,430 | 33,204 | 4,255 | -0.93% | -3.78% | -2.73% | -0.12% |
| Teachers | 2: Plan 2 | 55.38 | 60,700 | 25.75 | F | 320,049 | 282,910 | 6,128 | 333,616 | 294,159 | 6,294 | 0.00% | -4.07% | -3.82% | -2.64% |
| Teachers | 1: Plan 1 NonVested | 46.46 | 57,451 | 8.00 | F | 131,045 | 59,775 | 5,961 | 137,227 | 63,983 | 5,967 | 0.75% | -4.50% | -6.58% | -0.10% |
| Teachers | 1: Plan 1 NonVested | 46.46 | 51,977 | 8.92 | F | 97,024 | 7,027 | 7,161 | 100,626 | 7,324 | 7,247 | 0.98% | -3.58% | -4.06% | -1.19% |
| Teachers | 4: Hybrid | 56.29 | 64,664 | 3.00 | F | 48,368 | 16,290 | 4,894 | 49,905 | 16,765 | 4,864 | -0.48% | -3.08% | -2.83% | 0.61% |
| Teachers | 4: Hybrid | 40.04 | 40,084 | 0.33 | M | 21,280 | 277 | 2,105 | 22,003 | 0 | 2,116 | -0.74% | -3.29% | | -0.53% |
| SPORS | 0: Plan1 Vested | 63.62 | 179,325 | 41.75 | M | 1,621,482 | 1,602,570 | 19,563 | 1,657,216 | 1,638,563 | 18,653 | -1.71% | -2.16% | -2.20% | 4.88% |
| SPORS | 0: Plan1 Vested | 42.46 | 53,493 | 21.25 | M | 296,730 | 185,390 | 10,841 | 301,266 | 188,603 | 10,820 | 0.29% | -1.51% | -1.70% | 0.20% |
| SPORS | 0: Plan1 Vested | 51.21 | 72,618 | 27.67 | F | 414,068 | 317,890 | 15,776 | 426,965 | 329,275 | 15,687 | -0.46% | -3.02% | -3.46% | 0.57% |
| SPORS | 2: Plan 2 | 27.29 | 42,714 | 5.33 | F | 119,594 | 33,430 | 5,821 | 123,767 | 34,368 | 5,858 | -1.93% | -3.37% | -2.73% | -0.62% |
| SPORS | 2: Plan 2 | 31.38 | 51,488 | 5.08 | M | 136,566 | 25,537 | 7,927 | 139,710 | 26,479 | 7,939 | -0.70% | -2.25% | -3.56% | -0.15% |
| SPORS | 2: Plan 2 | 25.04 | 36,207 | 0.83 | M | 71,661 | 547 | 5,075 | 74,697 | 0 | 5,166 | -2.05% | -4.06% | | -1.77% |
| SPORS | 2: Plan 2 | 35.71 | 36,207 | 0.25 | M | 65,379 | 75 | 5,371 | 69,312 | 0 | 5,522 | -2.09% | -5.67% | | -2.74% |
| SPORS | 1: Plan 1 NonVested | 37.79 | 55,299 | 8.50 | M | 179,695 | 59,537 | 9,364 | 187,499 | 61,291 | 9,608 | -1.10% | -4.16% | -2.86% | -2.54% |
| JRS | 0: Plan1 Vested | 64.12 | 149,531 | 14.67 | M | 1,075,960 | 869,936 | 50,641 | 1,073,448 | 839,732 | 55,537 | -2.18% | 0.23% | 3.60% | -8.82% |
| JRS | 0: Plan1 Vested | 64.04 | 149,531 | 29.00 | F | 1,248,028 | 1,125,388 | 29,868 | 1,250,203 | 1,114,673 | 31,909 | -2.18% | -0.17% | 0.96% | -6.40% |
| JRS | 2: Plan 2 | 48.38 | 149,531 | 5.00 | M | 527,146 | 149,212 | 28,709 | 513,288 | 133,957 | 24,976 | -12.29% | 2.70% | 11.39% | 14.95% |
| JRS | 4: Hybrid | 51.79 | 149,531 | 17.50 | M | 297,390 | 0 | 28,515 | 287,945 | 0 | 26,691 | -2.18% | 3.28% | | 6.84% |
| VaLORS | 0: Plan1 Vested | 59.62 | 45,046 | 19.92 | M | 222,785 | 203,763 | 7,343 | 220,245 | 196,563 | 8,864 | -1.41% | 1.15% | 3.66% | -17.16% |
| VaLORS | 0: Plan1 Vested | 58.88 | 60,835 | 38.92 | F | 288,065 | 197,260 | 31,582 | 280,036 | 182,454 | 32,829 | -1.88% | 2.87% | 8.11% | -3.80% |
| VaLORS | 0: Plan1 Vested | 58.38 | 37,621 | 10.42 | F | 109,795 | 86,849 | 6,815 | 111,888 | 88,820 | 6,623 | -1.94% | -1.87% | -2.22% | 2.90% |
| VaLORS | 2: Plan 2 | 43.21 | 32,474 | 0.83 | F | 32,161 | 675 | 5,486 | 34,619 | 0 | 5,851 | -1.97% | -7.10% | | -6.23% |
| VaLORS | 2: Plan 2 | 28.04 | 32,474 | 3.83 | M | 28,393 | 717 | 3,530 | 29,623 | 0 | 3,671 | -1.80% | -4.15% | | -3.85% |
| VaLORS | 2: Plan 2 | 44.21 | 35,660 | 17.83 | M | 94,413 | 46,339 | 6,879 | 98,642 | 47,832 | 7,052 | -1.80% | -4.29% | -3.12% | -2.45% |
| VaLORS | 1: Plan 1 NonVested | 47.79 | 36,539 | 15.08 | F | 144,170 | 118,520 | 4,125 | 140,800 | 113,065 | 4,316 | -1.85% | 2.39% | 4.82% | -4.42% |
| VaLORS | 1: Plan 1 NonVested | 28.71 | 34,543 | 8.92 | M | 56,849 | 24,607 | 3,621 | 57,469 | 23,462 | 3,717 | -1.47% | -1.08% | 4.88% | -2.59% |
| Local | 1_Plan1 | 68.79 | 31,096 | 10.25 | F | 57,207 | 44,476 | 4,050 | 57,168 | 41,833 | 4,720 | -1.87% | 0.07% | 6.32% | -14.19% |
| Local | 4_Hybrid Plan | 43.38 | 28,450 | 3.42 | F | 14,995 | 4,908 | 1,255 | 15,152 | 4,407 | 1,296 | -1.99% | -1.04% | 11.37% | -3.19% |
| Local | 1_Plan1 | 61.04 | 112,490 | 31.25 | M | 596,678 | 547,981 | 20,507 | 605,753 | 556,516 | 20,045 | -1.71% | -1.50% | -1.53% | 2.30% |
| Local | 2_Plan2 | 54.54 | 71,893 | 5.50 | M | 145,908 | 75,998 | 13,473 | 147,656 | 73,135 | 13,904 | -2.10% | -1.18% | 3.91% | -3.10% |
| Local | 2_Plan2 | 25.96 | 32,425 | 4.92 | F | 64,247 | 22,934 | 4,176 | 68,581 | 22,940 | 4,498 | -1.41% | -6.32% | -0.03% | -7.17% |
| Local | 4_Hybrid Plan | 21.79 | 49,172 | 1.00 | M | 98,133 | 7,534 | 6,936 | 105,065 | 7,914 | 7,181 | -2.42% | -6.60% | -4.80% | -3.41% |

*Source: GRS Analysis*

# Appendix
# Table 2: VRS Pension Plan Terminated and Retired Member Test Cases

| Deferred/Retired Members | | | | | | | GRS | CMC | % Difference PVB | Contribution | GRS PVFB with | % Difference PVB |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| System | Plan | Status | Age | Benefit Amount | Payment Form | Sex | PVFB | PVFB | GRS to CMC | Balance | Contrib Minimum | GRS to CMC |
| State | Plan 1 | VT | 33.38 | $7,168.33 | Deferred Life Annuity | F | $11,000 | $11,015 | -0.14% | $23,645 | $23,645 | 114.66% |
| State | Plan 1 | Ret | 56.99 | 7,910.52 | Leveling Option | M | 56,585 | 56,753 | -0.30% | 0 | 56,585 | -0.30% |
| State | Plan 1 | Ret | 60.89 | 3,806.28 | Life Annuity | F | 55,946 | 56,036 | -0.16% | 0 | 55,946 | -0.16% |
| State | Plan 1 | Ret | 72.06 | 33,097.68 | 50% Joint & Survivor | M | 396,093 | 398,686 | -0.65% | 0 | 396,093 | -0.65% |
| State | Plan 1 | Ret | 71.76 | 64,193.04 | 35% Joint & Survivor | M | 739,336 | 739,831 | -0.07% | 247,952 | 739,336 | -0.07% |
| State | Plan 1 | Dis Ret | 51.10 | 16,216.56 | 100% Joint & Survivor | F | 270,692 | 270,954 | -0.10% | 0 | 270,692 | -0.10% |
| State | Plan 2 | NVT | 28.64 | 5,817.48 | Lump Sum | F | 5,817 | 5,817 | 0.00% | 5,817 | 5,817 | 0.00% |
| State | Plan 2 | VT | 35.83 | 3,691.98 | Deferred Life Annuity | F | 5,464 | 5,632 | -2.98% | 11,284 | 11,284 | 100.36% |
| State | Plan 1 Non-Vested | VT | 51.97 | 11,382.51 | Deferred Life Annuity | M | 45,100 | 47,915 | -5.87% | 32,036 | 45,100 | -5.87% |
| Teachers | Plan 1 | VT | 36.70 | 7,196.81 | Deferred Life Annuity | F | 14,883 | 15,256 | -2.44% | 23,710 | 23,710 | 55.42% |
| Teachers | Plan 1 | Ret | 69.95 | 49,105.32 | Life Annuity | M | 557,764 | 559,530 | -0.32% | 0 | 557,764 | -0.32% |
| Teachers | Plan 1 | Ret | 67.55 | 11,037.48 | Life Annuity | F | 146,185 | 145,100 | 0.75% | 0 | 146,185 | 0.75% |
| Teachers | Plan 1 | Ret | 66.97 | 60,575.64 | 100% Joint & Survivor | M | 1,038,052 | 1,039,429 | -0.13% | 0 | 1,038,052 | -0.13% |
| Teachers | Plan 1 | Ret | 62.26 | 32,848.56 | 45% Joint & Survivor | M | 507,636 | 510,669 | -0.59% | 0 | 507,636 | -0.59% |
| Teachers | Plan 1 | Ret | 60.79 | 50,516.88 | Leveling Option | F | 528,095 | 527,139 | 0.18% | 0 | 528,095 | 0.18% |
| Teachers | Plan 1 | Dis Ret | 91.89 | 29,113.92 | Life Annuity | F | 103,420 | 104,037 | -0.59% | 0 | 103,420 | -0.59% |
| Teachers | Plan 1 | BFRC | 65.09 | 13,848.36 | Life Annuity | F | 194,762 | 195,920 | -0.59% | 0 | 194,762 | -0.59% |
| Teachers | Plan 2 | RetELW | 64.84 | 8,998.08 | Life Annuity | F | 73,940 | 73,978 | -0.05% | 0 | 73,940 | -0.05% |
| Teachers | Plan 2 | DisRetELW | 40.86 | 9,431.52 | 50% Joint & Survivor | M | 61,363 | 61,543 | -0.29% | 0 | 61,363 | -0.29% |
| Teachers | Hybrid | VT | 45.31 | 2,706.88 | Deferred Life Annuity | F | 8,148 | 8,002 | 1.82% | 9,965 | 9,965 | 24.53% |
| Teachers | Hybrid | NVT | 27.71 | 342.16 | Lump Sum | F | 342 | 342 | 0.00% | 342 | 342 | 0.00% |
| SPORS | Plan 1 | Ret | 70.57 | 19,781.88 | Life Annuity | M | 90,917 | 89,950 | 1.08% | 0 | 90,917 | 1.08% |
| SPORS | Plan 1 | TransOut | 58.10 | 1,356.54 | Deferred Life Annuity | M | 15,780 | 16,360 | -3.55% | 4,766 | 15,780 | -3.55% |
| SPORS | Plan 1 | LTD Dis | 33.89 | 33,740.22 | Deferred Life Annuity | M | 54,936 | 58,456 | -6.02% | 27,376 | 54,936 | -6.02% |
| SPORS | Plan 1 | Ret | 68.10 | 47,479.32 | 50% Joint & Survivor | M | 610,830 | 615,017 | -0.68% | 0 | 610,830 | -0.68% |
| SPORS | Plan 1 | Dis Ret | 65.39 | 49,117.44 | 75% Joint & Survivor | M | 620,820 | 627,346 | -1.04% | 0 | 620,820 | -1.04% |
| SPORS | Plan 1 | Ret | 60.26 | 4,140.72 | Leveling Option | M | 34,582 | 34,475 | 0.31% | 0 | 34,582 | 0.31% |
| SPORS | Plan 1 Non-Vested | VT | 33.97 | 54.58 | Deferred Life Annuity | M | 116 | 127 | -8.17% | 49 | 116 | -8.17% |
| SPORS | Plan 2 | NVT | 30.73 | 8,417.88 | Lump Sum | M | 8,418 | 8,418 | 0.00% | 8,418 | 8,418 | 0.00% |
| SPORS | Plan 2 | VT | 33.51 | 5,108.02 | Deferred Life Annuity | M | 10,862 | 11,846 | -8.30% | 14,402 | 14,402 | 21.57% |
| VaLORS | Plan 1 | Ret | 59.02 | 50,214.00 | 100% Joint & Survivor | M | 381,328 | 413,935 | -7.88% | 0 | 381,328 | -7.88% |
| VaLORS | Plan 1 | Vt | 58.84 | 11,586.37 | Deferred Life Annuity | M | 152,878 | 149,609 | 2.18% | 40,418 | 152,878 | 2.18% |
| VaLORS | Plan 1 | BFRC | 57.99 | 31,589.76 | Life Annuity | F | 465,075 | 466,723 | -0.35% | 0 | 465,075 | -0.35% |
| VaLORS | Plan 1 | LTD Dis | 53.29 | 12,878.93 | Deferred Life Annuity | F | 87,340 | 85,070 | 2.67% | 6,293 | 87,340 | 2.67% |
| VaLORS | Plan 1 | Ret | 66.52 | 6,796.44 | Life Annuity | F | 82,027 | 81,301 | 0.89% | 0 | 82,027 | 0.89% |
| VaLORS | Plan 1 | Dis Ret | 51.58 | 16,409.64 | 100% Joint & Survivor | M | 297,126 | 296,765 | 0.12% | 0 | 297,126 | 0.12% |
| VaLORS | Plan 2 | NVT | 44.65 | 295.36 | Lump Sum | M | 295 | 295 | 0.00% | 295 | 295 | 0.00% |
| VaLORS | Plan 2 | TransOut | 35.33 | 345.60 | Deferred Life Annuity | F | 825 | 874 | -5.58% | 1,110 | 1,110 | 26.97% |
| VaLORS | Plan 2 | Dis Ret | 57.38 | 15,790.80 | Life Annuity | M | 178,941 | 180,893 | -1.08% | 0 | 178,941 | -1.08% |
| JRS | Plan 1 | VT | 63.43 | 41,829.18 | Deferred Life Annuity | F | 505,748 | 491,329 | 2.93% | 89,109 | 505,748 | 2.93% |
| JRS | Plan 1 | Ret | 76.75 | 30,114.96 | 50% Joint & Survivor | M | 235,442 | 235,562 | -0.05% | 0 | 235,442 | -0.05% |
| JRS | Plan 1 | RetELW | 76.01 | 108,945.72 | 50% Joint & Survivor | M | 1,069,118 | 1,074,905 | -0.54% | 0 | 1,069,118 | -0.54% |
| Locals | Plan 1 | Ret | 64.69 | 40,091.76 | Life Annuity | M | 493,906 | 505,030 | -2.20% | 0 | 493,906 | -2.20% |
| Locals | Plan 1 | Ret | 68.05 | 33,131.04 | Life Annuity | F | 404,782 | 407,198 | -0.59% | 0 | 404,782 | -0.59% |
| Locals | Plan 1 | Dis Ret | 57.99 | 7,574.04 | 50% Joint & Survivor | M | 104,515 | 105,027 | -0.49% | 0 | 104,515 | -0.49% |
| Locals | Plan 1 Non-Vested | VT | 37.39 | 10,500.60 | Deferred Life Annuity | M | 14,006 | 15,290 | -8.40% | 29,365 | 29,365 | 92.06% |
| Locals | Plan 1 Non-Vested | VT | 53.05 | 1,783.04 | Deferred Life Annuity | F | 8,458 | 8,433 | 0.30% | 6,058 | 8,458 | 0.30% |
| Locals | Hybrid | NVT | 58.17 | 1,258.78 | Lump Sum | M | 1,259 | 1,259 | 0.00% | 1,259 | 1,259 | 0.00% |
| | | | | | **Total Test Lives** | | **10,750,955** | **10,815,078** | **-0.59%** | **583,669** | **10,799,247** | **-0.15%** |
| **Total by Status** | | **Status** | | | | | | | | | | |
| | | BFRC | | | | | 659,837 | 662,644 | -0.42% | 0 | 659,837 | -0.42% |
| | | Dis Ret | | | | | 1,575,515 | 1,585,022 | -0.60% | 0 | 1,575,515 | -0.60% |
| | | DisRetELW | | | | | 61,363 | 61,543 | -0.29% | 0 | 61,363 | -0.29% |
| | | LTD Dis | | | | | 142,275 | 143,526 | -0.87% | 33,669 | 142,275 | -0.87% |
| | | NVT | | | | | 16,132 | 16,132 | 0.00% | 16,132 | 16,132 | 0.00% |
| | | Ret | | | | | 6,359,507 | 6,415,641 | -0.87% | 247,952 | 6,359,507 | -0.87% |
| | | RetELW | | | | | 1,143,058 | 1,148,884 | -0.51% | 0 | 1,143,058 | -0.51% |
| | | TransOut | | | | | 16,605 | 17,234 | -3.65% | 5,876 | 16,890 | -2.00% |
| | | VT | | | | | 776,663 | 764,453 | 1.60% | 280,040 | 824,671 | 7.88% |

*Source: GRS Analysis*

# Appendix
# Actuarial Standard of Practice No. 4

ASOP No. 4, Measuring Pension Obligations and Determining Pension Plan Costs, provides guidance for measuring pension obligations and communicating the results. The Standard lists specific elements to be included, either directly or by references to prior communication, in pension actuarial communications. The pertinent items that should be included in an actuarial valuation report for a pension plan should include:

a) a statement of the intended purpose of the measurement and a statement to the effect that the measurement may not be applicable for other purposes;
b) the measurement date;
c) a description of adjustments made for events after the measurement date under section 3.4.2;
d) an outline or summary of the plan provisions included in the actuarial valuation, a description of known changes in significant plan provisions included in the actuarial valuation from those used in the immediately preceding measurement prepared for a similar purpose, and a description of any significant plan provisions not included in the actuarial valuation, along with the rationale for not including such significant plan provisions;
e) the date(s) as of which the participant and financial information were compiled;
f) a summary of the participant information;
g) if hypothetical data is used, a description of the data;
h) a description of any accounting policies or funding elections made by the principal that are pertinent to the measurement;
i) a description of the methods used to value any significant benefit provisions described in section 3.5.3 such that another actuary qualified in the same practice area could make an objective appraisal of the reasonableness of the actuary's work as presented in the actuarial report;
j) a description of the actuarial cost method and the manner in which normal costs are allocated, in sufficient detail to permit another actuary qualified in the same practice area to assess the significant characteristics of the method (for example, how the actuarial cost method is applied to multiple benefit formulas, compound benefit formulas, or benefit formula changes, where such plan provisions are significant);
k) a description of the cost allocation procedure or contribution allocation procedure including a description of amortization methods and any pay-as-you- go funding (i.e., the intended payment by the plan sponsor of some or all benefits when due). The actuary should disclose the outstanding amortization balance, the amortization payment included in the periodic cost or actuarially determined contribution, and the remaining amortization period for each amortization base along with a disclosure if the unfunded actuarial accrued liability is not expected to be fully amortized. For purposes of this section, the actuary should assume that all actuarial assumptions will be realized and actuarially determined contributions will be made when due;
l) a statement indicating that the contribution allocation procedure is significantly inconsistent with the plan accumulating adequate assets to make benefit payments when due, if applicable in accordance with section 3.14.1;
m) a qualitative description of the implications of the contribution allocation procedure or plan sponsor's funding policy on future expected plan contributions and funded status in accordance with section 3.14.2. The actuary should disclose the significant characteristics of the contribution allocation procedure or plan sponsor's funding policy, and the significant assumptions used in the assessment;

n) a description of the types of benefits regarded as accrued or vested if the actuary measured the value of accrued or vested benefits, and, to the extent the attribution pattern of accrued benefits differs from or is not described by the plan provisions, a description of the attribution pattern;
o) a description of whether and how benefit payment default risk or the financial health of the plan sponsor was included, if a market-consistent present value measurement was performed;
p) funded status based on an immediate gain actuarial cost method if the actuary discloses a funded status based on a spread gain actuarial cost method. The immediate gain actuarial cost method used for this purpose should be disclosed in accordance with section 4.1(j);
q) if applicable, a description of the particular measures of plan assets and plan obligations that are included in the actuary's disclosure of the plan's funded status. For funded status measurements that are not prescribed by federal law or regulation, the actuary should accompany this description with each of the following additional disclosures:
    1. whether the funded status measure is appropriate for assessing the sufficiency of plan assets to cover the estimated cost of settling the plan's benefit obligations;
    2. whether the funded status measure is appropriate for assessing the need for or the amount of future contributions; and
    3. if applicable, a statement that the funded status measure would be different if the measure reflected the market value of assets rather than the actuarial value of assets.
r) a statement, appropriate for the intended users, indicating that future measurements (for example, of pension obligations, periodic costs, actuarially determined contributions or funded status as applicable) may differ significantly from the current measurement. For example, a statement such as the following could be applicable: "Future actuarial measurements may differ significantly from the current measurements presented in this report due to such factors as the following: plan experience differing from that anticipated by the economic or demographic assumptions; changes in economic or demographic assumptions; increases or decreases expected as part of the natural operation of the methodology used for these measurements (such as the end of an amortization period or additional cost or contribution requirements based on the plan's funded status); and changes in plan provisions or applicable law."

    In addition, the actuarial communication should include one of the following:
    i. if the scope of the actuary's assignment included an analysis of the range of such future measurements, disclosure of the results of such analysis together with a description of the factors considered in determining such range; or
    ii. a statement indicating that, due to the limited scope of the actuary's assignment, the actuary did not perform an analysis of the potential range of such future measurements;
s) description of known changes in assumptions and methods from those used in the immediately preceding measurement prepared for a similar purpose. For assumption and method changes that are not the result of a prescribed assumption or method set by another party or a prescribed assumption or method set by law, the actuary should include an explanation of the information and analysis that led to those changes. The explanation may be brief but should be pertinent to the plan's circumstances;

t) description of all changes in cost allocation procedures or contribution allocation procedures that are not a result of a prescribed assumption or method set by law, including the resetting of an actuarial asset value. The actuary should disclose the reason for the change and the general effects of the change on relevant periodic cost, actuarially determined contribution, funded status, or other measures, by words or numerical data, as appropriate. The disclosure of the reason for the change and the general effects of the change may be brief but should be pertinent to the plan's circumstances;

u) a description of adjustments of prior measurements used under section 3.4.3; and

v) if, in the actuary's professional judgment, the actuary's use of approximations and estimates could produce results that differ materially from results based on a detailed calculation, a statement to this effect.

# Appendix
# Actuarial Standard of Practice No. 41

ASOP No. 41, Actuarial Communications, provides guidance to actuaries with respect to actuarial communications.

The requirements for actuarial communications are as follows:

- The actuary should take appropriate steps to ensure that the form and content of each actuarial communication are appropriate to the particular circumstances, taking into account the intended users.
- The actuary should take appropriate steps to ensure that each actuarial communication is clear and uses language appropriate to the particular circumstances, taking into account the intended users.
- The actuary should issue each actuarial communication within a reasonable time period, unless other arrangements as to timing have been made. In setting the timing of the communication, the needs of the intended users should be considered.
- An actuarial communication should clearly identify the actuary responsible for it. When two or more individuals jointly issue a communication (at least some of which is actuarial in nature), the communication should identify all responsible actuaries, unless the actuaries judge it inappropriate to do so. The name of an organization with which each actuary is affiliated also may be included in the communication, but the actuary's responsibilities are not affected by such identification. Unless the actuary judges it inappropriate, the actuary issuing an actuarial communication should also indicate the extent to which the actuary is available to provide supplementary information and explanation.
- An actuarial report may comprise one or several documents. The report may be in several different formats (such as formal documents produced on word processing, presentation or publishing software, e-mail, paper or websites). Where an actuarial report for a specific intended user comprises multiple documents, the actuary should communicate which documents comprise the report.
- An actuarial communication should identify the party responsible for each material assumption and method. Where the communication is silent about such responsibility, the actuary who issued the communication will be assumed to have taken responsibility for that assumption or method. The actuary's obligation when identifying the other party who selected the assumption or method depends upon how the assumption or method was selected.