VRS Stress Test and Sensitivity Analysis

Report to the General Assembly of Virginia

Virginia Retirement System

TABLE OF CONTENTS

Contents

STRESS TEST MANDATE

Section 51.1-124.30:1 of the *Code of Virginia* requires the Virginia Retirement System to formally adopt a policy to regularly report sensitivity and stress testing analyses for members of the General Assembly (Appendix A). The analyses shall include projections of benefit levels, pension costs, liabilities, and debt reduction under various economic and investment scenarios.

This report provides an analysis of the potential impact of various scenarios and hypothetical situations on VRS-administered retirement plans and supports transparency with regard to the future health of the retirement system.

It should be noted that when we examine future potential outcomes for the plans, probabilities exist for both positive and negative scenarios. This report focuses primarily on the negative scenarios as they help to identify areas of risk and generally provide the most challenges to plan sponsors.

EXECUTIVE SUMMARY

The purpose of this report is to assist the VRS Board, stakeholders, policymakers and the public to better understand and assess the risks inherent in the funding of the pension system. This year's report investigates various risks faced by VRS and measures their potential impact on the defined benefit programs.

Over the last fiscal year, financial markets have provided better than assumed returns, positively impacting projected funding levels and contribution rates. While VRS was a leader in lowering the expected long-term rate of return of the pension funds, several risks remain and opportunities exist to further strengthen the health of the plans, particularly the statewide retirement plans.

Key results and findings of this report are:

• Strong investment performance in fiscal year 2017 mitigated some of the impact of the assumption changes resulting in slightly lower contribution requirements for most plans.

• Significant resources must remain dedicated to addressing the amortization of the legacy unfunded liabilities.

• The outcomes related to investment risk for VRS statewide retirement plans with large unfunded liabilities would be more severe than the better funded local retirement plans.

• Analysis suggests that accelerating the payback of the legacy unfunded liabilities could provide significant long-term savings and better position the statewide plans to weather future volatility in investment returns, thereby serving to reduce investment risk.

• Even while mortality assumptions have already been adjusted to reflect members living longer, new studies suggest additional improvements in mortality are likely, which could increase plan liabilities in coming years.

• Decreases in active covered membership in some statewide plans could cause increases in future employer rates as a percentage of a smaller covered payroll.

• As roughly two-thirds of benefits are funded by investment income, receiving 100% of the Board-certified actuarially determined contributions not only avoids adding liabilities to the plans, but also ensures assets are available timely to be invested and take advantage of compound interest.

EXECUTIVE SUMMARY

• Pension reforms, specifically plan design changes, have reduced the future costs of benefits. In addition, these reforms have reduced employer's risk by introducing shared risk in the defined contribution component of the hybrid plan. Approximately 30% of a hybrid member's benefit has no future investment or longevity risk for employers.

• Due to strong market returns and movement to fully funding the actuarially determined and Board certified contribution rates, unfunded liabilities have declined and over the last five years the funded status of the plans has improved by approximately 10 percent.

INTRODUCTION

This is the second published annual report on funding levels and risk associated with VRS pension plans. This report is intended to assist stakeholders in assessing the soundness and sustainability of the System. To better understand the risks associated with funding the System, this report examines a range of potential outcomes, both economic and demographic, that could endanger the long-term funding of the System and prevent the System from reaching full funding.

This report is based on the June 30, 2017 Annual Valuation and reflects the changes that have occurred over the past year, including the changes to actuarial assumptions adopted by the VRS Board of Trustees in April 2017 and the 7.5% net investment return reported for fiscal year ending 2018. In this report, the focus is on:

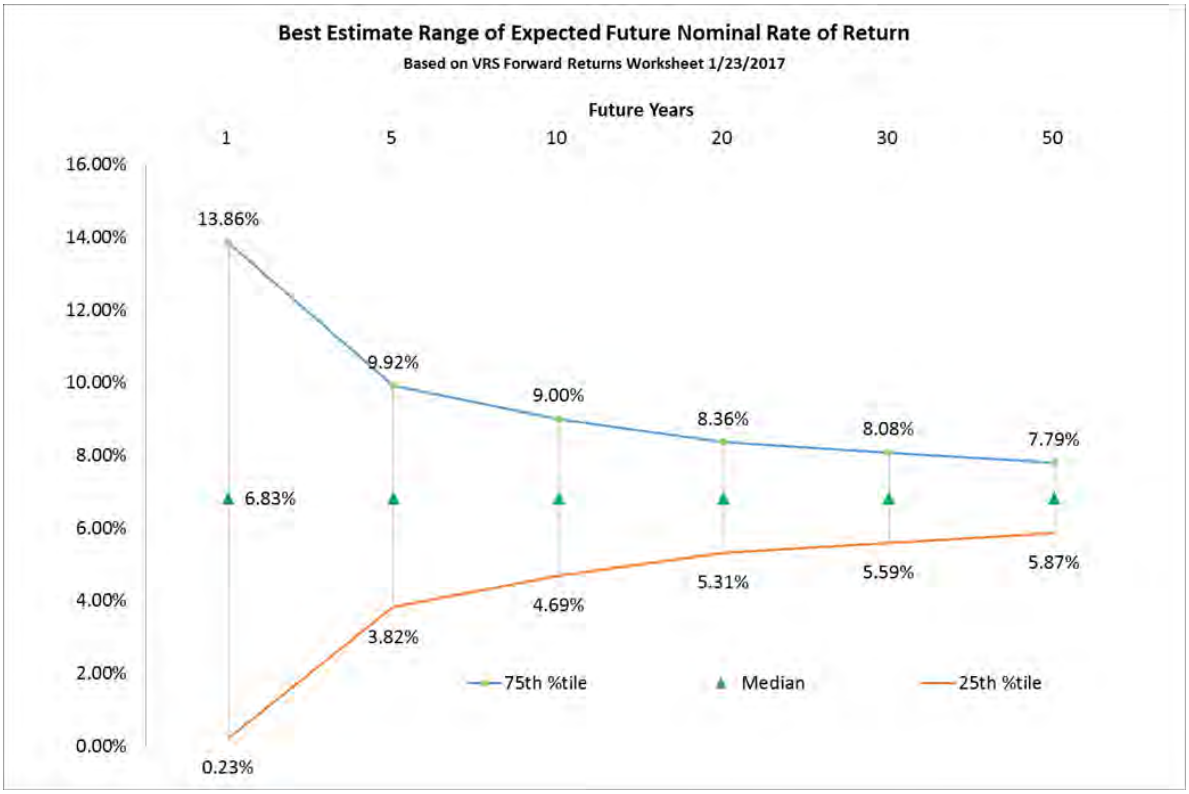
- The changing pension environment, including the plan maturity and volatility.
- Negative amortization and its impact on long-term funding.
- Risks to long-term funding, including investment volatility, longevity risk, and risks of membership decline.

Analysis of Discount Rate Sensitivity

The discount rate reflects expectations of what investment earnings the markets will deliver in the future, and it is calculated based on two components: expected price inflation and real rate of return. A change in either of those components over the long term would necessitate further evaluation of the discount rate.

A recent review of the economic assumptions during the quadrennial experience study for the actuarial valuations included a statistical analysis of the reasonable range for the plan's assumed investment rate of return. Using the plan's 2.5% assumed rate of inflation and the 10-year forward looking capital market estimates and policy investment target provided by the VRS investment staff, the plan actuary computed an expected median nominal rate of return of 6.83%, with a reasonable range of 5.87% - 7.79%, representing the 25th and 75th percentiles, respectively.

Exhibit 1



FUTURE RISK ANALYSIS

Analysis of discount rate sensitivity on employer contribution rates gives a sense of the long-term risk to the employer contribution rates and changes to the funded status. The analysis provides the impact on employer contribution rates assuming discount rates that are up to two percentage points above or below the current valuation discount rate. This analysis gives an indication of the potential required employer contribution rates if the discount rate ranged from 5% to 9% over the long term. Governmental Accounting Standards Board (GASB) Statement 67 currently requires sensitivity analysis of plus or minus 1% from the plan's discount rate. Adding a wider range of plus or minus 2% around the plan discount rate resulted from discussions during deliberations of the Commission on Employee Retirement Security and Pension Reform.

Exhibits 2 and 3 illustrate how the assumed annual rate of return would affect pension contribution rates for the State and Teacher plans had it been changed for the June 30, 2017 valuation. A lower assumed annual rate of return requires higher contribution rates from employers. Although the assumed rate of return dictates how contribution rates are calculated in the short term, the actual investment returns will determine how much of pension costs must be covered by contributions in the long term.

With the 10-year economic forecasts suggesting potentially lower expectations in the near term, the cost impacts of smaller changes in the discount rate of 25 and 50 basis point reductions are also included in the exhibit below.

Exhibit 2 – State Plan

($Thousands)

Discount Rate	9.00%	8.00%	Current 7.00%	6.75%	6.50%	6.00%	5.00%
Total Normal Cost Rate	6.44%	7.66%	9.29%	9.77%	10.30%	11.49%	14.50%
Member Contribution Rate	4.68%	4.68%	4.68%	4.68%	4.68%	4.68%	4.68%
Employer Normal Cost Rate	1.76%	2.98%	4.61%	5.09%	5.62%	6.81%	9.82%
Administrative Expense Load	0.29%	0.29%	0.29%	0.29%	0.29%	0.29%	0.29%
Total Employer Normal Cost Rate	2.05%	3.27%	4.90%	5.38%	5.91%	7.10%	10.11%
Total Amortization Rate	1.08%	4.52%	8.04%	8.94%	9.84%	11.66%	15.37%
Defined Contribution Hybrid Plan	0.58%	0.58%	0.58%	0.58%	0.58%	0.58%	0.58%
Total Employer Rate	3.71%	8.37%	13.52%	14.90%	16.33%	19.34%	26.06%
Change in Employer Rate	(9.81)%	(5.15)%	0.00%	1.38%	2.81%	5.82%	12.54%
Estimated Change in Annual Funding	($396,037)	($207,909)		$55,712	$113,442	$234,958	$506,249
Unfunded Liability	$1,489,771	$3,447,486	$5,763,770	$6,408,154	$7,081,383	$8,520,910	$11,815,038
Funded Status	92.2%	83.6%	75.3%	73.3%	71.2%	67.3%	59.8%

Results based on June 30, 2017 actuarial valuation and represent employer rates that would be effective with the 2019/2020 fiscal years.

Exhibit 3 – Teacher Plan

($Thousands)

Discount Rate	9.00%	8.00%	Current 7.00%	6.75%	6.50%	6.00%	5.00%
Total Normal Cost Rate	6.95%	8.54%	10.71%	11.37%	12.07%	13.68%	17.79%
Member Contribution Rate	4.75%	4.75%	4.75%	4.75%	4.75%	4.75%	4.75%
Employer Normal Cost Rate	2.20%	3.79%	5.96%	6.62%	7.32%	8.93%	13.04%
Administrative Expense Load	0.26%	0.26%	0.26%	0.26%	0.26%	0.26%	0.26%
Total Employer Normal Cost Rate	2.46%	4.05%	6.22%	6.88%	7.58%	9.19%	13.30%
Total Amortization Rate	1.77%	5.29%	9.02%	9.95%	10.91%	12.87%	16.94%
Defined Contribution Hybrid Plan	0.44%	0.44%	0.44%	0.44%	0.44%	0.44%	0.44%
Total Employer Rate	4.67%	9.78%	15.68%	17.27%	18.93%	22.50%	30.68%
Change in Employer Rate	(11.01)%	(5.90)%	0.00%	1.59 %	3.25 %	6.82 %	15.00 %
Estimated Change in Annual Funding	($871,931)	($467,248)		$125,919	$257,382	$540,106	$1,187,918
Unfunded Liability	$3,184,002	$7,330,355	$12,321,149	$13,723,870	$15,195,516	$18,363,658	$25,703,187
Funded Status	91.1%	81.7%	72.6%	70.4%	68.3%	64.0%	56.0%

Results based on June 30, 2017 actuarial valuation and represent employer rates that would be effective with the 2019/2020 fiscal years.

Exhibit 4 demonstrates in more detail the estimated additional annual contributions that would be required if the long-term rate of return assumption was reduced to 6.75%. A 25 basis point reduction in plan discount rate equates to an approximately 10% increase in employer rates. This in turn increases expected funding for statewide plans by nearly $194 million each year.

Exhibit 4

Estimated Impact on Funding of 25 Basis Point Reduction in Long-Term Rate of Return

($ Millions)

Plan	General Fund	Non-General Fund	Total
State	$23.4	$32.3	$55.7
SPORS	$2.4	$0.4	$2.8
VaLORS	$7.1	$0.6	$7.7
JRS	$2.3	$0.0	$2.3
Teachers	$50.4	$75.5	$125.9
Total Statewide Plans	$85.6	$108.8	$194.4

Results based on June 30, 2017 actuarial valuation

Public pension plans have historically estimated future benefit liabilities using a discount rate that is based on estimated future investment returns of fund assets. This approach has come under mounting criticism by financial economists and public policy groups. These groups argue that a rate based on investment return assumptions vastly understates pension liabilities. In their view, the rate should be based on low-risk, or even risk-free, bond rates to reflect the risk of the payments to plan members.

The long-term rate of return and risk-free rate are measurements that are designed to answer fundamentally different questions. Consequently, the usefulness of the information they provide depends on the needs and purposes of any given user. The long-term rate of return measure provides information about expected actual costs to the employer and, ultimately, to the taxpayer. It is the best estimate of what it will cost to provide pension benefits today and into the future. This is why benefit obligations are discounted using the long-term expected return on plan assets. Since investment earnings reduce the net cost to the employer, an estimate of future investment earnings is appropriate in a measurement whose primary purpose is to inform stakeholders about current and future costs.

The risk-free rate, on the other hand, is not directly concerned with the question of funding. It is a measurement designed to estimate the theoretical market price of a plan's obligations. The risk-free rate could be viewed as a "settlement value" or as a "replacement value," meaning the price the market would charge if all plan participants wanted to replicate their accrued pension benefits by purchasing fixed-income securities that would provide the same stream of income or what the market would charge if the employer were able to terminate the plan and transfer its benefit obligations to a third party. Under either of these scenarios, liabilities should be valued independently of the long-term expected return on assets if the question being asked is: what is the market's "going price" today if the benefits are to be provided by fixed-income market instruments.

Using a risk-free rate for funding purposes is inconsistent with the basic reason why pension plans are established: to provide employers with a more efficient, cost-effective means of delivering retirement benefits rather than simply having individual employees obtain those benefits at fixed-income market rates. Although calculating this market replacement value of benefits might make for an interesting illustration of the economic efficiency of pension plans, it has limited relevance for trustees or employers looking for information on a plan's current and long-term prospects.

To the extent that funding costs are the overriding practical concern facing stakeholders of public-sector plans, it is easy to see how using an assumed long-term discount rate measurement provides viable information that can be used for hands-on decision making. Decision makers must be concerned not only with the here and now, but also with anticipating future developments.

GASB and the Actuarial Standards Board (ASB) have reaffirmed the basic conceptual framework underlying the long-term rate of return method and the appropriateness of using the expected rate of return to discount pension liabilities for both accounting expense and funding cost. However, these reviews have raised some important questions, and the answers may have an impact on public plans.

Under the GASB approach, only benefits that are projected to be funded from plan assets are discounted using the expected return on plan assets, while any remaining benefits are discounted using a current bond index rate. This provides an explicit measure of the cost of long-term underfunding by denying the use of the long-term earnings rate for future unfunded benefit payments. Under this measure, the liability and cost estimates will only be

accurate if the plan sponsor is actually funding the plan in accordance with the actuarially determined needs of the plan and the current assumptions hold true. To the extent that an employer fails to fund the actuarially required contributions, the plan will fail to achieve the investment earnings expected. Consequently, plans may be underestimating long-term plan costs.

Decision makers and stakeholders certainly need reliable information on the consequences that flow from a failure to appropriately fund a plan. In its revised accounting standards, GASB determined that liabilities should continue to be calculated using the expected return on plan assets for plans that are being properly funded on an actuarial basis. However, for those not being funded in accordance with the actuarially determined needs of the plan, GASB determined that liabilities should be discounted using a "blended rate."

Note that in contrast, because risk-free measures are divorced from the concept of funding, they offer no information on the incremental cost of a failure to fund future benefits.

As for the Actuarial Standards of Practice (ASOPs), as noted earlier the ASB has issued revised standards both for measuring pension obligations and for selecting discount rates. Unlike GASB's accounting and financial reporting standards for public plans, pension ASOPs apply to all actuarial measurements related to pensions and, therefore, are much wider in scope. That is why rather than attempting to specify particular measurements, the revised pension ASOPs require that, "when measuring pension obligations and determining periodic costs or actuarially determined contributions, the actuary should reflect the purpose of the measurement."

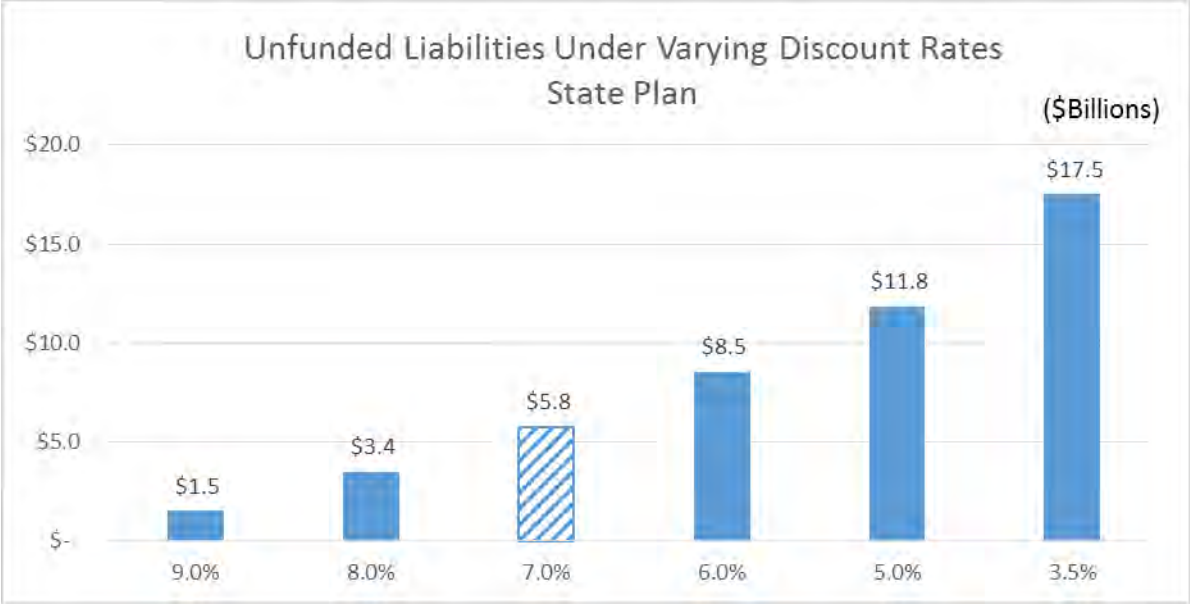
Under the revised ASOPs, there may be purposes for which a risk-free measure would be appropriate. These might include settlement values for withdrawing employers (as discussed earlier) or values for use in market-based financial economic models. Nonetheless, the expected earnings-based method is most consistent with the purpose of measuring the current costs and accrued liabilities for an ongoing public pension plan.

Using an estimated rate of return to discount future pension liabilities actually reflects the costs of funding pension benefits far better than using a risk-free or low-risk bond rate of return. If appropriately set, the former will reflect an estimate that is much closer to the actual cost of pension benefits and, therefore, the liabilities of the system. In contrast, discounting these liabilities using a hypothetical bond rate reflects an estimate of the future

value of these benefits to plan members, but would require employers to fund larger amounts, which could create intergenerational inequities if funds were still invested in a diversified portfolio with expectations for a larger return on investments.

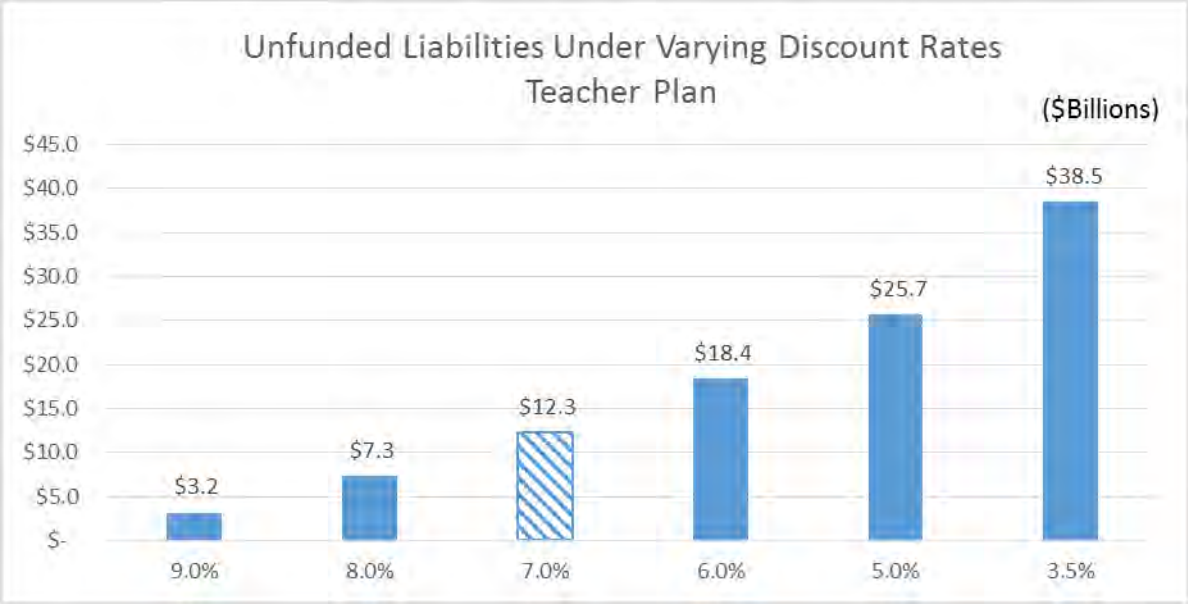
Employers and taxpayers should know the value of pension benefits received by public employees. But estimating this benefit amount does not reflect the actual costs of funding public pensions. Exhibits 5 and 6 show the estimated unfunded liability of the State and Teacher plans under different discount rate assumptions, including the estimated risk-free rate of 3.5%.

Exhibit 5



Values above based on 2017 actuarial valuation results.

Exhibit 6



Values above based on 2017 actuarial valuation results.

Cash Flow Projections

Pension plans are designed to provide employees with a guaranteed income stream upon retirement. Contributions in VRS plans are generally shared by employees and their employer and are a systematic way of pre-funding the system's costs. The benefit of prefunding is that investment returns on the pre-funded plan assets reduce the employer's long-term contributions.

Retirement plans that have been in operation for a number of years generally have contributions coming into the plan and benefits being paid out. The net (non-investment) cash flow is the difference between the contributions and benefits and expenses of the fund. These cash flows will vary for each plan since all plans have different demographics and maturities.

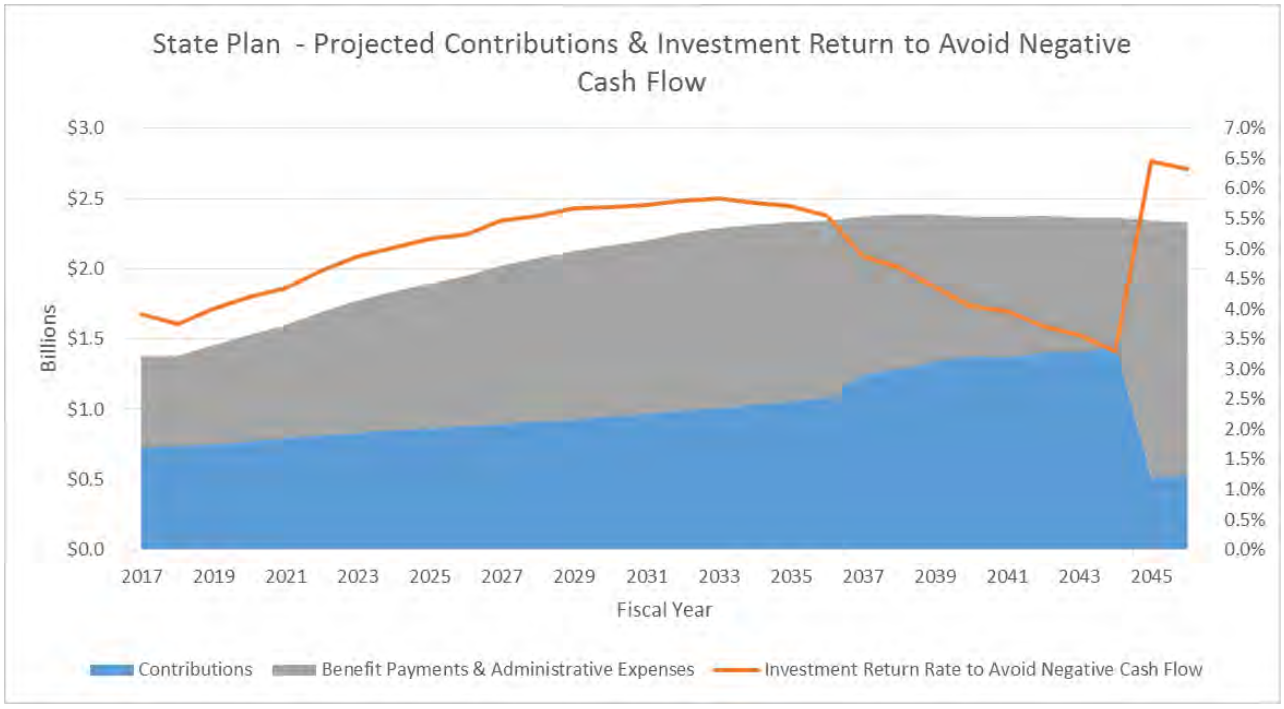
Mature plans often have negative cash flows over time, which is considered the normal cycle of pension plans. Negative cash flows do not necessarily imply a plan is in trouble. In

fact, part of the benefit of pre-funding is so the investment returns can pay a significant portion of the benefit payments.

Exhibit 7 below shows the projected contributions and investment returns needed by the State plan to avoid negative cash flows over the next 30 years. Benefit payments in the State plan are expected to peak in 2039 before beginning to reduce as more members are covered by the Hybrid retirement plan. Note that the drop off in contribution requirements in 2044 coincide with the payoff of the legacy unfunded liabilities. Less contribution dollars flowing into the plan will require higher investment returns to cover cash flow requirements in later years.

The investment return needed over this period to avoid negative cash flow ranges from 3.25% - 6.45%, with an average return of approximately 4.9% to stay cash flow positive to the fund.

Exhibit 7



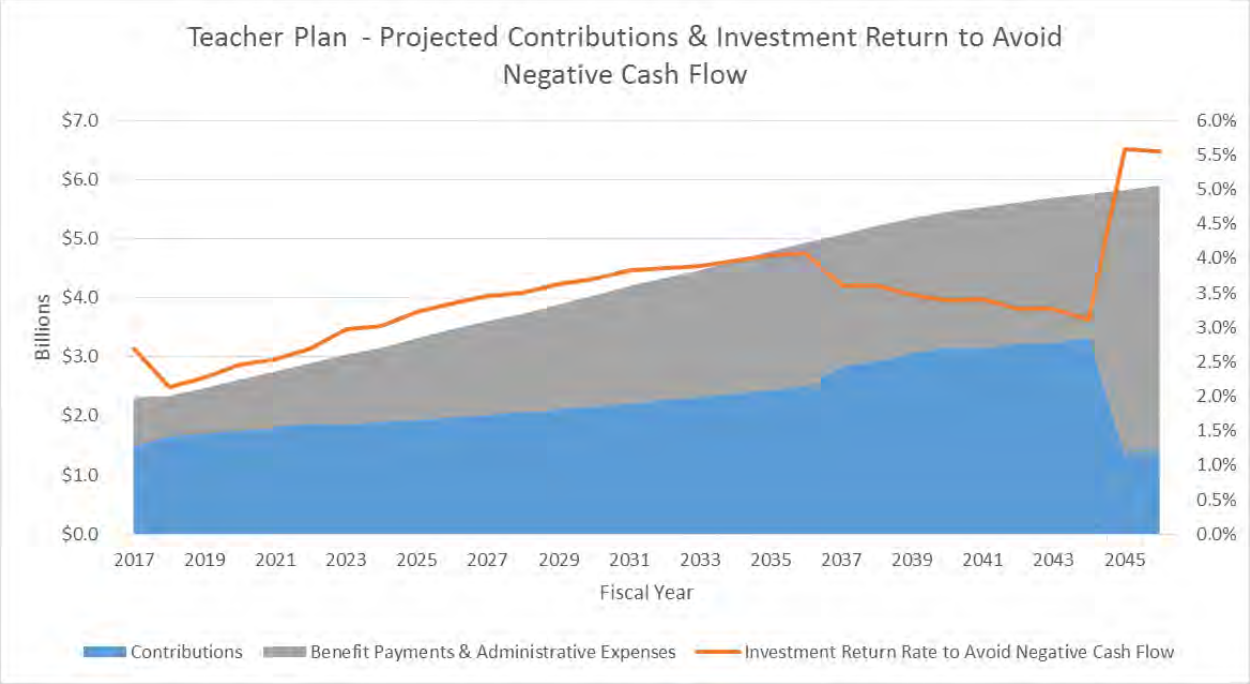
Results based on June 30, 2017 actuarial valuation

FUTURE RISK ANALYSIS

Exhibit 8 below shows the projected contributions and investment returns needed by the Teacher plan to avoid negative cash flows over the next 30 years. Benefit payments in the Teacher plan are expected to peak beyond 2046 as turnover in this plan is less than in the State plan. Note that a similar drop off in contribution requirements in 2044 also coincides with the payoff of the legacy unfunded liabilities in the Teacher plan. Less contribution dollars flowing into the plan will require higher investment returns to cover cash flow requirements in later years.

The investment return needed over this period to avoid negative cash flow ranges from 2.13% - 5.58% with an average return of approximately 3.5% to stay cash flow positive.

Exhibit 8



Results based on June 30, 2017 actuarial valuation

INVESTMENT RISK

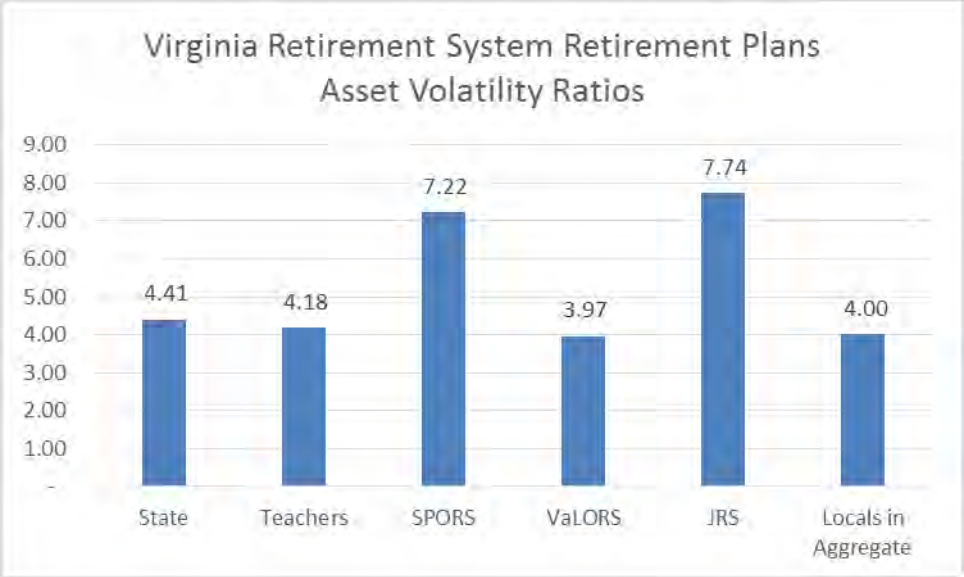
Volatility

As retirement systems become more mature, these systems are subject to increased volatility in the contributions needed to fully fund the benefits. The drop in the active-to-retiree ratio over the last decade has increased the contribution rate volatility for VRS, and this volatility risk will continue to increase as the ratio continues to drop in the future. This is typical for mature plans like VRS.

The asset volatility ratio is a metric that helps plan sponsors anticipate the impact of investment volatility on actuarially determined contribution rates. The asset volatility ratio is the ratio of plan assets to the payroll of active members covered by the plan. Plans with a high ratio will be subject to higher contribution rate volatility. These higher ratios mean that actuarially determined contributions are now more sensitive than they once were to investment volatility, despite the use of asset smoothing methods to help mitigate the impact of market movements. This volatility in asset returns is further magnified for the VRS statewide plans due to the significant unfunded liability that exists for these plans at this time.

Exhibit 9 shows the current asset volatility ratios for the various VRS retirement plans as of June 30, 2017. The chart suggests that SPORS, JRS, and the State plan would be more sensitive to market swings than the Teacher and VaLORS plans, while the impacts for political subdivision plans would vary by plan, but in aggregate would be less sensitive than the statewide plans.

Exhibit 9



To illustrate the contribution volatility, exhibit 10 below shows the estimated increase in contribution rates to fund a 5% investment loss under various asset volatility ratios, assuming losses are amortized over 20 years. This would mean that with an assumed long-term rate of return assumption of 7%, the fund returned 2% for the year. Plans with a higher asset volatility ratio will have a larger increase in rates to pay down the investment loss. For example, if the plan assets were to see a 5% investment loss, the State plan may see an increase in employer rates of approximately 1.76% of covered payroll while the SPORS plan could see an increase of 3.09% of covered payroll.

Exhibit 10

Asset Volatility Ratio Illustration for Hypothetical Pension Plan

($ Billions)

Market Value of Assets	$6.00	$8.00	$10.00	$12.00	$14.00	$16.00
Covered Payroll	$2.00	$2.00	$2.00	$2.00	$2.00	$2.00
Asset Volatility Ratio	3.00	4.00	5.00	6.00	7.00	8.00
Estimated Increase in Contribution Rate Resulting from 5% Asset Loss (Using 20 Year Level Dollar Amortization)	1.32%	1.76%	2.21%	2.65%	3.09%	3.53%

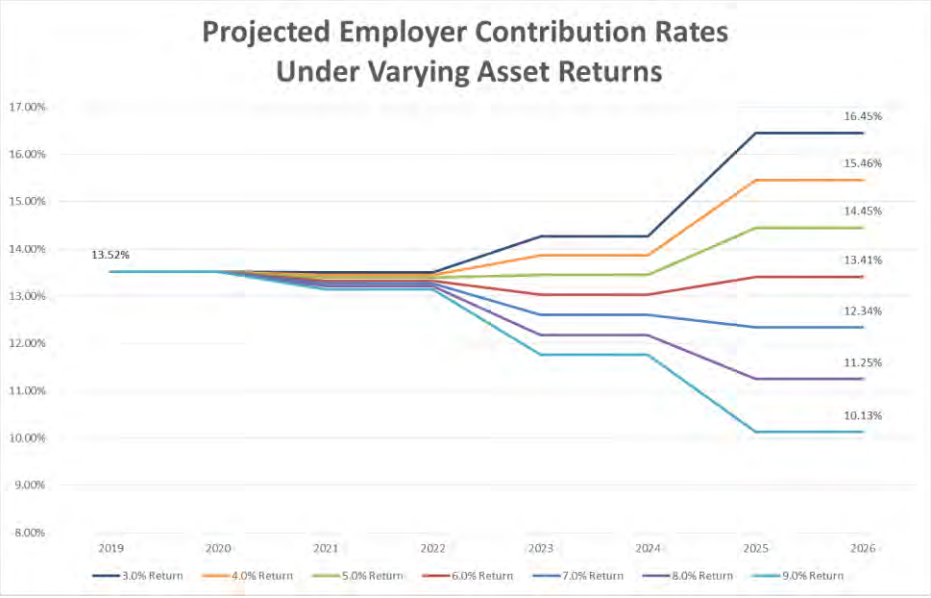
INVESTMENT RISK

Possible Future Outcomes

As discussed earlier, investment returns will have a greater impact on the funding of the plans as the VRS plans continue to mature. When investment returns are below expectation, the unfunded actuarial accrued liability increases and additional contributions are needed, which historically have been funded by employers. The exhibits below provide a range of expected employer contribution rates under varying expected rates of return from 3% - 9% over the next eight years. As shown in Exhibit 11, if the fund actually earned 5% each year for the next five years, employer contribution rates would increase to 14.45% beginning in 2025.

Again, as shown in Exhibit 11, rates at the assumed rate of return of 7% trend lower primarily due to the impact of the lower cost Hybrid Plan reducing the employer normal cost rate as new members enroll in the plan.

Exhibit 11 - State Plan

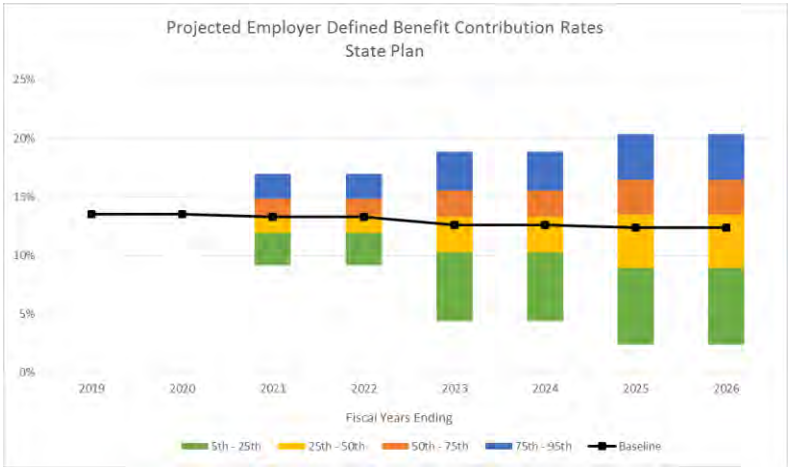


Results based on June 30, 2017 actuarial valuation

FUTURE RISK ANALYSIS

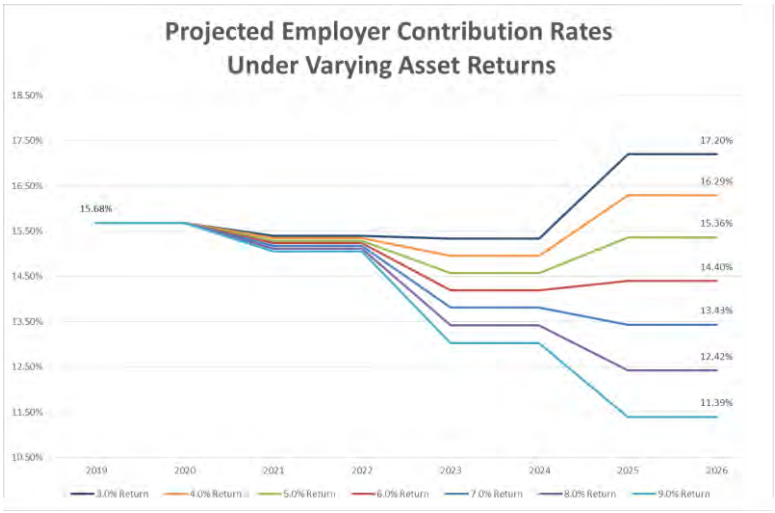
When we look at probabilistic or stochastic forecasts of future investment returns and the impact on future rates, we see a 50% probability that employer rates will be between 8.9% and 16.4% by FY 2026.

Exhibit 12



As shown in Exhibit 13, the significant drop in rates in FY 2023 for Teachers is due to the 10-year deferred contributions from the 2010-2012 biennium being paid off, which subsequently lowers rates by approximately 0.7% of covered payroll.

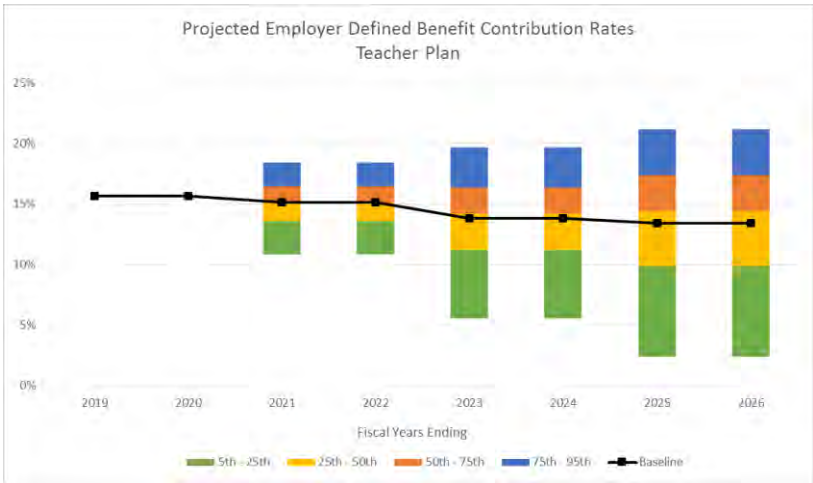
Exhibit 13 – Teacher Plan



Results based on June 30, 2017 actuarial valuation

When we look at probabilistic or stochastic forecasts of future investment returns and the impact on future rates, we see a 50% probability that employer rates in the Teacher plan will be between 9.9% and 17.4% by FY 2026.

Exhibit 14



Sustained Low Returns

For many in the economic and investment fields, the consensus view is that a lower return environment may persist into the near future. The purpose of this section is not to validate whether this view is correct or incorrect but to determine the possible impacts on contribution rates and funded status that a sustained low-return environment could have assuming five- and 10-year scenarios with observed fund returns of 5% per year during those periods. If we expand our analysis beyond the eight years shown above, we can see the longer term impacts of sustained lower returns.

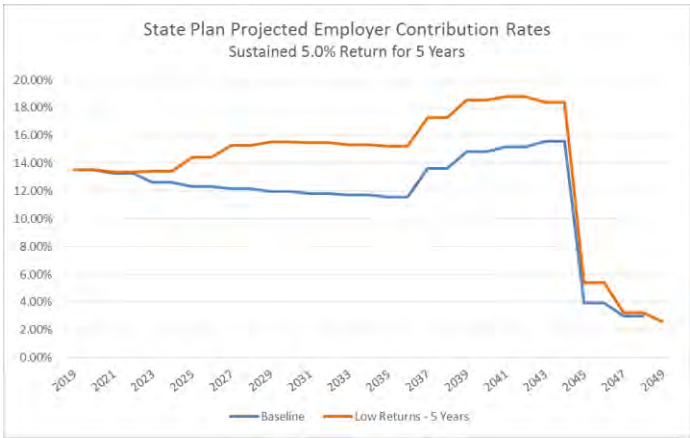
It is worth noting that these scenarios do not include any reduction in plan discount rate or benefits that could result due to lower than expected returns over a sustained period of time.

Sustained low returns of 5% in each of next five years

If the VRS fund only returned 5% annually each of the next five years, the State plan would see an increase in unfunded liability of approximately $2.2 billion, peaking in 2027 at $7.8

billion. Since actuarial losses are amortized over 20-year periods, the plan could see increased contribution rates out through 2047. Exhibit 15 shows employer rates could increase to approximately 15.5% over the next 10 years, which would require additional funding in order to maintain funding of 100% of the required contribution.

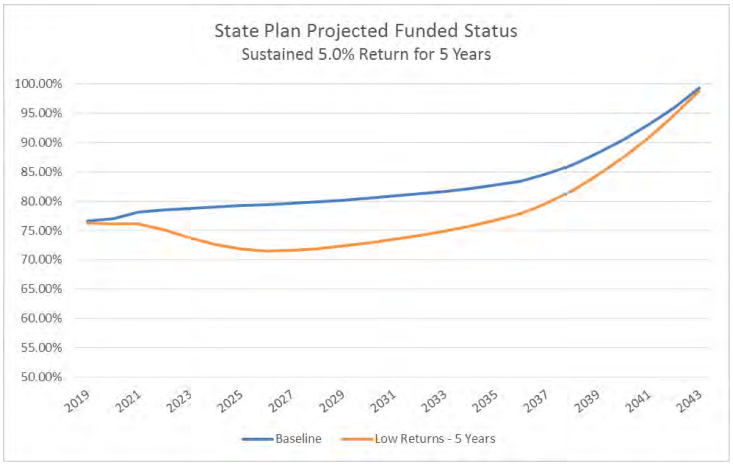
Exhibit 15



Results based on June 30, 2017 actuarial valuation

Exhibit 16 illustrates the impact on funded status of a sustained period of lower than expected returns of 5% in each of the next five years. The funded status would lose approximately 10% of its value during the five year event.

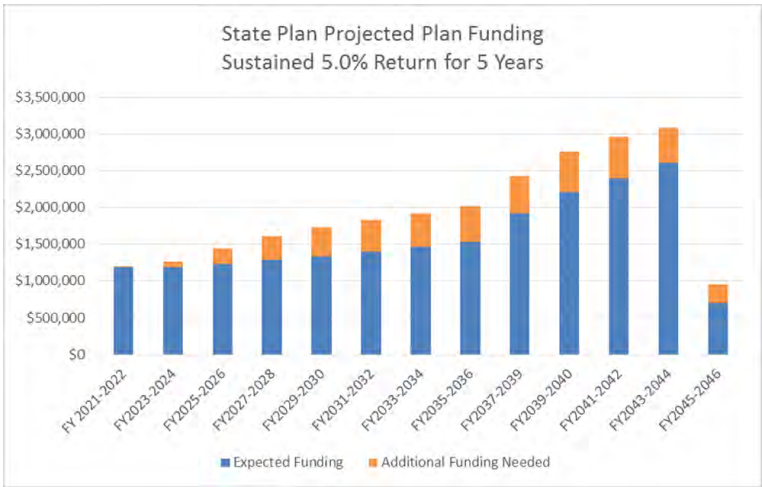
Exhibit 16



Results based on June 30, 2017 actuarial valuation

Exhibit 17 shows estimated additional funding that would be required to pay down five consecutive years of lower than expected returns. Using 20-year closed period amortization, the additional funding would start at $5.5 million in fiscal year 2023 and gradually increase to approximately $280 million in fiscal year 2041.

Exhibit 17

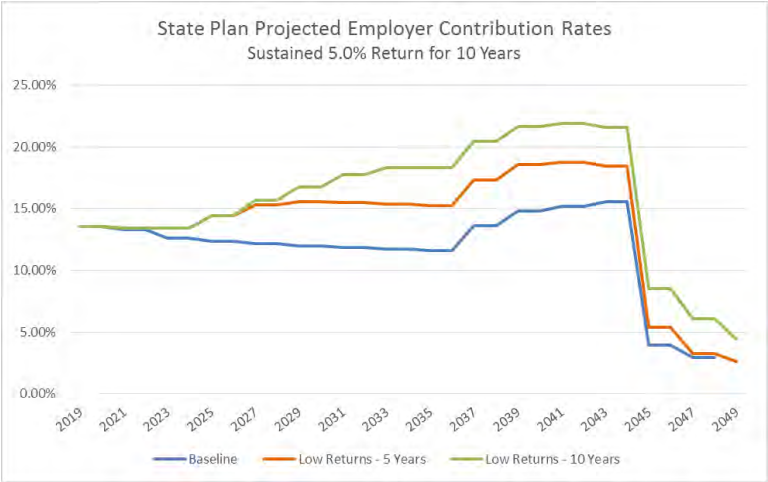


Results based on June 30, 2017 actuarial valuation

Sustained low returns of 5% in each of next 10 years

If lower than expected returns of 5% continued for a decade, the impacts would be even greater. Note that while this scenario is shown for illustrative purposes, if asset returns were to stay low for an extended period of time, action would most likely be taken to mitigate the impacts by way of plan design changes or other reforms. The State plan would see an increase in unfunded liability of approximately $4.2 billion, peaking in 2032 at $9.5 billion. Exhibit 18 demonstrates that employer rates could increase to over 18% over the next 10 years, which would require additional funding in order to maintain funding at 100% of the required contribution.

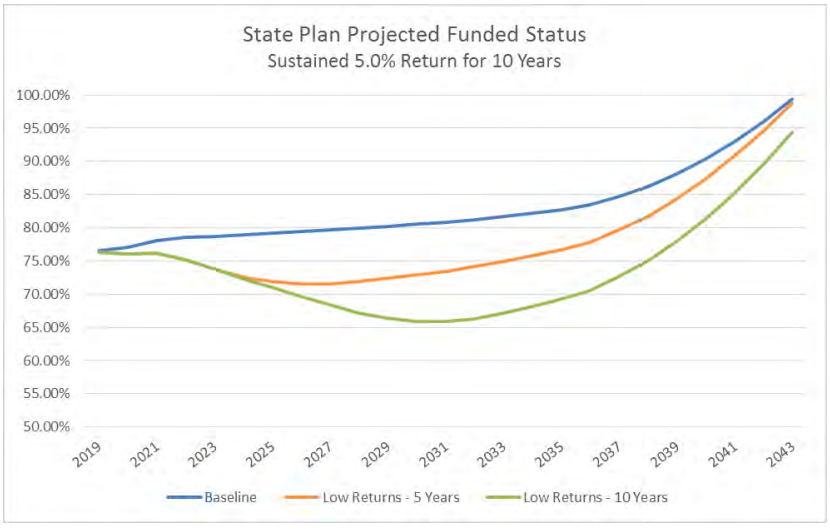
Exhibit 18



Results based on June 30, 2017 actuarial valuation

Exhibit 19 illustrates the impact on funded status of a sustained period of lower than expected returns of 5% in each of the next ten years. The funded status would lose approximately 15% of its value during the 10- year event.

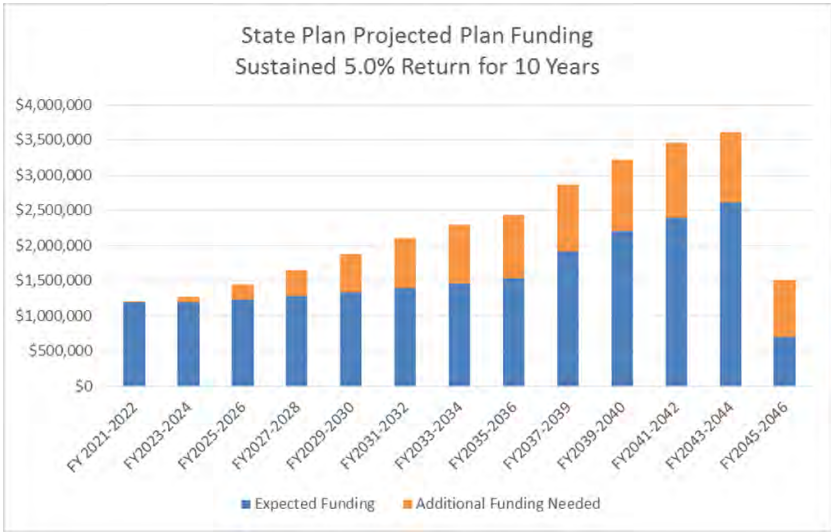
Exhibit 19



Results based on June 30, 2017 actuarial valuation

Exhibit 20 shows estimated additional funding that would be required over the next five budget cycles beginning in 2021. Using a 20-year closed period amortization, the additional funding would start at $5.5 million in fiscal year 2023 and gradually increase to approximately $550 million in fiscal year 2041.

Exhibit 20



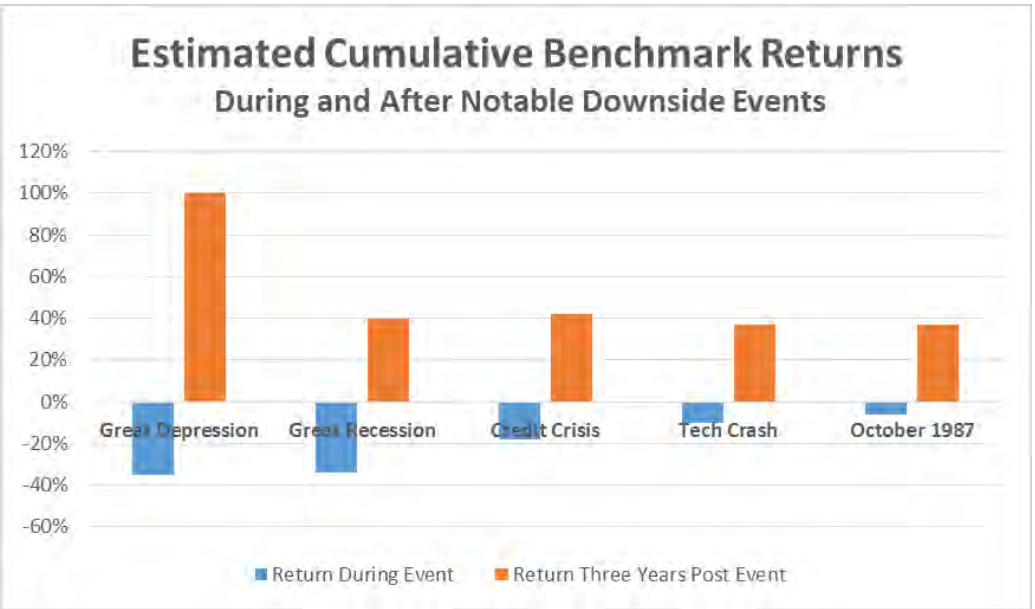
Results based on June 30, 2017 actuarial valuation

Shock Scenario (Unexpected or Unpredictable Economic Event)

In 2008-2009, financial markets crashed around the world resulting in the worst annual investment performance on record for VRS. This single event caused the funded status of the System to drop nearly 25% in a single year. Since that time, even with the pension reforms and more diligent funding of the state-wide plans by the Governor and General Assembly, the System remains at risk if another investment return "shock" were to occur. Since the statewide plans still have a legacy unfunded liability that needs to be paid off, a large shock could have a drastic impact on the long-term funding of the System.

In looking at the five worst historical stock market events that have occurred, one being the Great Recession that began in late 2007, history shows that market recoveries generally follow these types of events. Exhibit 21 shows the estimated cumulative returns assuming a 65/35 mix of stocks and bonds during and after the events.

Exhibit 21



In reviewing the most recent of these events, the Great Recession, VRS recorded the following rates of return for the five year period ending June 30, 2012.

Exhibit 22

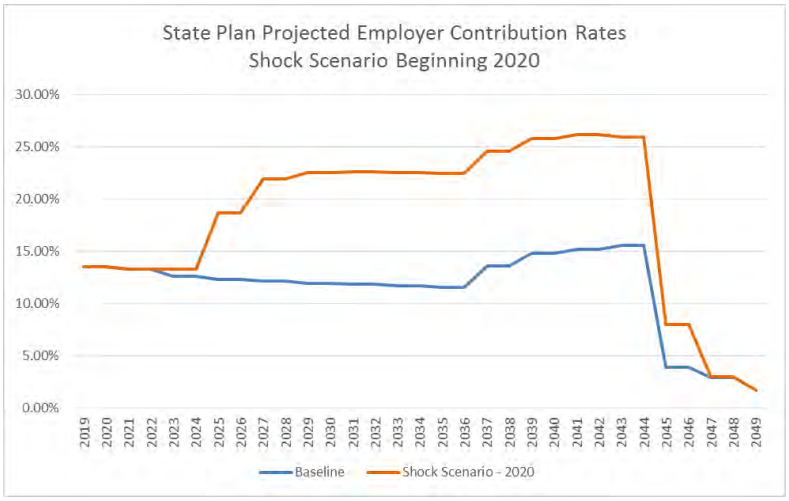
Shock Scenario - Great Recession

Returns During Event		Returns 3 Years After Event		
2008	2009	2010	2011	2012
-4.40%	-21.10%	14.10%	19.10%	1.14%

The following analysis shows that if a repeat of the five-year returns observed by the plan from fiscal year 2008 – 2012 were to occur beginning in fiscal year 2020, the State plan would be in a worse position to absorb the impacts of the investment losses than it was in 2009. The State plan would see an increase in unfunded liability of approximately $6.9 billion, peaking at $12.5 billion in 2026. Since actuarial losses are amortized over 20-year periods, the plan could see increased contribution rates out through 2047. Exhibit 23 shows that employer rates could increase to over 22% of covered payroll within a few years of the event. Because the statewide plans have not paid down the legacy unfunded liabilities, an

additional investment loss of the magnitude seen in fiscal years 2008 and 2009 would put the State plan in a worse position than seen in 2008 and 2009, with a potential funded status below 55% post event.

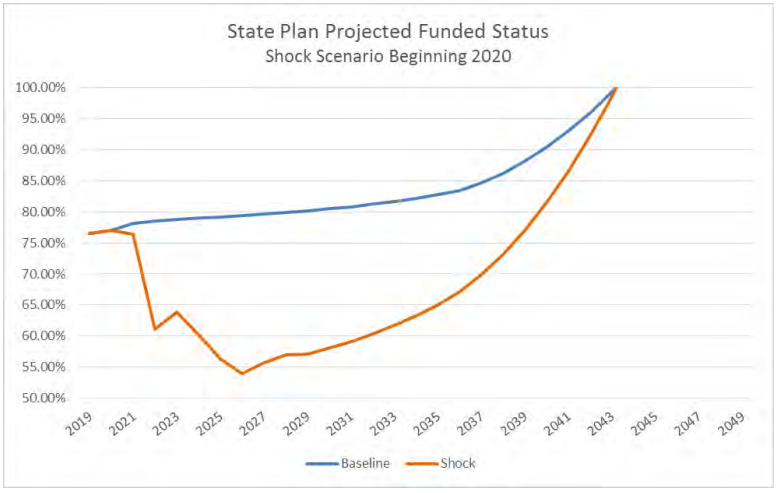
Exhibit 23



Results based on June 30, 2017 actuarial valuation

Exhibit 24 illustrates the impact on funded status of this shock scenario. The funded status would lose approximately 25% of its value during shock event.

Exhibit 24



Results based on June 30, 2017 actuarial valuation

Please note, the impact of a decline on the fund would also be different depending on the timing of the event. This is due to the fact that the State plan currently has an unfunded liability that makes up approximately two-thirds of the plan's contribution rate. Taking on another large unfunded liability prior to the legacy unfunded liability being paid off would cause rates to increase more sharply and for a longer period of time. If the shock scenario occurs closer to 2040, then the impacts would be similar to what occurred in 2008 and 2009, with funded status dropping to about 75% and employer contribution rates around 14% of covered payroll.

This result suggests that paying down unfunded liabilities on a more accelerated basis may help to cushion any potential uncertainty that may occur with future market returns.

Additional Risks to Long-Term Funding

In addition to investment return risk, below are a few other areas that VRS has identified as potential risks to plan funding levels.

Mortality /Longevity Risk

Mortality assumptions in use by public pension plans in the United States vary widely. The tables being used today by many public plans are based on mortality experience collected from the private sector. Recently, the Retirement Plans Experience Committee (RPEC) and the Society of Actuaries released an exposure draft of the Pub-2010 Public Retirement Plans Mortality Tables, which are based on a mortality study of public pension plan participants in the United States.

This is the first time the Society of Actuaries has released tables that are specifically based on public sector experience. While RPEC collected (and analyzed) the mortality data from a number of large public pension plans in the previous RP-2014 study, only the data collected on uninsured private plans were used in the development of the RP-2014 mortality tables.

In the study of public plan mortality experience, the RPEC found clear differences among three job categories that were studied individually, and published mortality tables accordingly: general employees, safety employees and teachers.

Preliminary analysis provided by the Society of Actuaries suggests that the new tables could increase liabilities for certain employer groups, particularly teachers. However, since VRS

generally incorporates actual plan experience from the plans' population, actual impacts may differ from observations provided by the Society of Actuaries (SOA), but an increase in liabilities with incorporation of new tables that generally reflect longer life expectancy appears probable. It should be noted that the Pub-2010 tables have not been formally adopted by the SOA as they have only been issued as an exposure draft as they look for comments through the end of October 2018.

Past updates to mortality tables have increased plan liabilities approximately 1% - 5% depending on the plan. Below are the estimated impacts on employer rates and funding requirements assuming a hypothetical 3% increase in liabilities due to future mortality improvements. However, actual impacts could vary based on final Pub-2010 tables and how they relate to actual VRS experience.

Exhibit 25

Estimated Impact of Mortality Improvements Assuming 3.0% Increase in Liabilities

($ Millions)

Plan	Estimated Increase in Employer Rate as Percent of Covered Payroll	Estimated Increase in Annual Funding		
		General Fund	Non-General Fund	Total
State	1.4%	$23.1	$31.9	$55.0
SPORS	2.3%	$2.2	$0.4	$2.5
VaLORS	1.1%	$3.4	$0.3	$3.7
JRS	2.3%	$1.5	$0.0	$1.5
Teachers	1.3%	$41.7	$62.6	$104.3
Total Statewide Plans		$72.0	$95.1	$167.0

Results based on June 30, 2017 actuarial valuation

Membership and Payroll Growth Risk

When the actuarial valuation is performed each year, it determines the funded status of the plan as of the valuation date and the contributions needed to fully fund the System. The contributions are expressed as a percentage of payroll consistent with the way contributions are collected each year.

FUTURE RISK ANALYSIS

One of the actuarial assumptions in the funding of the System is the assumed growth in payroll. The current payroll growth assumption adopted by the Board is 3% annually. This assumption assumes that the number of active members in the system will remain stable over time and that covered payroll will increase over time. The required rates for certain plans could be impacted if there is a material shift in active covered membership.

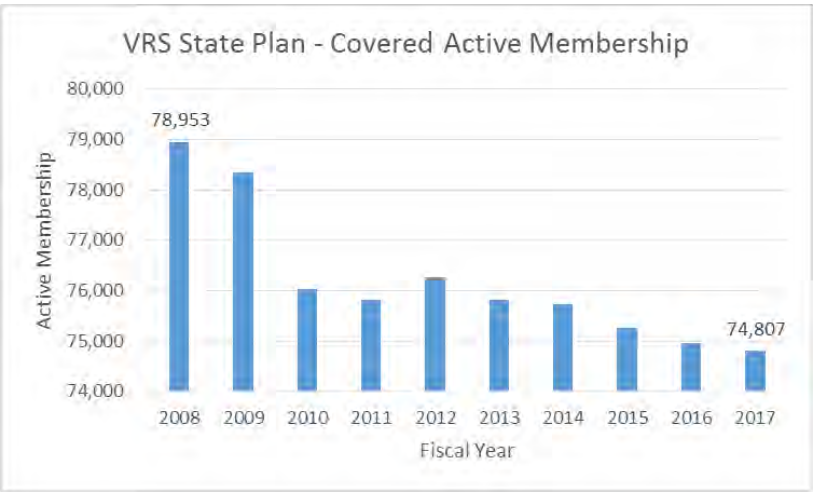
When the payroll of a plan's covered members declines, it requires increases in contribution rates to ensure full funding, even if the unfunded actuarial obligation has remained the same. Since contributions are collected as a percentage of payroll, the contribution rates have to increase in order to collect the same amount of funds required. There is a risk that declines in payroll could increase required rates to ensure full funding of the actuarially determined contribution.

VRS has observed decreasing trends in membership in a few of the statewide plans. This assumption was reviewed during the last experience study, but it was not clear at that time that this trend would remain intact and that payroll growth would not return to previously observed patterns.

Statewide plans with decreasing trends in membership

The VRS State plan had 78,953 active members as of June 30, 2008. Since that time, the plan has shown a fairly consistent decline in active membership, with 74,807 active members as of June 30, 2017 (Exhibit 26).

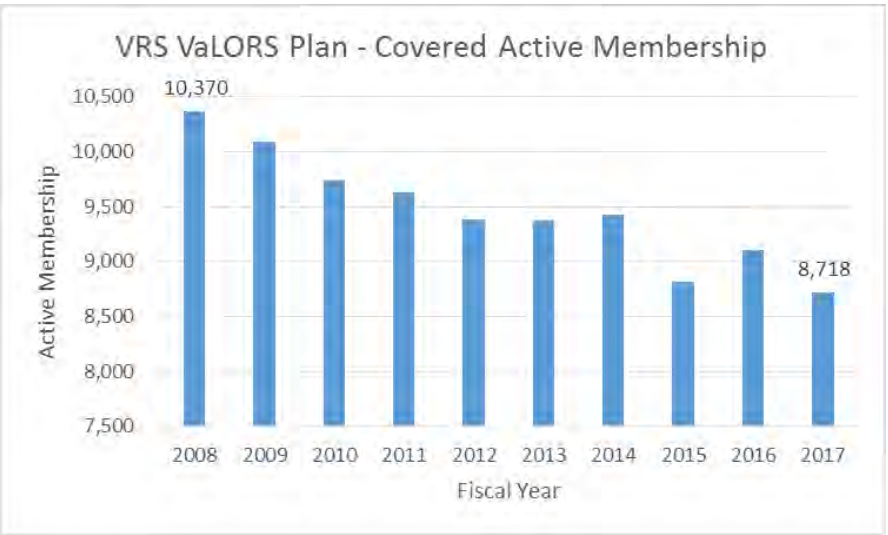
Exhibit 26



While the drop in membership cannot be attributed to any one employer, layoffs, reductions in force, and facility closures have contributed to the declining membership. In addition, higher education employers, which represent approximately 40% of the State plan membership, appear to be expanding the population of members eligible to make an election for coverage in the Optional Retirement Plan for Higher Education (ORPHE), which also contributes to the decline in State plan membership.

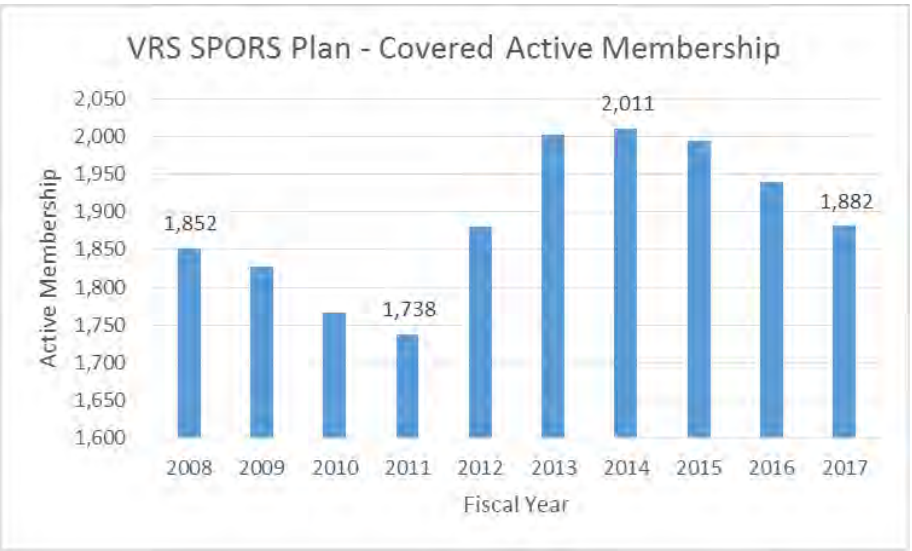
Similarly, the VaLORS plan has also seen a steady decline in membership from 10,370 in 2008 to 8,718 active members in 2017 (Exhibit 27). The VaLORS plan includes a large number of correctional officers, and much of the decline in membership can be attributed to the closing of facilities over the past several years.

Exhibit 27



Another plan that has shown changes in membership over this same time period is the SPORS plan. However, unlike the State and VaLORS plans, the covered payroll associated with the SPORS members has generally kept pace with current assumptions of the plan.

Exhibit 28



The funding for the VRS retirement plans is based on the premise that employers are ongoing entities and that active covered populations will remain relatively level over time. Therefore, a declining active membership can have a material impact on plan costs for a couple reasons:

1. For the State plan, new members generally are covered under the Hybrid Plan, which has a lower employer normal cost. Fewer new members entering the Hybrid Plan could slow the expected decrease in employer normal cost.
2. Since unfunded liabilities are amortized assuming that the payroll of the plan will grow in the future, decreasing headcounts could cause the covered payroll to lag behind assumed projected levels, causing unfunded amortization rates to grow rather than remain stable.

Exhibit 29 shows how the State plan covered payroll has lagged behind expected increases and caused the unfunded amortization rate to increase to compensate for the lower payroll over which to spread costs.

Exhibit 29

Results based on June 30, 2017 actuarial valuation

Exhibit 30 shows how the lagging payroll growth has increased the legacy unfunded liability payment as a percent of payroll since it was established 2013. VRS would expect that the legacy unfunded payment as a percent of covered payroll would remain at 10.52% each year. What we have observed is that the legacy unfunded amortization payment has increased to 10.89% of payroll over the last four years.

Exhibit 30

State Plan Legacy Unfunded Liability Payment as Percent of Covered Payroll

	2013	2015	2017
Legacy Amortization Payment	$390,645,428	$414,435,735	$439,674,871
Expected Covered Payroll	$3,712,665,300	$3,938,766,600	$4,178,637,500
Expected Amortization Payment as Percent of Payroll	10.52%	10.52%	10.52%
Actual Covered Payroll	$3,712,665,300	$3,872,749,000	$4,037,109,400
Amortization Payment as Percent of Payroll	10.52%	10.70%	10.89%
Increase in Amortization Rate Due to Lagging Payroll		0.18%	0.37%

Potential Strategies to Enhance Funding

Shorten Period for Amortization of Legacy Unfunded Liability

Although the current funding policy puts the plans on a path to full funding, it is important to understand how the legacy unfunded liability is being amortized and how it is expected to change over time.

As discussed above, to keep plan costs level over time, unfunded liabilities are generally amortized using a "level percentage of payroll" method. This method takes into account that payroll will increase over time due to both inflation and merit increases, so it aims to collect roughly the same percentage of payroll each year, which should inherently collect larger dollars in later years as payrolls increase. This is essentially a "back-loaded" funding method. This is a common method for funding of public sector plans, though some plans opt to use revenue growth rather than growth of payroll as the basis for the growth rate. The alternative would be to amortize unfunded liabilities as a "level dollar" amount, which would collect the same cash contribution each year similar to a home mortgage. This generally causes "front-loading" of contributions by paying a higher percentage of contributions as a percent of payroll early in the amortization period and a smaller percentage towards the end of the amortization period.

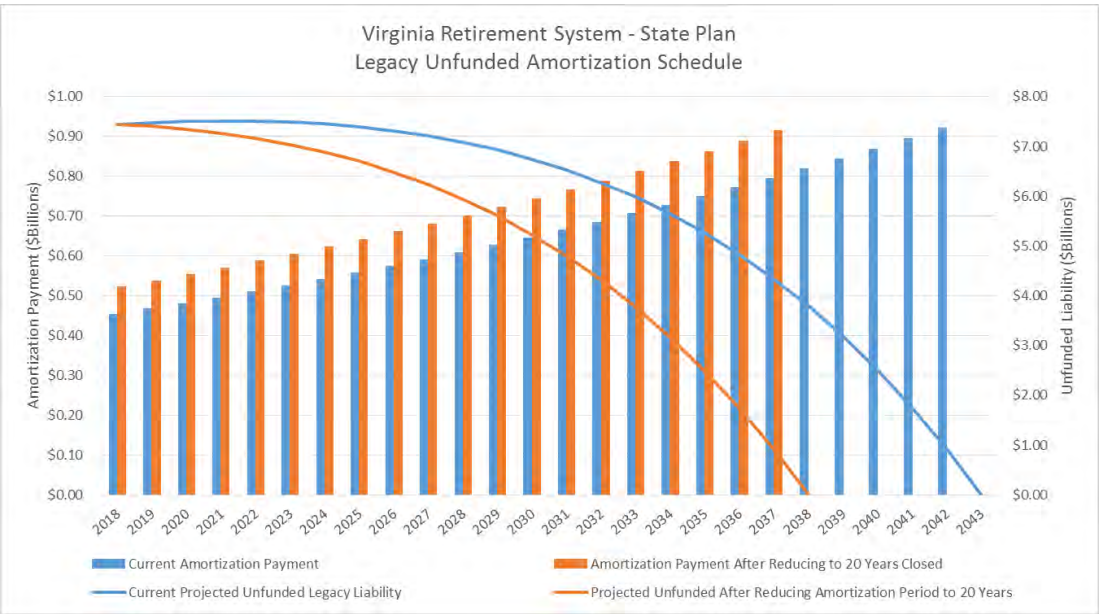
In 2013 when VRS changed its funding policy, one of the changes was to use closed amortization periods to pay down unfunded liabilities. It was decided that all future gains and losses would be amortized over 20-year closed periods. This method would avoid "negative amortization" and also pay down losses more closely related to the working lifetime of members rather than pushing costs beyond their working career. Negative amortization occurs when the amortization payment is set too low to cover the interest payment on the outstanding balance, which results is an increase in the principal balance of the loss.

The legacy unfunded liability established as of 2013 was amortized over a 30-year closed period. This was done in an effort to moderate employer rates, which at the time were not being fully funded by the Governor and General Assembly. Using a shorter amortization period would have increased rates even more steeply than the move to the closed amortization period. One issue with amortizing unfunded liabilities over longer periods of time—such as 30 years—is that during the first nine or 10 years, the interest payments on

the unfunded liability will be in excess of the amortization payment, which creates "negative amortization," so the outstanding balance actually increases during the first eight or nine years of amortization as payments go toward interest rather than principal.

As of June 30, 2018, the State plan legacy unfunded liability has 25 years of the original 30 years remaining to be paid with an outstanding balance of $7.4 billion. Under the current amortization schedule, $9.1 billion of interest will be paid over the next 25 years on the $7.4 billion outstanding balance. As shown in Exhibit 31, adjusting the remaining period for the legacy unfunded liability down to 20 years would avoid any additional negative amortization and save the State $2.5 billion in interest payments. The shorter amortization period would increase employer rates by approximately 1.7% of covered payroll each year of the amortization period.

Exhibit 31



Results based on June 30, 2017 actuarial valuation

Maintain Current Contribution Rates

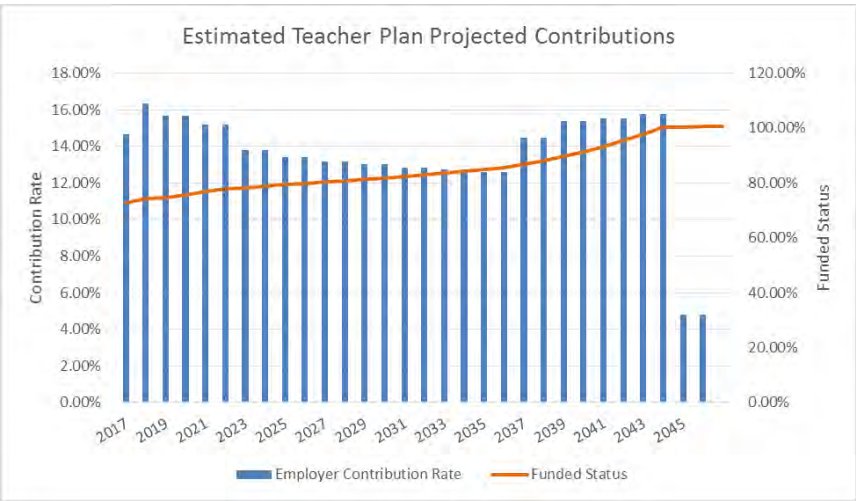
Maintaining current contribution levels following years in which the plan experiences actuarial gains could help create a cushion against future actuarial losses while improving the plan funded status. This strategy could require adjustments to the plan's funding policy

to broaden the context of the contribution requirement, as well as review of the Office of Management and Budget's regulations and guidance surrounding the use of federal grant monies on annual pension contributions.

The exhibits below show the potential impact of maintaining higher plan funding rates for the Teacher plan if the current 15.68% rate that has been budgeted is maintained rather than reducing the rate in future years following good experience.

Exhibit 32 shows that if the Teacher plan achieves the assumed 7% investment return going forward that plan rates are expected to drop from the current 15.68% down to 12.61% in 2036 before increasing in 2037 due to prior gains being fully amortized.

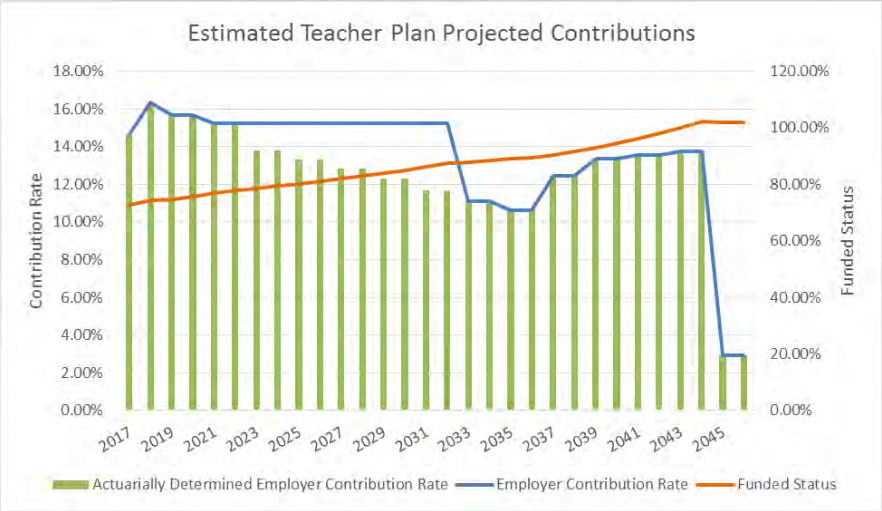
Exhibit 32



Results based on June 30, 2017 actuarial valuation

If rather than reducing the contributions in future budgets, the General Assembly maintained the 15.68% rate through 2032, Exhibit 33 shows that not only would this lower future actuarially determined contribution rates, but it would also get the plan to full funding at the same time and save approximately $1.3 billion in contributions over the next 25 years by reducing contribution requirements in later years.

Exhibit 33



Results based on June 30, 2017 actuarial valuation

FINDINGS AND CONCLUSIONS

Over the last fiscal year, financial markets have provided better than assumed returns, positively impacting projected funding levels and contribution rates. The plans continue to show improvement in funded status and contribution rates have been trending slightly lower. However, the potential exists for future volatility due largely to changing markets and demographic experience.

Opportunities exist to proactively address some of these concerns and to better position the retirement plans to provide the financial stability for current and future members of VRS. Accelerating payback of the legacy unfunded liability has the potential to save billions in future employer contributions while enhancing the funded status of the retirement plans. This could be achieved by:

- Reducing amortization periods for remaining legacy unfunded payments.
- Maintaining current employer contribution rates when positive experience would otherwise allow for a reduction in employer rates.
- Adjusting methodology used to amortize unfunded liabilities.
- Considering making lump sum contributions such as those used to pay down of 2010-2012 deferred contributions for State and Teacher plans.
- Avoiding the expansion of benefits while plans remain underfunded.

APPENDIX

§ 51.1-124.30:1. Adoption of stress testing and reporting policies.

The Virginia Retirement System (VRS) shall adopt a formal policy to:

1. Develop and regularly report sensitivity and stress test analyses. Such analyses and reporting shall include projections of benefit levels, pension costs, liabilities, and debt reduction under various economic and investment scenarios;

2. Improve investment transparency and reporting policy by (i) providing a clear and detailed online statement of investment policy; (ii) including one-year, three-year, five-year, and 10-year investment performance data in quarterly investment reports; (iii) including 20-year and 25-year investment performance data in annual investment reports; (iv) reporting net investment returns on a quarterly basis; and (v) reporting gross investment returns and returns by asset class on an annual basis; and

3. Regularly report investment performance and expenses such as external manager fees, carried interest fees, and investment department expenses for all asset classes, including private equity, public equity, fixed income, credit strategies, real assets, strategic opportunities, and other investments.

2017, c. 639.