



VRS Stress Test and Sensitivity Analysis

Report to the General Assembly of Virginia

TABLE OF CONTENTS

Contents

| | |
|--|----|
| Stress Test and Sensitivity Analysis Mandate | 1 |
| Executive Summary | 2 |
| Future Risk Analysis | 4 |
| Findings and Conclusions | 42 |
| Appendix | 46 |

STRESS TEST AND SENSITIVITY ANALYSIS 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 VRS examines 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 of Trustees, the Virginia General Assembly, the Governor, stakeholders, and the public to better understand and assess the risks inherent in the funding of the pension system. This year's report investigates various possible risks faced by VRS and measures their potential impact on the defined benefit programs.

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:

- COVID-19 creates uncertainty in global markets and unpredictable impacts to future market returns.
- Significant resources must remain dedicated to addressing the amortization of the legacy unfunded liabilities.
- 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. However, available resources to take such action are limited at this time due to the current economic climate and uncertainty regarding revenue.
- Adjustments to mortality assumptions are expected in spring of 2021 as part of the next quadrennial plan experience study. New tables suggest additional improvements in mortality are likely, which could increase plan liabilities in coming years. However, as a matter of course VRS has routinely adjusted its mortality assumptions to reflect actual plan experience. Therefore, the impact of the new mortality tables may be muted by VRS' long-standing demographic assumption review, analysis, and adjustments conducted to more closely align assumptions and tables with actual plan experience. In addition, COVID-19 may affect longevity expectations, but it is too early to have any relevant data related to these potential impacts.
- 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

EXECUTIVE SUMMARY

advantage of compound interest. The Governor and General Assembly met and even accelerated the statutory requirement to fund 100% of the Board-certified contribution rates.

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

This report is intended to assist policymakers and stakeholders in assessing the soundness 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. Again, this report focuses primarily on analyzing negative outcomes, since such outcomes would result in the greatest challenges for the plan sponsors and System.

This report is based on the June 30, 2019 Annual Actuarial 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 change in plan discount rate adopted in October 2019. In this report, the focus is on:

- The impacts of COVID-19 and resulting forward looking expectations.
- Risks to long-term funding, including investment volatility, contribution risk, and longevity risk.

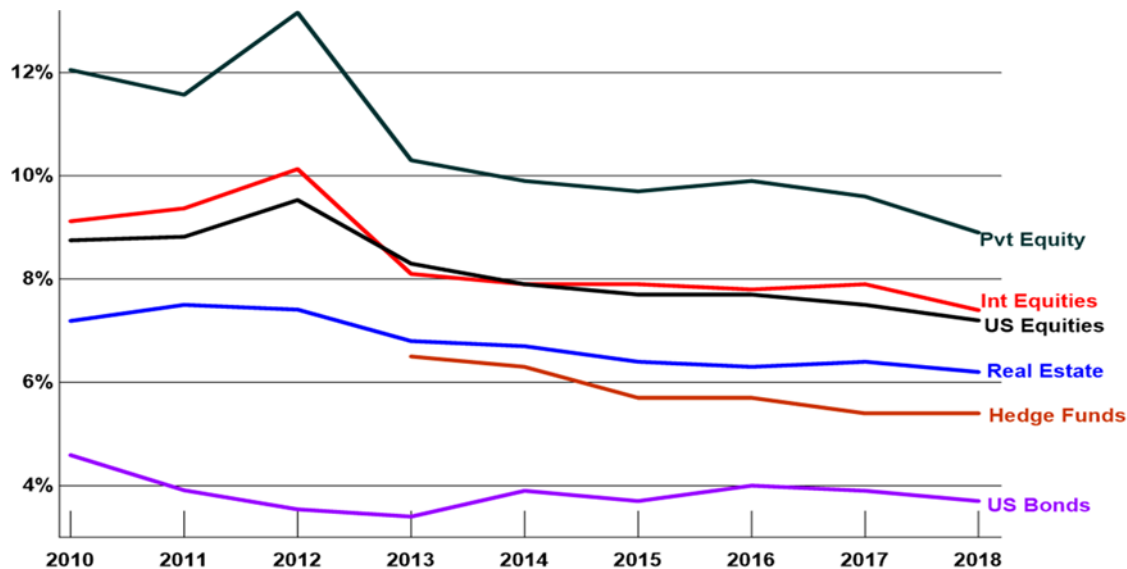
Investment Rate of Return Assumption

Pension plans are generally pre-funded, meaning money is invested during a member's career so that by the time they retire adequate funds will exist to pay benefits for the member while they are retired. Investment earnings on plan contributions currently account for nearly two-thirds of pension funding. The discount rate, the rate used to determine the present value of a future benefit payments, influences the level of contributions required, assuming they will generate investment income throughout a member's career and into retirement. VRS uses the long-term rate of return as the plan discount rate and these terms are used interchangeably in this report.

The discount rate assumption is one of the most influential and sensitive assumptions used in determining the liability of the plan benefits. Market conditions, including the continued low interest rate environment, have resulted in public pension funds reviewing their expected long-term rate of return with many plans lowering future expectations. One challenging facet of setting the investment return assumption that has emerged more recently is a divergence between expected returns over the near term, i.e., the next five to 10 years, and over the longer term, i.e., 20 to 30 years. A growing number of market outlooks are concluding that near-term returns may be materially lower than both historic norms as well as projected returns over longer timeframes. Exhibit 1 shows public pension plan market return expectations have generally declined over time for various asset classes.

FUTURE RISK ANALYSIS

Exhibit 1



Horizon Actuarial Services

NASRA: Public Pension Funding Overview – Aug. 2019

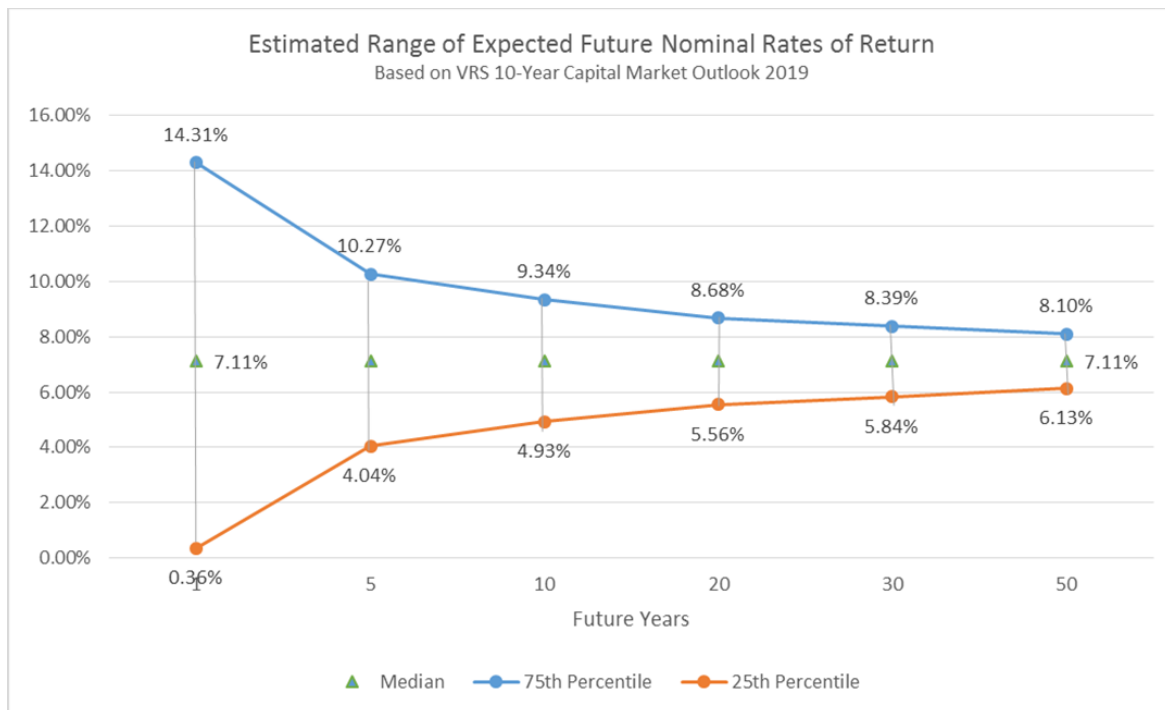
The discount rate reflects expectations of what investment earnings the markets will deliver in the future, and it is calculated based on two components: expected price inflation and real rate of return. A change in either of those components over the long term would necessitate further evaluation of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

Fund long-term health requires careful management and decision making for the asset allocation needed to fund members' pensions and Other Post-Employment Benefits (OPEBS), such as group life insurance and the health insurance credit, over the long term. The VRS Board of Trustees conducted an Asset Liability Study during 2019 to ensure responsible investment practices and strategies are being used in recommending and deploying investment allocations. As shown in Exhibit 2, using the plan's 2.5% assumed rate of inflation and the 10-year forward looking capital market estimates and policy investment targets provided by the VRS investment staff, a statistical analysis of the reasonable range for the plan's assumed investment rate of return provided an expected median nominal rate of return of 7.11%, with a reasonable range of 6.13% to 8.10%, representing the 25th and 75th percentiles, respectively. The nominal rate of return is the

FUTURE RISK ANALYSIS

total rate of return earned on an investment before adjusting for any deductions and premiums, such as investment fees, trading costs, tax expenses, and inflation.

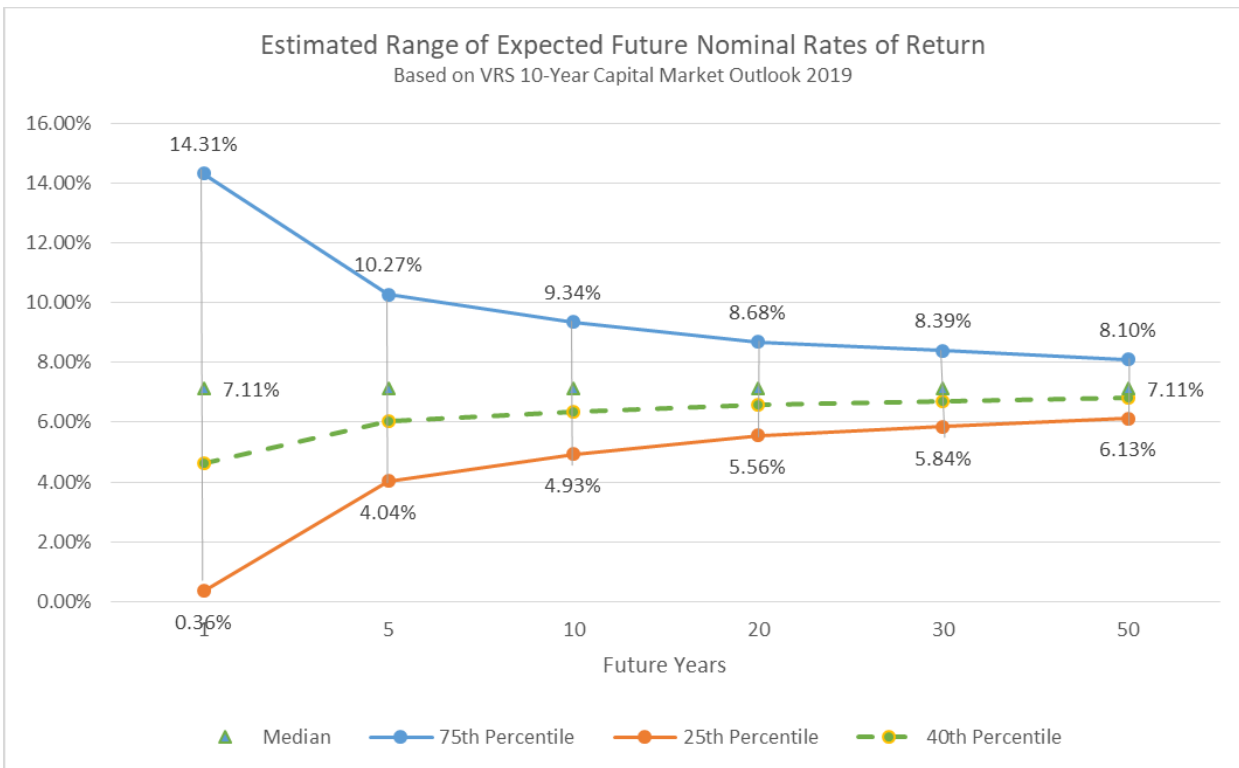
Exhibit 2



Long-term practice has been to set the investment rate of return expectation at the median assumed rate, but there are reasons to alter past practice. Due to the divergence between expected returns over the near-term, i.e., the next five to 10 years, and over the longer term, i.e., 20 to 30 years, reflecting a blended discount rate to incorporate near-term uncertainty in the markets would require selecting a discount rate below the median expected long-term rate. As displayed in Exhibit 3, while the median return of 7.11% is expected to be achieved 50% of the time, selecting a discount rate of 6.75% would move the assumption closer to the 40th percentile, providing approximately a 60% chance of achieving the long-term rate of return over time.

FUTURE RISK ANALYSIS

Exhibit 3



In effect, the downside tail risk (i.e., the chance of a loss occurring due to a rare event, as predicted by a probability distribution) is mitigated by selecting a rate at the 40th percentile rather than the median.

Impact of Lowering Plan Discount Rate

Exhibit 4 provides the additional unfunded liabilities that were associated with the Board's October 2019 decision to lower the plan discount rate from 7.00% to 6.75%, effective with the June 30, 2019 actuarial valuations. As shown in Exhibit 4, before the change in discount rate and using a 7.00% discount rate, the State plan's unfunded liabilities were \$5.79 billion. Using a using the current discount rate of 6.75%, the State plan's unfunded liabilities are \$6.47 billion or an increase of \$0.68 billion. Across all plans, the increase in unfunded liabilities as a result of the change in discount rate was \$2.99 billion.

FUTURE RISK ANALYSIS

Exhibit 4

(\$Billions)

| Unfunded Liability Using Actuarial Value of Assets as of June 30, 2019 | | | |
|---|-----------------------------------|----------------------------------|--------------------------------------|
| Plan | Before Change in Discount Rate | After Change in Discount Rate | Increase in Unfunded Liability |
| State | \$5.79 | \$6.47 | \$0.68 |
| Teachers | \$11.60 | \$13.07 | \$1.47 |
| SPORS | \$0.29 | \$0.32 | \$0.03 |
| ValORS | \$0.66 | \$0.73 | \$0.07 |
| JRS | \$0.10 | \$0.12 | \$0.02 |
| Local Plans in Aggregate | \$2.64 | \$3.36 | \$0.72 |
| Total Retirement Plans | \$21.08 | \$24.07 | \$2.99 |

Exhibit 5 provides the estimated additional funding required in fiscal year 2021 associated with lowering the plan discount rate to 6.75%. A 25 basis point reduction in plan discount rate equates to an approximately 10% increase in employer contribution rates. This in turn increases expected funding for statewide plans by nearly \$209 million each year.

Exhibit 5

Impact on FY 2021 Funding of 25 Basis Point Reduction in Long-Term Rate of Return

(\$Millions)

| Increase in Funding Due to Lowering Discount Rate 25 Basis Points | | | | | |
|---|--|---|---------------------|--------------|------------------|
| Plan | Employer Contribution Rate Before Change in Discount Rate | Employer Contribution Rate After Change in Discount Rate | Increase in Funding | General Fund | Non-General Fund |
| State | 13.12% | 14.46% | \$58.6 | \$22.6 | \$36.0 |
| Teachers | 15.00% | 16.62% | \$139.5 | \$55.8 | \$83.7 |
| SPORS | 23.88% | 26.26% | \$3.1 | \$2.7 | \$0.4 |
| ValORS | 20.19% | 21.88% | \$6.2 | \$5.7 | \$0.6 |
| JRS | 27.76% | 29.84% | \$1.6 | \$1.6 | \$0.0 |
| Local Plans in Aggregate | 6.96% | 8.33% | \$72.0 | \$0.0 | \$72.0 |
| Total Retirement Plans | | | \$281.1 | \$88.4 | \$192.7 |

Results based on June 30, 2019 actuarial valuation

FUTURE RISK ANALYSIS

Analysis of Discount Rate Sensitivity

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 4.75% to 8.75% 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 6 and 7 illustrate how various assumed annual rates of return would affect pension contribution rates for the State and Teacher plans had they been applied to the June 30, 2019 valuation. A lower assumed annual rate of return requires higher contribution rates from employers. A higher assumed annual rate of return requires lower employer contribution rates. Although the assumed rate of return dictates how contribution rates are calculated in the short term, the actual investment returns will determine what portion of pension costs must be covered by contributions in the long term.

FUTURE RISK ANALYSIS

Exhibit 6 – State Plan

(\$Thousands)

| Discount Rate | 8.75% | 7.75% | Current 6.75% | 5.75% | 4.75% |
|------------------------------------|-----------|-----------|---------------|-----------|------------|
| Total Normal Cost Rate | 6.45% | 7.70% | 9.39% | 11.68% | 14.83% |
| Member Contribution Rate | 4.60% | 4.60% | 4.60% | 4.60% | 4.60% |
| Employer Normal Cost Rate | 1.85% | 3.10% | 4.79% | 7.08% | 10.23% |
| Administrative Expense Load | 0.29% | 0.29% | 0.29% | 0.29% | 0.29% |
| Total Employer Normal Cost Rate | 2.14% | 3.39% | 5.08% | 7.37% | 10.52% |
| Total Amortization Rate | 1.76% | 5.14% | 8.59% | 12.13% | 15.74% |
| Defined Contribution Hybrid Plan | 0.79% | 0.79% | 0.79% | 0.79% | 0.79% |
| Total Employer Rate | 4.69% | 9.32% | 14.46% | 20.29% | 27.05% |
| Change in Employer Rate | (9.77)% | (5.14)% | 0.00% | 5.83% | 12.59% |
| Estimated Change in Annual Funding | (427,443) | (224,878) | | 255,066 | 550,820 |
| Unfunded Liability | 1,816,410 | 3,945,510 | 6,466,084 | 9,465,033 | 13,044,464 |
| Funded Status | 91.2% | 82.8% | 74.5% | 66.7% | 59.2% |

Results based on June 30, 2019 actuarial valuation and represent employer contribution rates that would be effective with the 2021/2022 fiscal years.

Exhibit 7 – Teacher Plan

(\$Thousands)

| Discount Rate | 8.75% | 7.75% | Current 6.75% | 5.75% | 4.75% |
|------------------------------------|-----------|-----------|---------------|------------|------------|
| Total Normal Cost Rate | 7.03% | 8.73% | 11.01% | 14.08% | 18.25% |
| Member Contribution Rate | 4.68% | 4.68% | 4.68% | 4.68% | 4.68% |
| Employer Normal Cost Rate | 2.35% | 4.05% | 6.33% | 9.40% | 13.57% |
| Administrative Expense Load | 0.27% | 0.27% | 0.27% | 0.27% | 0.27% |
| Total Employer Normal Cost Rate | 2.62% | 4.32% | 6.60% | 9.67% | 13.84% |
| Total Amortization Rate | 1.80% | 5.56% | 9.46% | 13.52% | 17.79% |
| Defined Contribution Hybrid Plan | 0.56% | 0.56% | 0.56% | 0.56% | 0.56% |
| Total Employer Rate | 4.98% | 10.44% | 16.62% | 23.75% | 32.19% |
| Change in Employer Rate | (11.64)% | (6.18)% | 0.00% | 7.13 % | 15.57 % |
| Estimated Change in Annual Funding | (955,659) | (507,386) | | 585,382 | 1,278,317 |
| Unfunded Liability | 3,011,919 | 7,582,426 | 13,070,163 | 19,711,183 | 27,812,775 |
| Funded Status | 92.3% | 82.7% | 73.5% | 64.8% | 56.6% |

Results based on June 30, 2019 actuarial valuation and represent employer contribution rates that would be effective with the 2021/2022 fiscal years.

FUTURE RISK ANALYSIS

INVESTMENT RISK

Possible Future Outcomes

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 expectations, the unfunded actuarial accrued liability increases and additional contributions are needed, which historically have been funded by employers.

Projecting future outcomes can be done under two sets of analyses, deterministic or stochastic.

Deterministic analysis assumes full certainty about future outcomes, particularly with future plan experience and assumptions including investment returns. The deterministic approach is useful for gauging the general direction of change and associated consequences, and is useful when trying to assess best case or worst case scenarios, or isolating the impacts of a single assumption such as lowering the plan discount rate.

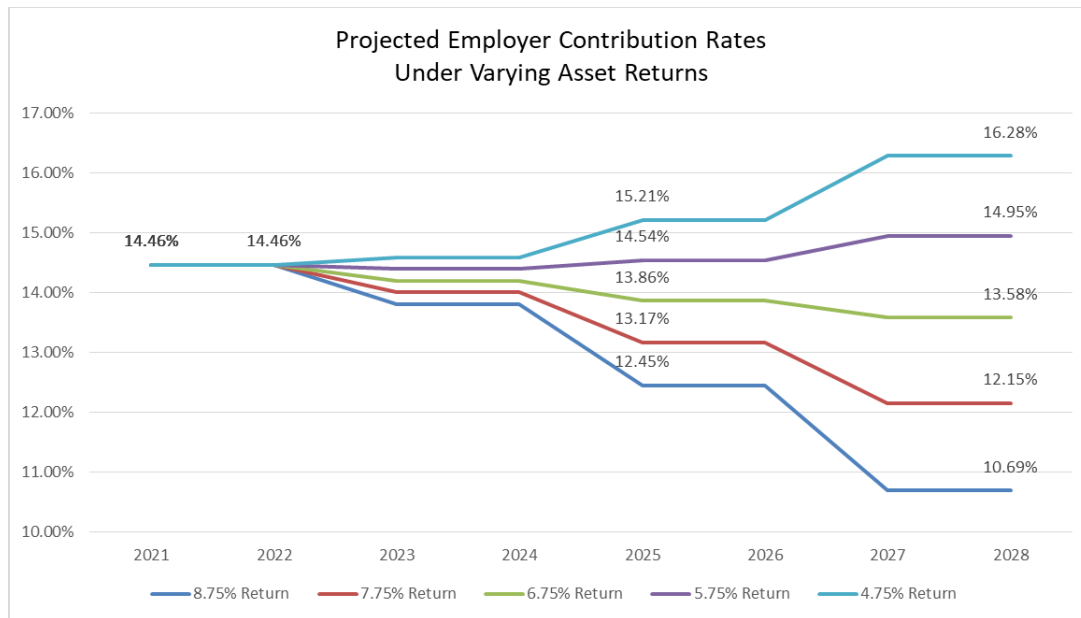
Stochastic analysis reflects the realistic view that pension plan investment returns, like the market itself, may be volatile and uncertain. Rather than using exact assumptions, the model uses probability distributions to provide a range of possible results based on these probabilities. The projections are intended to present general contribution rate trends under varying economic scenarios and helps to quantify the likelihood and magnitude of possible future outcomes.

Exhibit 8 below is a deterministic projection that provides a range of expected employer contribution rates under varying expected rates of return from 4.75% - 8.75% over the next eight years. If the fund actually earned 5.75% each year for the next five years, employer contribution rates for the State plan would increase from 14.46% to 14.95% beginning in 2027. Conversely, if the fund earned 7.75% each of the next five years, employer contribution rates would decrease from 14.46% to 12.15% beginning in 2027.

If all assumptions are met, employer rates are inherently expected to trend lower in the future due to blending in the lower cost hybrid plan as new members are enrolled into the plan. This can be seen most clearly in the 6.75% return scenario in Exhibit 8 below which assumes no additional investment gains or losses over the projection period but shows that the contribution rate trends downward.

FUTURE RISK ANALYSIS

Exhibit 8 - State Plan



Results based on June 30, 2019 actuarial valuation

Exhibit 9 shows probabilistic or stochastic projections of future investment returns and the impact on future contribution rates for the State plan. Based on VRS's capital market outlook and projected asset allocation, the median employer contribution rate is expected to be slightly less than the baseline employer contribution rates, which assume a constant 6.75% rate of return, since VRS's assumed rate of return was set closer to the 40th percentile returns rather than the median during the Asset Liability Study in 2019. There is a 50% probability that employer rates will be between 9.29% and 16.90% by FY 2028 with an expected employer rate of 13.22%.

FUTURE RISK ANALYSIS

Exhibit 9

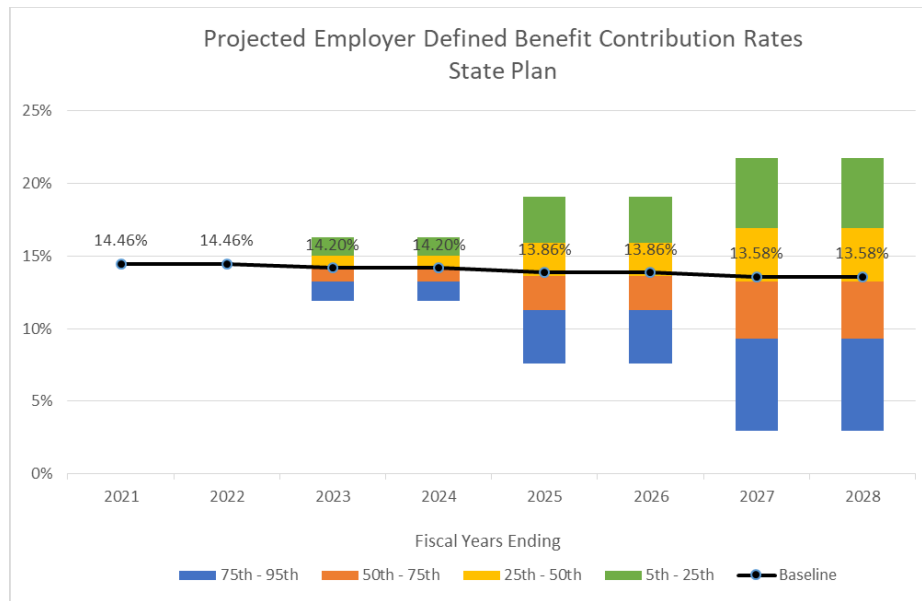
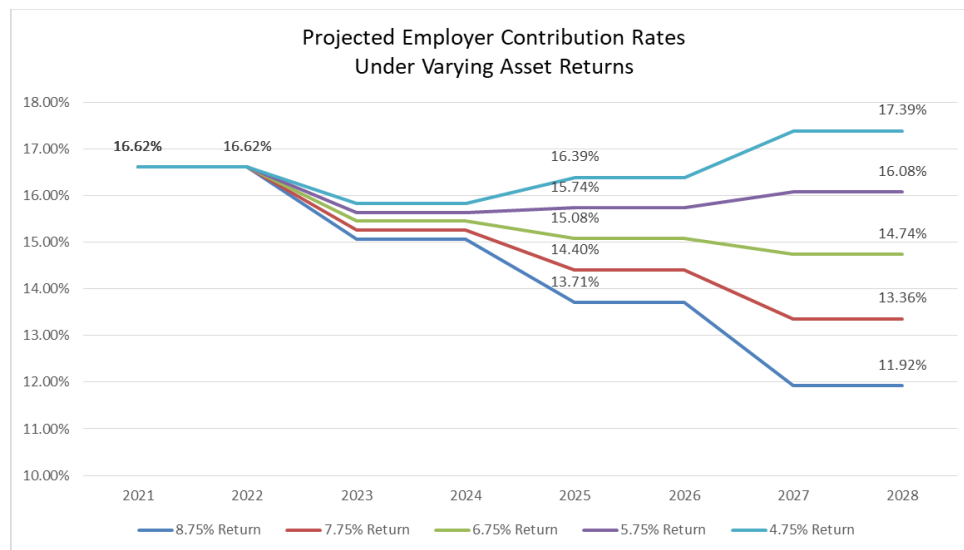


Exhibit 10 provides similar deterministic analysis for the Teacher plan. The significant drop in rates in FY 2023 for the Teacher plans is due to the 10-year deferred contributions from the 2010-2012 biennium being paid off, which subsequently lowers rates by approximately 0.70% of covered payroll.

FUTURE RISK ANALYSIS

Exhibit 10 – Teacher Plan

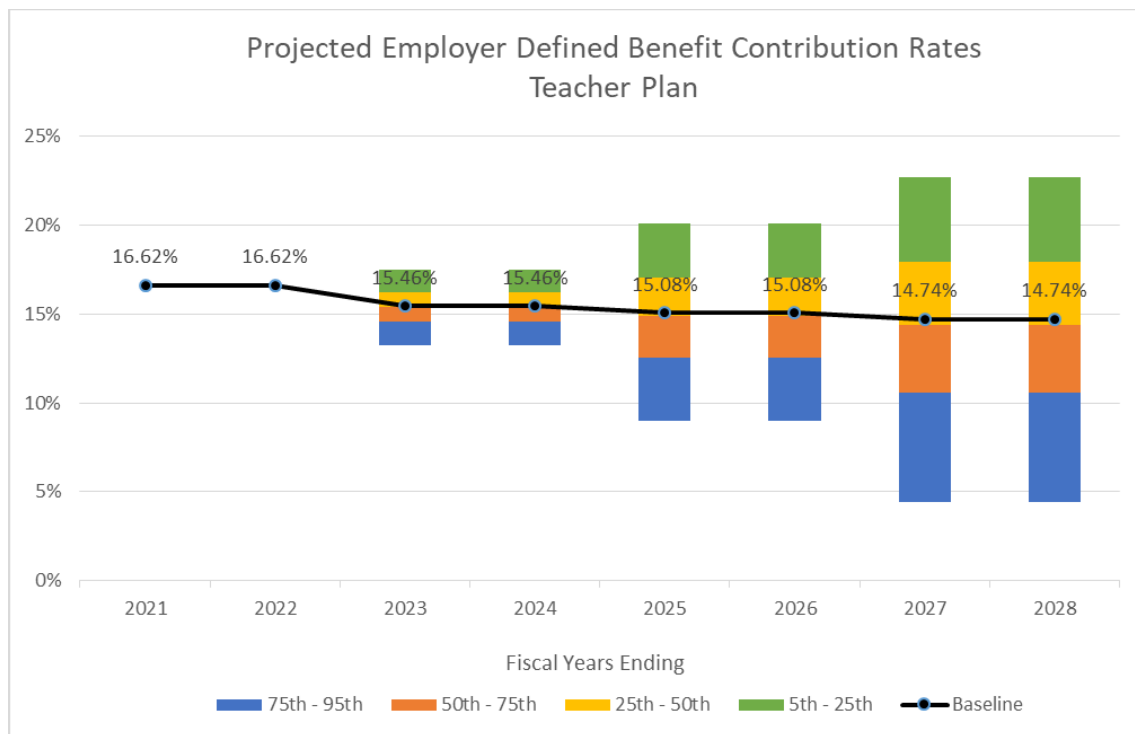


Results based on June 30, 2019 actuarial valuation

Exhibit 11 shows the probabilistic or stochastic projections of future investment returns and the impact on future contribution rates for the Teacher plan. There is a 50% probability that employer rates will be between 10.58% and 17.95% by FY 2028, with an expected contribution rate of 14.40%.

FUTURE RISK ANALYSIS

Exhibit 11



Impacts of COVID-19 (Unexpected or Unpredictable Economic Event)

We are in the midst of an economic crisis caused by the Novel Coronavirus (COVID-19). The virulent novel coronavirus emerged in China in November 2019, and in just a few months advanced across the planet. To reduce the spread of the virus, people around the world have isolated in their homes and businesses temporarily closed or in some cases shut down.

Unlike other economic recessions, there is no particular fiscal policy or business error behind this decline. It was brought on by the pandemic and the consequences and likely future path of the economy will depend very much on how the pandemic evolves.

These are truly unprecedented events which make it difficult to precisely model projections or predictions. Therefore, we cannot stress enough the degree of uncertainty surrounding these simulations and recovery scenarios.

FUTURE RISK ANALYSIS

At the start of the year, most investors expected the 11-year bull market to continue in 2020, only to see it shockingly interrupted by the spread of COVID-19. As a result, the markets fell from record highs into bear-market territory in a matter of weeks. As of this writing there are simply too many unknowns surrounding COVID-19 to accurately predict the economic impact.

Adjusted Baseline

Through mid-May 2020 the VRS fund return for fiscal year 2020 was approximately 0.0%. For the purposes of scenario testing we adjusted our baseline results assuming the fund would maintain the 0.0% return for the fiscal year ending June 30, 2020. Ultimately, actual returns may vary from this point in time estimate used in these illustrative examples. Exhibits 12 and 13 provide estimates of how a 0.0% return for fiscal year 2020 impacts future employer contribution rates over the next six years for the State and Teacher plans. Note that due to asset smoothing, the impacts of a single year event are recognized over a five-year period. Therefore the employer contribution rate will gradually rise over the next three rate-setting cycles to account for the new unfunded liability created by fund returns being below the assumed rate of 6.75%. Any subsequent returns over 6.75% will help moderate or offset the impact of this one year event.

The one-year asset loss of 6.75% for fiscal year ending 2020 is estimated to increase State employer contribution rates for fiscal year 2023 by 0.92% of covered payroll, from an estimated 14.20% to 15.12%. Similarly, the Teacher rate is estimated to increase 0.89%, from an estimated 15.46% to 16.35%.

FUTURE RISK ANALYSIS

Exhibit 12 – State Adjusted Baseline (0.0% Fund Return FY 2020)

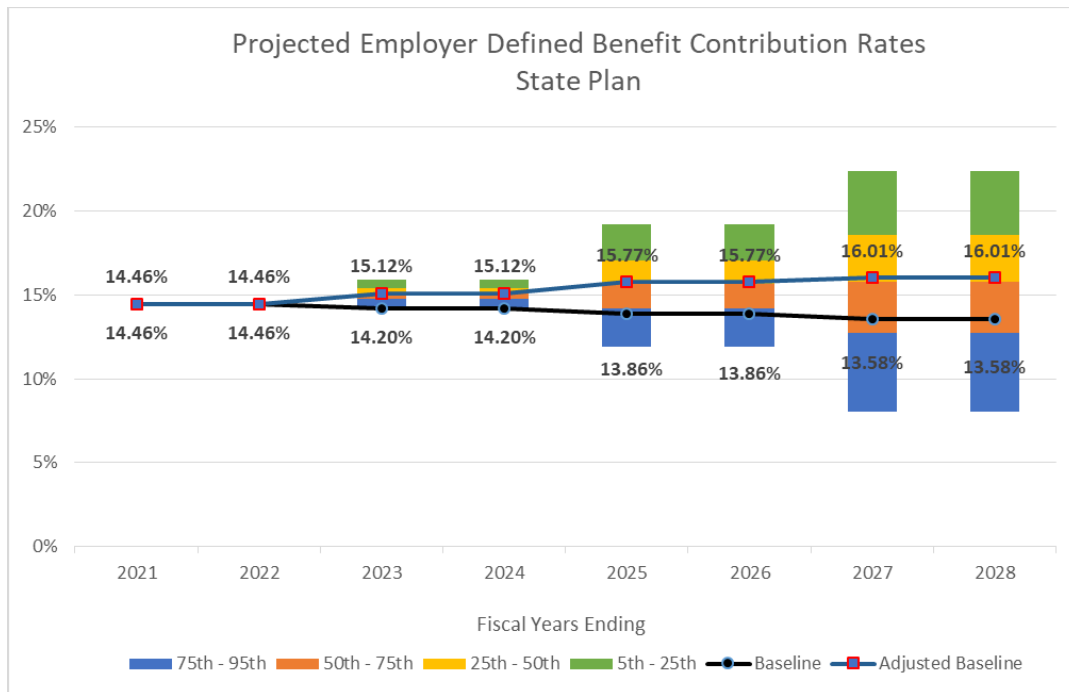
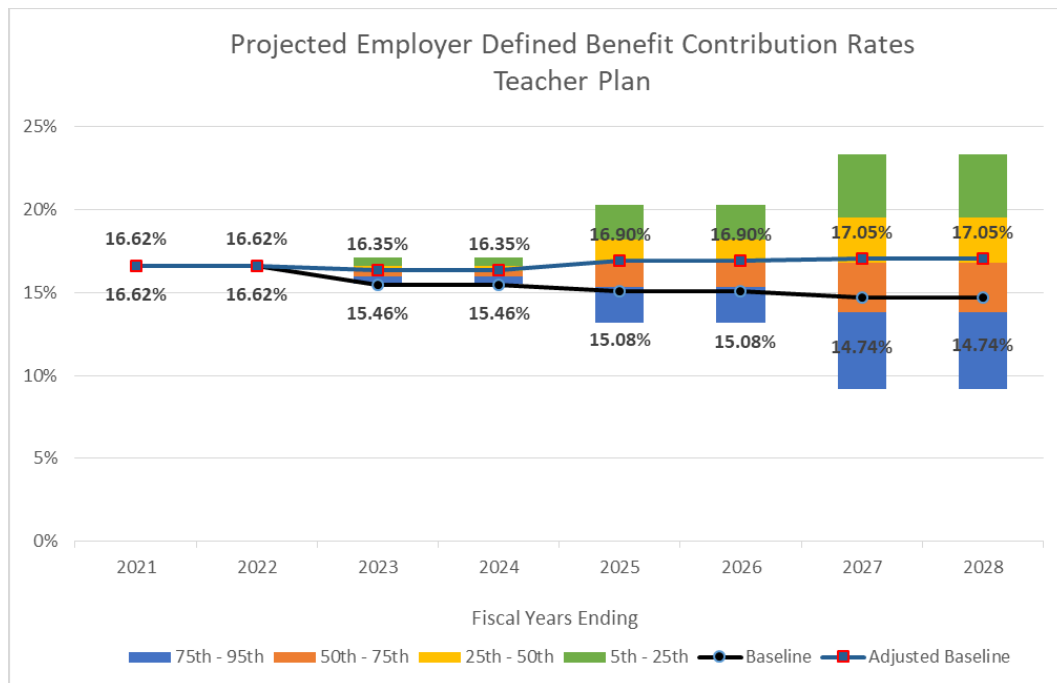


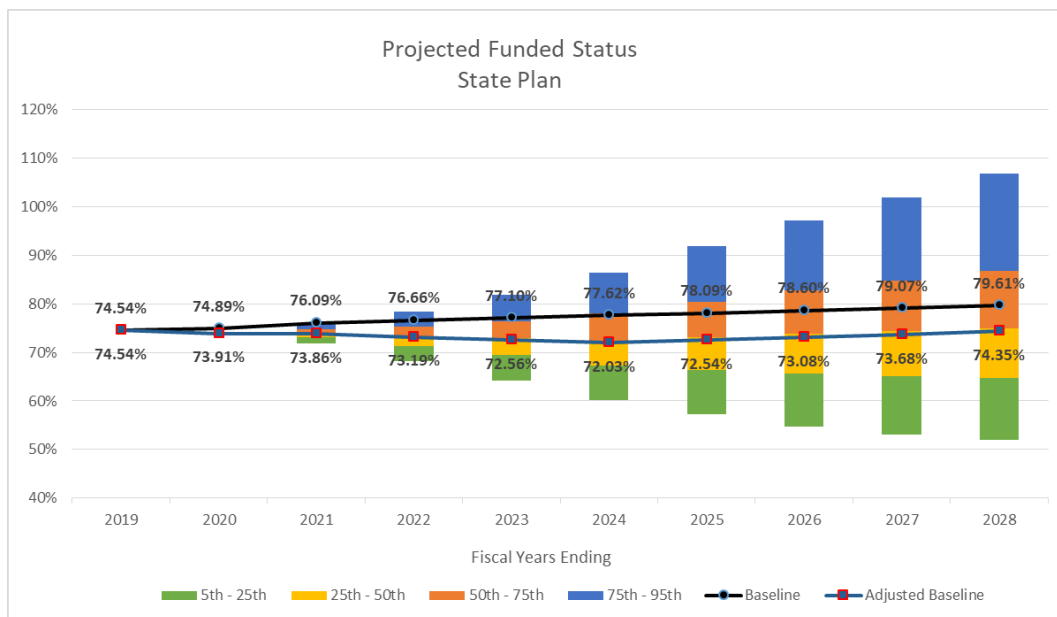
Exhibit 13 – Teacher Adjusted Baseline (0.0% Fund Return FY 2020)



FUTURE RISK ANALYSIS

Exhibits 14 and 15 estimate the impact to the State and Teacher plan funded status due to a 0.0% return in fiscal year 2020. As was the case with the contribution rate analysis, the impact on the funded status is also expected to be blended in over five years due to the actuarial asset smoothing method. The estimated impact to the funded status as of June 30, 2020 for the State plan if the fiscal year return is 0.0% would be a reduction from 74.89% to 73.91%. The funded status beyond 2020 is based on the plan achieving the 6.75% return. Any subsequent returns over 6.75% will help moderate or offset the impact of this one year event.

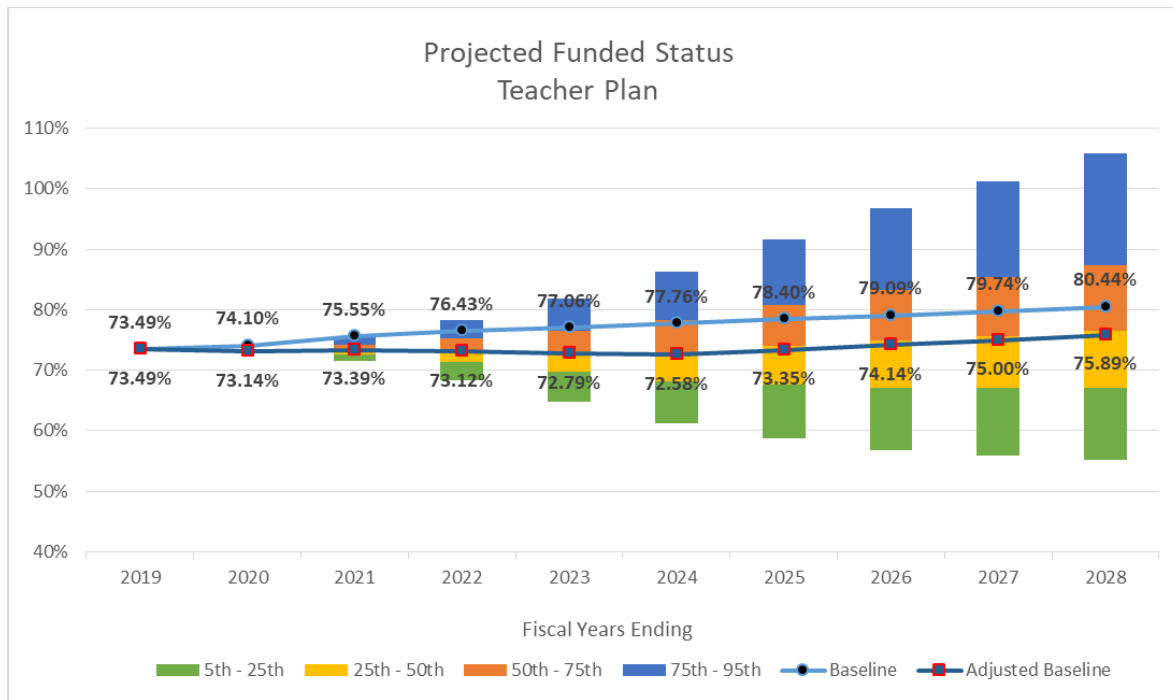
Exhibit 14 – State Adjusted Baseline (0.0% Fund Return FY 2020)



Similarly for the Teacher plan, the estimated impact to the funded status as of June 30, 2020 if the fiscal year return is 0.0% would be a reduction from 74.10% to 73.14%. The projected or estimated funded status beyond 2020 is based on the plan achieving the 6.75% return.

FUTURE RISK ANALYSIS

Exhibit 15 – Teacher Adjusted Baseline (0.0% Fund Return FY 2020)



While the initial economic impacts of COVID-19 on the VRS fund are apparent, further impacts are likely and will depend on the type and extent of economic recovery that takes place after among other things the COVID-19-linked various restrictions are lifted.

Predictions for economic recovery are generating various expectations on whether a bounce back, a slow-burn recovery or a possible relapse can be expected.

To understand the different scenarios emerging post-COVID-19, it is important to understand the immediate near-term policy responses to COVID-19. This overarching discussion can generally be condensed into whether the economic and health responses will either be strong and effective, or weak and reactionary.

As stated above, these are truly unprecedented events which make it difficult to precisely model projections or predictions. Therefore, the degree of uncertainty surrounding these simulations and recovery scenarios cannot be stressed enough. The VRS investment team compiled several post-COVID-19 economic scenarios that provide a framing of possible global economic responses over the next several years. These scenarios form the basis of the analysis related to recovery following the COVID-19 impacts that occurred around the world. The following three illustrative scenarios are estimates of possible recovery scenarios designed to show the magnitude of impacts on plan funding. There is no degree of certainty that any of these three scenarios will correctly simulate what will actually happen over the next five years.

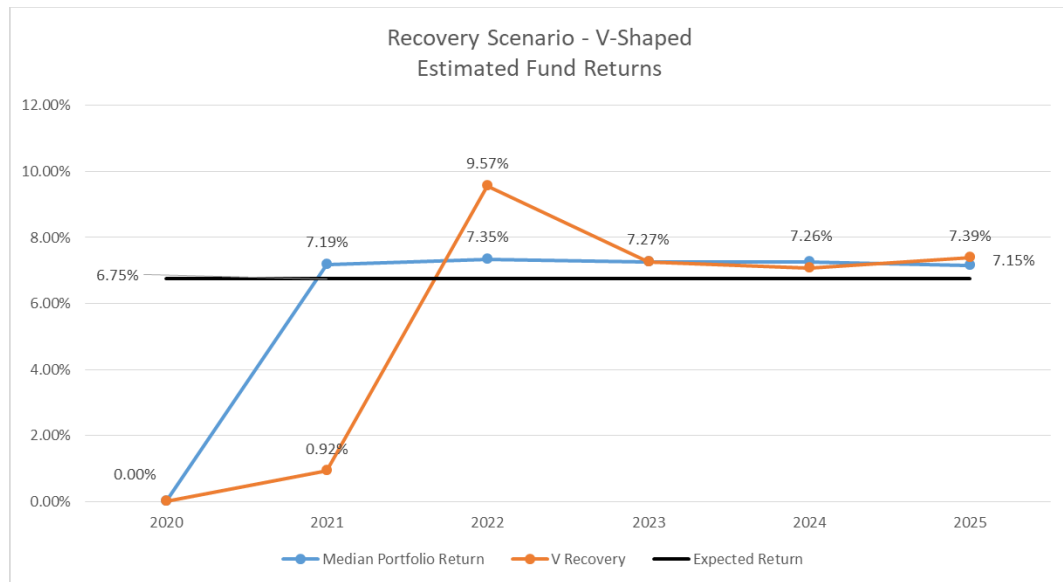
COVID-19 Economic Recovery Scenarios

• **V-shaped:** In the current environment, a V-shaped recovery would result in continued recovery in the third quarter of 2020. Listed below are examples of potential elements and conditions generally viewed to be associated with a V-shaped recovery.

- Easing of restrictions by states produces small resurgence in COVID-19 cases which are easily managed.
- Testing is more available and faster, treatments come on-line and vaccine research is encouraging; pharma lines ramp up to mass produce vaccines for up to two-thirds of global population over the next two to three years.
- Employment surges as retail and hospitality industries begin to come back on-line.
- The markets look to 2020 as a transitory shock. Growth recovers in the third quarter of 2020 to approximately 3%.
- This scenario is probably closest to what the market is currently tracking as of mid-May 2020.

FUTURE RISK ANALYSIS

Exhibit 16



The expected cumulative return from 2020 – 2025 would be 5.31% as compared to 6.00% for the adjusted baseline return and 6.75%, which is the assumed return over this period.

Below are estimated impacts on funding measures over the next eight years for the State and Teacher plans assuming the V-shaped recovery economic scenario. Employer contribution rates would increase approximately 1.25% of covered payroll each of the next three biennia before trending downward in 2029. This type of recovery could add \$2 billion to unfunded liabilities for the State plan and approximately \$4 billion to the Teacher plan or approximately 35% increase in unfunded liability over the next 5 years.

FUTURE RISK ANALYSIS

Exhibit 17

State Plan - V-Shaped Recovery Scenario

| | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
|--|---------|---------|----------|----------|-----------|-----------|-----------|-----------|
| Baseline Contribution Rates | 14.46% | 14.46% | 14.20% | 14.20% | 13.86% | 13.86% | 13.58% | 13.58% |
| V-Shaped Scenario Contribution Rates | 14.46% | 14.46% | 15.44% | 15.44% | 16.56% | 16.56% | 17.04% | 17.04% |
| Estimated Increase in Employer Rate | | | 1.24% | 1.24% | 2.70% | 2.70% | 3.46% | 3.46% |
| Estimated Additional Funding Required - All Sources (\$Millions) | | | \$ 59.00 | \$ 60.50 | \$ 134.86 | \$ 138.22 | \$ 181.81 | \$ 186.77 |
| Baseline Funded Status | 76.09% | 76.66% | 77.10% | 77.62% | 78.09% | 78.60% | 79.07% | 79.61% |
| V-Shaped Scenario Funded Status | 73.07% | 71.74% | 70.70% | 69.82% | 70.18% | 71.38% | 72.43% | 73.57% |
| Baseline Unfunded Liability - (\$Billions) | \$ 6.30 | \$ 6.26 | \$ 6.24 | \$ 6.18 | \$ 6.12 | \$ 6.04 | \$ 5.95 | \$ 5.84 |
| V-Shaped Scenario Unfunded Liability - (\$Billions) | \$ 7.09 | \$ 7.58 | \$ 7.98 | \$ 8.33 | \$ 8.33 | \$ 8.07 | \$ 7.84 | \$ 7.57 |
| Change in Unfunded Liability - (\$Billions) | \$ 0.80 | \$ 1.32 | \$ 1.74 | \$ 2.15 | \$ 2.21 | \$ 2.04 | \$ 1.89 | \$ 1.73 |

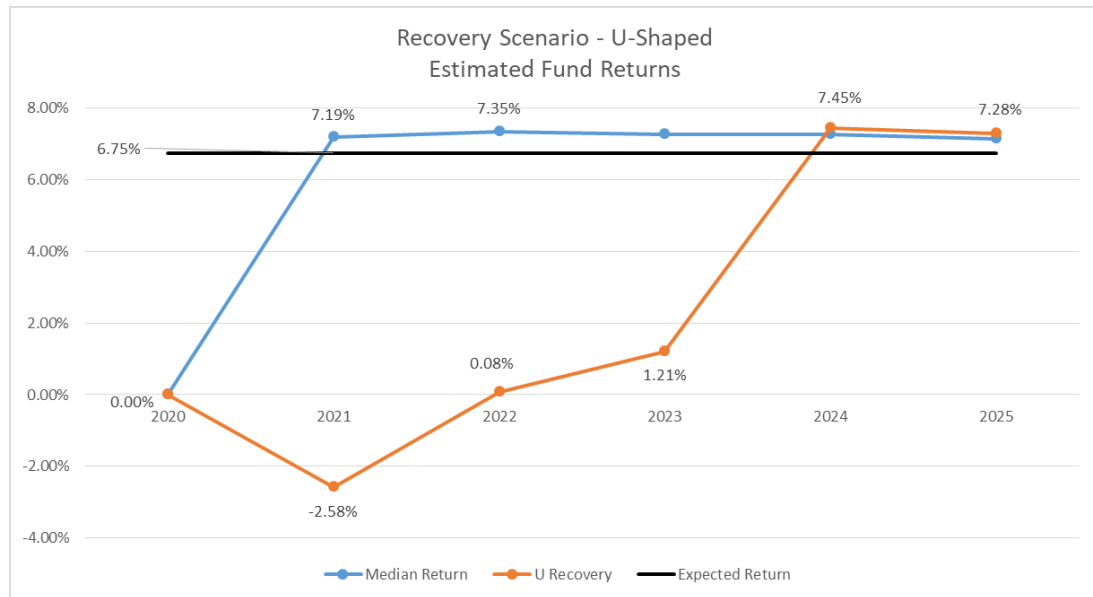
Teacher Plan - V-Shaped Recovery Scenario

| | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
|--|----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Baseline Contribution Rates | 16.62% | 16.62% | 15.46% | 15.46% | 15.08% | 15.08% | 14.74% | 14.74% |
| V-Shaped Scenario Contribution Rates | 16.62% | 16.62% | 16.66% | 16.66% | 17.66% | 17.66% | 18.01% | 18.01% |
| Estimated Increase in Employer Rate | | | 1.20% | 1.20% | 2.58% | 2.58% | 3.27% | 3.27% |
| Estimated Additional Funding Required - All Sources (\$Millions) | | | \$ 115.45 | \$ 118.76 | \$ 262.67 | \$ 270.09 | \$ 352.52 | \$ 361.83 |
| Baseline Funded Status | 75.55% | 76.43% | 77.06% | 77.76% | 78.40% | 79.09% | 79.74% | 80.44% |
| V-Shaped Scenario Funded Status | 72.61% | 71.71% | 71.02% | 70.53% | 71.20% | 72.67% | 73.98% | 75.35% |
| Baseline Unfunded Liability - (\$Billions) | \$ 12.84 | \$ 12.77 | \$ 12.81 | \$ 12.79 | \$ 12.76 | \$ 12.68 | \$ 12.60 | \$ 12.47 |
| V-Shaped Scenario Unfunded Liability - (\$Billions) | \$ 14.39 | \$ 15.33 | \$ 16.19 | \$ 16.94 | \$ 17.01 | \$ 16.57 | \$ 16.18 | \$ 15.71 |
| Change in Unfunded Liability - (\$Billions) | \$ 1.54 | \$ 2.56 | \$ 3.37 | \$ 4.15 | \$ 4.25 | \$ 3.89 | \$ 3.58 | \$ 3.24 |

- **U-shaped:** This scenario includes stabilization in the second half of 2020, the COVID-19 virus controlled, but a slower economic recovery over the next several years due to economic damage sustained in 2020. Listed below are examples of potential underlying elements and conditions associated with a U-shaped recovery.
 - Intermediate-to-long-term structural changes in labor markets and unemployment, on-shoring, trade policy, market operations, work force participation patterns, precautionary savings, and declining productivity.
 - Shifts in growth drivers to staples, health care, and technology.
 - Deflationary risks and slower growth expected.
 - Complications related to United States and China relations contribute to increased market uncertainty and volatility.

FUTURE RISK ANALYSIS

Exhibit 18



The expected cumulative return from 2020 – 2025 would be 2.17% as compared to 6.00% for the adjusted baseline return and 6.75%, which is the assumed return over this period.

Below are estimated impacts on funding measures over the next eight years for the State and Teacher plans assuming the U-shaped recovery economic scenario. Employer contribution rates would increase approximately 1.5% of covered payroll and grow to an estimated 8.0% increase by 2027 before trending downward in 2031. This type of recovery could add \$5.7 billion to unfunded liabilities for the State plan and approximately \$11.4 billion to the Teacher plan nearly doubling the unfunded liability over the next 5 years.

FUTURE RISK ANALYSIS

Exhibit 19

State Plan - U-Shaped Recovery Scenario

| | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
|--|---------|---------|----------|----------|-----------|-----------|-----------|-----------|
| Baseline Contribution Rates | 14.46% | 14.46% | 14.20% | 14.20% | 13.86% | 13.86% | 13.58% | 13.58% |
| U-Shaped Scenario Contribution Rates | 14.46% | 14.46% | 15.63% | 15.63% | 18.64% | 18.64% | 21.49% | 21.49% |
| Estimated Increase in Employer Rate | | | 1.43% | 1.43% | 4.78% | 4.78% | 7.91% | 7.91% |
| Estimated Additional Funding Required - All Sources (\$Millions) | | | \$ 68.04 | \$ 69.77 | \$ 238.76 | \$ 244.70 | \$ 415.64 | \$ 426.97 |
| Baseline Funded Status | 76.09% | 76.66% | 77.10% | 77.62% | 78.09% | 78.60% | 79.07% | 79.61% |
| U-Shaped Scenario Funded Status | 72.59% | 69.46% | 65.59% | 61.72% | 59.41% | 58.41% | 58.78% | 59.92% |
| Baseline Unfunded Liability - (\$Billions) | \$ 6.30 | \$ 6.26 | \$ 6.24 | \$ 6.18 | \$ 6.12 | \$ 6.04 | \$ 5.95 | \$ 5.84 |
| U-Shaped Scenario Unfunded Liability - (\$Billions) | \$ 7.22 | \$ 8.19 | \$ 9.37 | \$ 10.57 | \$ 11.34 | \$ 11.73 | \$ 11.72 | \$ 11.48 |
| Change in Unfunded Liability - (\$Billions) | \$ 0.92 | \$ 1.93 | \$ 3.13 | \$ 4.39 | \$ 5.22 | \$ 5.69 | \$ 5.77 | \$ 5.64 |

Teacher Plan - U-Shaped Recovery Scenario

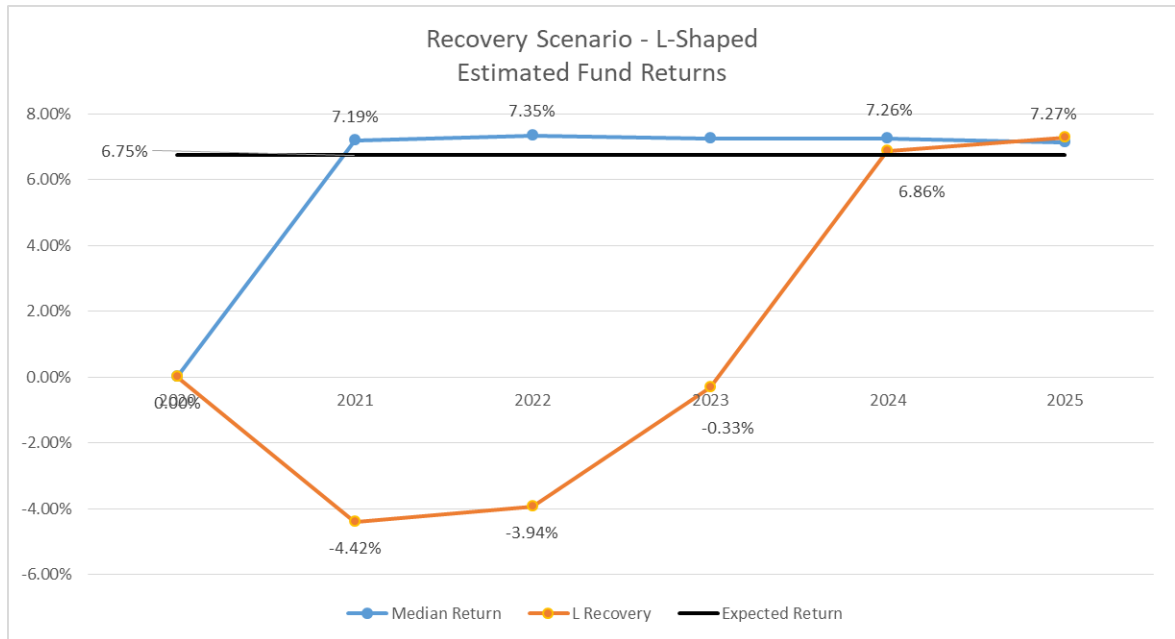
| | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
|--|----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Baseline Contribution Rates | 16.62% | 16.62% | 15.46% | 15.46% | 15.08% | 15.08% | 14.74% | 14.74% |
| U-Shaped Scenario Contribution Rates | 16.62% | 16.62% | 16.85% | 16.85% | 19.71% | 19.71% | 22.39% | 22.39% |
| Estimated Increase in Employer Rate | | | 1.39% | 1.39% | 4.63% | 4.63% | 7.65% | 7.65% |
| Estimated Additional Funding Required - All Sources (\$Millions) | | | \$ 133.73 | \$ 137.56 | \$ 471.38 | \$ 484.69 | \$ 824.70 | \$ 846.48 |
| Baseline Funded Status | 75.55% | 76.43% | 77.06% | 77.76% | 78.40% | 79.09% | 79.74% | 80.44% |
| U-Shaped Scenario Funded Status | 72.14% | 69.48% | 66.04% | 62.73% | 60.99% | 60.56% | 61.44% | 63.02% |
| Baseline Unfunded Liability - (\$Billions) | \$ 12.84 | \$ 12.77 | \$ 12.81 | \$ 12.79 | \$ 12.76 | \$ 12.68 | \$ 12.60 | \$ 12.47 |
| U-Shaped Scenario Unfunded Liability - (\$Billions) | \$ 14.63 | \$ 16.54 | \$ 18.97 | \$ 21.42 | \$ 23.05 | \$ 23.92 | \$ 23.99 | \$ 23.57 |
| Change in Unfunded Liability - (\$Billions) | \$ 1.79 | \$ 3.77 | \$ 6.15 | \$ 8.64 | \$ 10.29 | \$ 11.24 | \$ 11.39 | \$ 11.10 |

• **L-shaped:** This recovery scenario would involve the persistence of the COVID-19 virus, continued shelter-in-place orders, inadequate economic stimulus and subsequent economic stagnation. The losses would be expected to be more severe and last longer than in the U-shaped recovery. Listed below are examples of potential elements and underlying conditions generally viewed to be associated with an L-shaped recovery.

- Developed economies forced to remain in lock-down mode into 2021.
- Authoritarianism, disruptions in trade, travel, and social interaction push the economy into a prolonged severe recession/depression with attendant uncertainty where unknowns dominate any feasible return to normal.
- Developed Market Economies' ties with China reach all-time lows.
- United States-China relations antagonistic with higher likelihood of escalated conflict.

FUTURE RISK ANALYSIS

Exhibit 20



The expected cumulative return from 2020 – 2025 would be 0.80% as compared to 6.00% for the adjusted baseline return and 6.75%, which is the assumed return over this period.

Below are estimated impacts on funding measures over the next eight years for the State and Teacher plans assuming the L-shaped recovery economic scenario. Employer contribution rates would increase approximately 1.5% of covered payroll and grow to an estimated 10.0% increase by 2027 before trending downward in 2033. This type of recovery could add \$7 billion to unfunded liabilities for the State plan and approximately \$14.4 billion to the Teacher plan more than doubling the unfunded liability over the next 5 years.

FUTURE RISK ANALYSIS

Exhibit 21

State Plan - L-Shaped Recovery Scenario

| | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
|--|---------|---------|----------|----------|-----------|-----------|-----------|-----------|
| Baseline Contribution Rates | 14.46% | 14.46% | 14.20% | 14.20% | 13.86% | 13.86% | 13.58% | 13.58% |
| L-Shaped Scenario Contribution Rates | 14.46% | 14.46% | 15.74% | 15.74% | 19.58% | 19.58% | 23.25% | 23.25% |
| Estimated Increase in Employer Rate | | | 1.54% | 1.54% | 5.72% | 5.72% | 9.67% | 9.67% |
| Estimated Additional Funding Required - All Sources (\$Millions) | | | \$ 73.28 | \$ 75.13 | \$ 285.71 | \$ 292.82 | \$ 508.12 | \$ 521.98 |
| Baseline Funded Status | 76.09% | 76.66% | 77.10% | 77.62% | 78.09% | 78.60% | 79.07% | 79.61% |
| L-Shaped Scenario Funded Status | 72.35% | 68.21% | 63.30% | 58.51% | 55.19% | 53.40% | 53.58% | 54.64% |
| Baseline Unfunded Liability - (\$Billions) | \$ 6.30 | \$ 6.26 | \$ 6.24 | \$ 6.18 | \$ 6.12 | \$ 6.04 | \$ 5.95 | \$ 5.84 |
| L-Shaped Scenario Unfunded Liability - (\$Billions) | \$ 7.29 | \$ 8.52 | \$ 9.99 | \$ 11.46 | \$ 12.52 | \$ 13.14 | \$ 13.20 | \$ 12.99 |
| Change in Unfunded Liability - (\$Billions) | \$ 0.99 | \$ 2.27 | \$ 3.76 | \$ 5.28 | \$ 6.40 | \$ 7.11 | \$ 7.25 | \$ 7.15 |

Teacher Plan - L-Shaped Recovery Scenario

| | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
|--|----------|----------|-----------|-----------|-----------|-----------|------------|------------|
| Baseline Contribution Rates | 16.62% | 16.62% | 15.46% | 15.46% | 15.08% | 15.08% | 14.74% | 14.74% |
| L-Shaped Scenario Contribution Rates | 16.62% | 16.62% | 16.95% | 16.95% | 20.56% | 20.56% | 24.12% | 24.12% |
| Estimated Increase in Employer Rate | | | 1.49% | 1.49% | 5.48% | 5.48% | 9.38% | 9.38% |
| Estimated Additional Funding Required - All Sources (\$Millions) | | | \$ 143.35 | \$ 147.46 | \$ 557.92 | \$ 573.67 | \$1,011.20 | \$1,037.91 |
| Baseline Funded Status | 75.55% | 76.43% | 77.06% | 77.76% | 78.40% | 79.09% | 79.74% | 80.44% |
| L-Shaped Scenario Funded Status | 71.90% | 68.45% | 64.02% | 59.64% | 56.97% | 55.85% | 56.63% | 58.21% |
| Baseline Unfunded Liability - (\$Billions) | \$ 12.84 | \$ 12.77 | \$ 12.81 | \$ 12.79 | \$ 12.76 | \$ 12.68 | \$ 12.60 | \$ 12.47 |
| L-Shaped Scenario Unfunded Liability - (\$Billions) | \$ 14.76 | \$ 17.10 | \$ 20.10 | \$ 23.20 | \$ 25.42 | \$ 26.77 | \$ 26.98 | \$ 26.63 |
| Change in Unfunded Liability - (\$Billions) | \$ 1.92 | \$ 4.32 | \$ 7.28 | \$ 10.41 | \$ 12.66 | \$ 14.09 | \$ 14.38 | \$ 14.16 |

From an historical perspective, the scenarios provided above would rival previous recessionary periods. As depicted in the chart below, Exhibit 22 shows the rolling 5-year returns over the last 25 years as compared to the expected return of the fund and includes estimated rolling 5-year returns assuming the V-shaped recovery scenario. This chart shows that the V-shaped recovery scenario would provide for a mild recessionary period as compared to the recessions observed in both the early 2000's and following the Great Recession from 2009 – 2013. The green bars represent years in which the Board lowered the long-term expected rate of return of the fund.

FUTURE RISK ANALYSIS

Exhibit 22

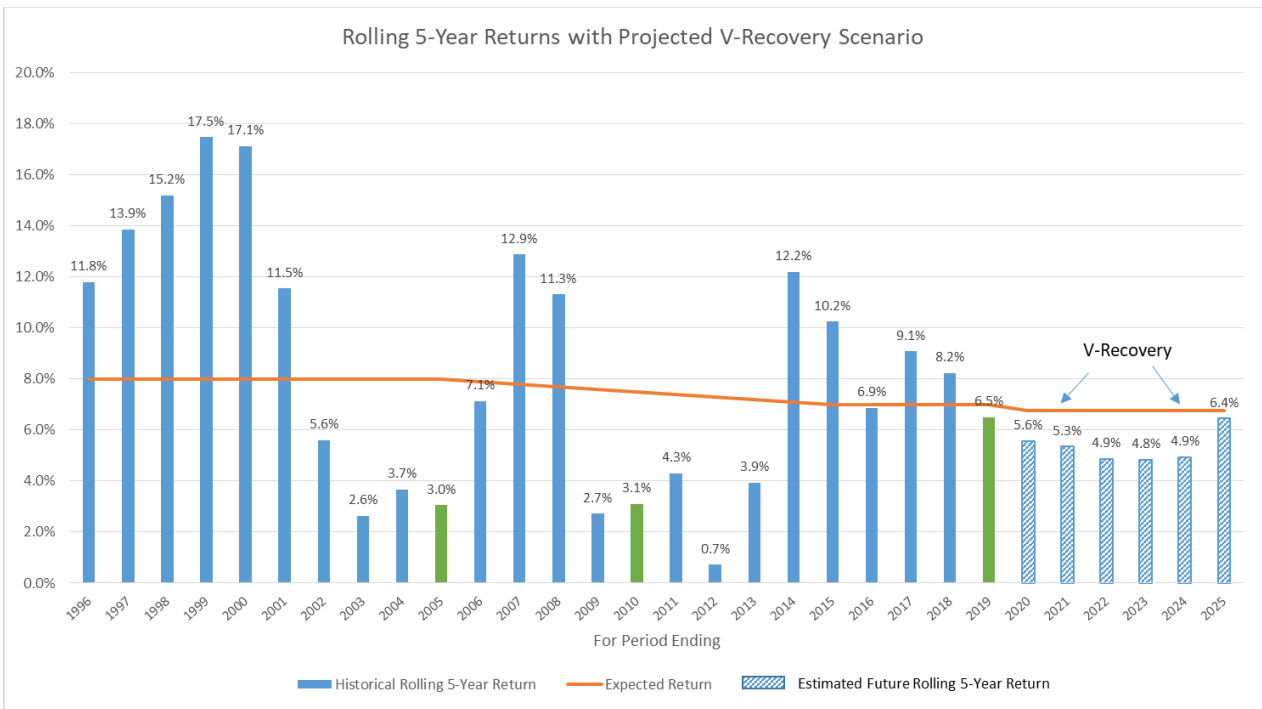


Exhibit 23 shows the rolling 5-year returns over the last 25 years as compared to the expected return of the fund and includes estimated rolling 5-year returns assuming the U-shaped recovery scenario. As was shown above, the U-shaped recovery scenario provides for a deeper recession than depicted by the V-shaped recovery. While the market returns do not include as large a drop off as seen during the Great Recession, the prolonged duration of the below average returns provides for cumulative returns that would be similar to what was experienced during the Great Recession.

FUTURE RISK ANALYSIS

Exhibit 23

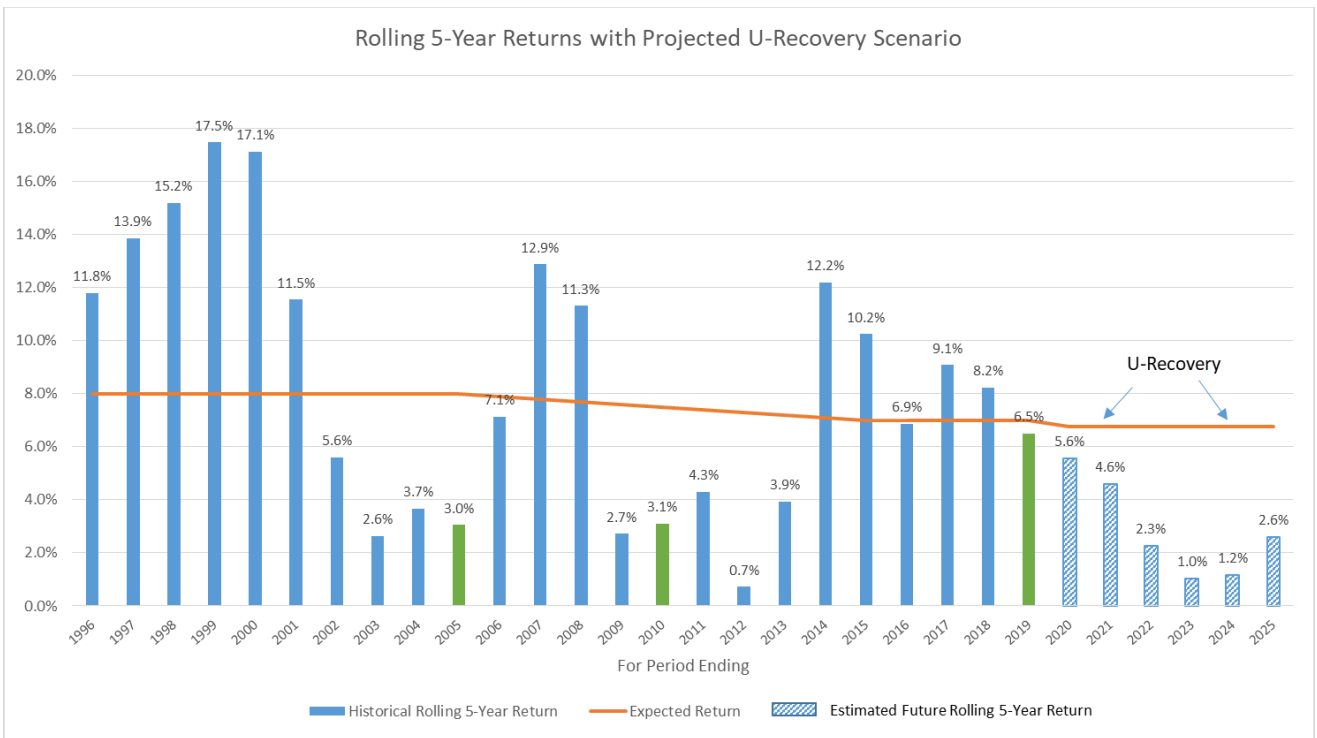
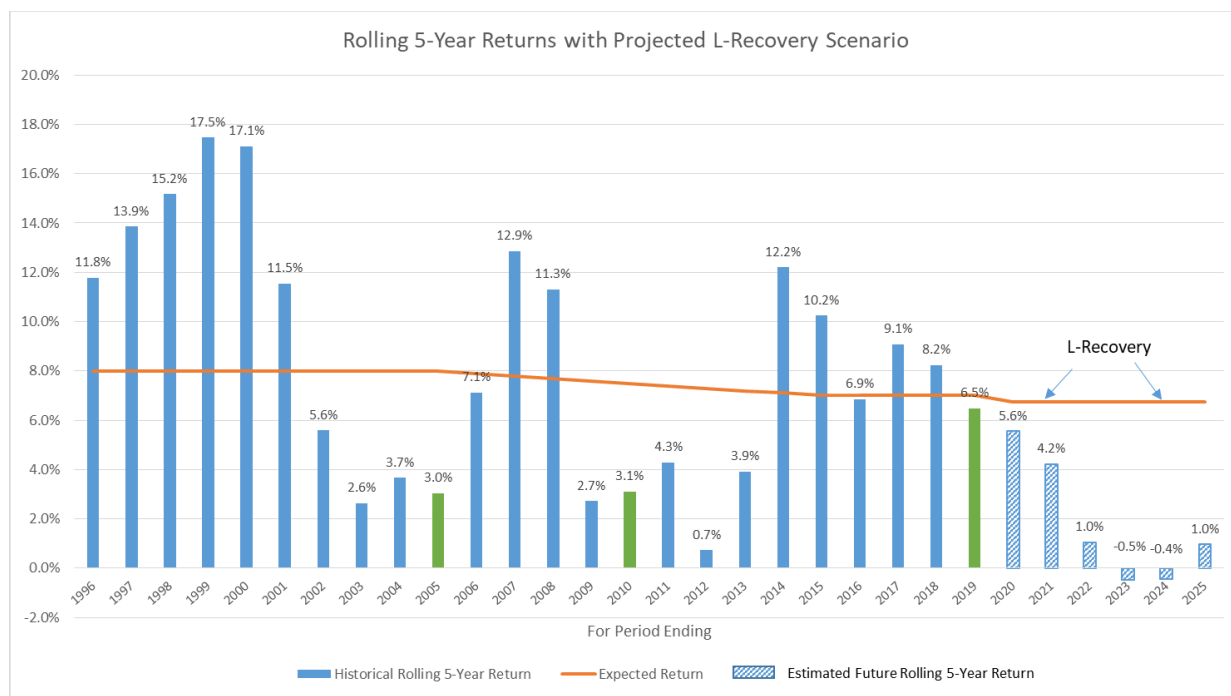


Exhibit 24 shows the rolling 5-year returns over the last 25 years as compared to the expected return of the fund and includes estimated rolling 5-year returns assuming the L-shaped recovery scenario. The L-shaped recovery scenario provides for a much deeper recession than depicted by either the V-shaped recovery or U-shaped recovery. It is worth noting that the L-shaped recovery scenario models a recessionary period that would be worse than historical periods observed by the VRS fund.

FUTURE RISK ANALYSIS

Exhibit 24



Cash Flow Projections

Defined benefit 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.

FUTURE RISK ANALYSIS

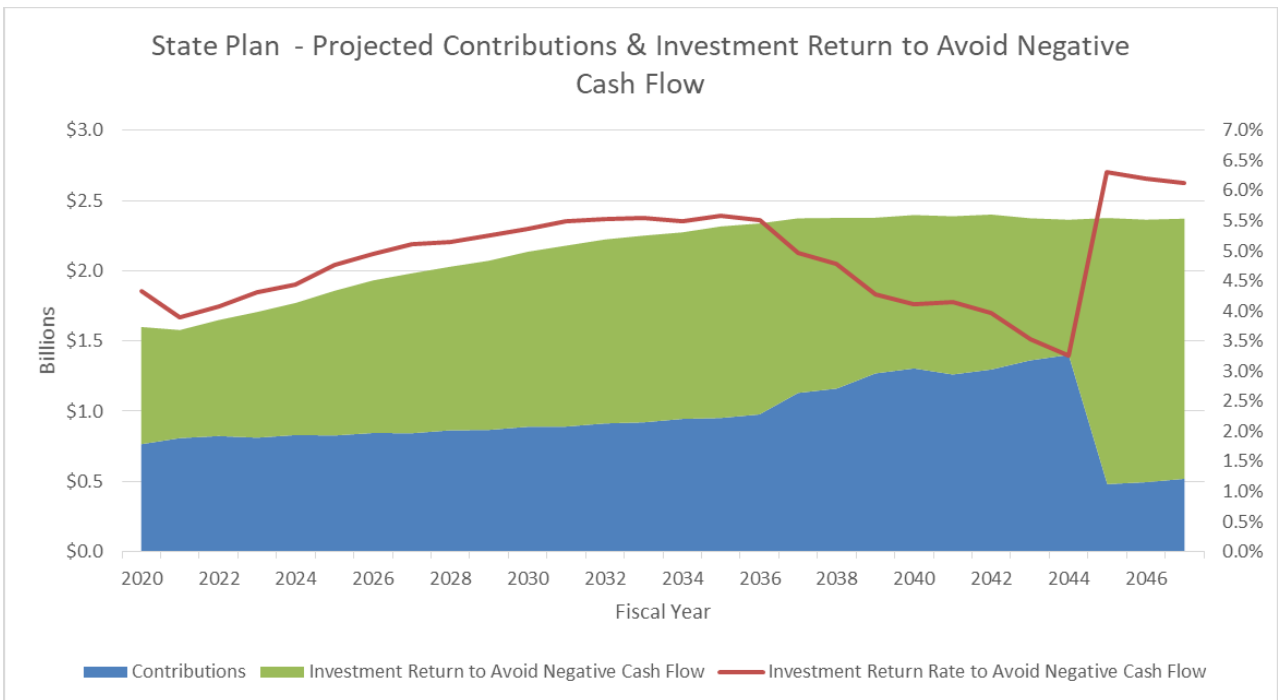
In fact, part of the benefit and efficiency of pre-funding is so the investment returns can pay a significant portion of the benefit payments.

Exhibit 25 below shows the projected contributions and investment returns needed by the State plan to avoid negative cash flows over the next 30 years. The blue portion of the chart represents the contributions that are expected to be made each year. The green portion of the chart represents the level of investment return that is needed, while the blue and green added together represent the expected benefit payments from the plan. The red line is the level of investment return needed (scale on left of the chart) to generate the investment return (green portion of chart) to keep the incoming cash flow (contributions plus investment return) equal to the plans expected benefit payments and expenses. Benefit payments in the State plan are expected to peak in 2037 before beginning to reduce as more members are covered by the Hybrid Retirement Plan. The overall employer cost of the Hybrid Plan is lower than Plan 1 or Plan 2, which means that as the population covered by the Hybrid Plan grows fewer employer contributions will go into the plan. Note that the drop off in contribution requirements in 2044 coincides with the payoff of the legacy unfunded liabilities. Fewer contribution dollars flowing into the plan generally causes more reliance on 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% to 6.45%, with an average return of approximately 4.90% to stay cash flow positive to the fund.

FUTURE RISK ANALYSIS

Exhibit 25



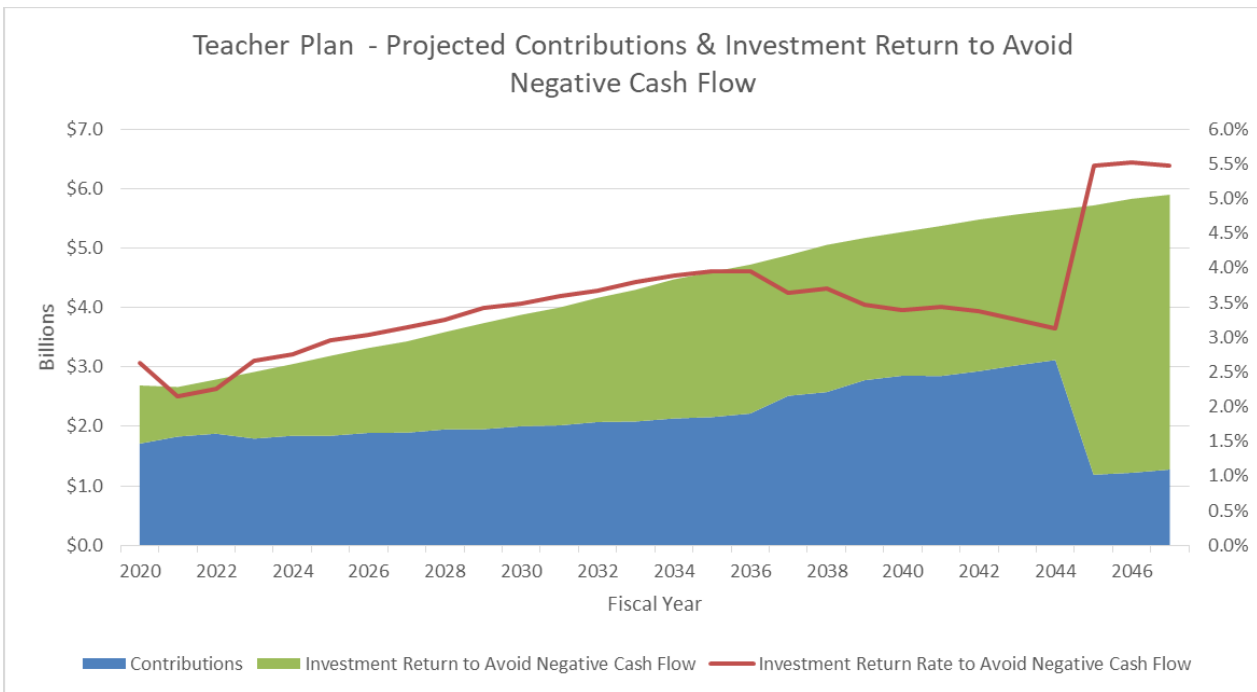
Results based on June 30, 2019 actuarial valuation

Exhibit 26 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 in 2048 compared to 2037 for the State plan 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. Fewer 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% to 5.58%, with an average return of approximately 3.50% to stay cash flow positive. The average return needed for the Teacher plan is less than the State plan due to higher contribution requirements for the Teacher plan during much of the projection period, which offsets the need for additional investment return to cover plan costs during those years.

FUTURE RISK ANALYSIS

Exhibit 26



Results based on June 30, 2019 actuarial valuation

According to S&P Global Ratings pension brief from March 2020, given the current market downturn, some United States public pension plans may experience liquidity stress to cover benefit payments. Through periods of continued volatility, assets in plans with weak liquidity are likely to be sold at a loss and may contribute to decreasing funded ratios. In the United States, plans have an average of 1% of their target portfolios held in cash and short-term investments to pay ongoing expenses, such as benefit payments and administrative costs. A liquidity-to-assets ratio can be useful in determining the liquidity risk, if any, of a pension plan.

$$\text{Liquidity to Assets Ratio} = \frac{\text{Cash} + \text{Contributions} - \text{Benefit Payments \& Expenses}}{\text{Market Value of Assets}}$$

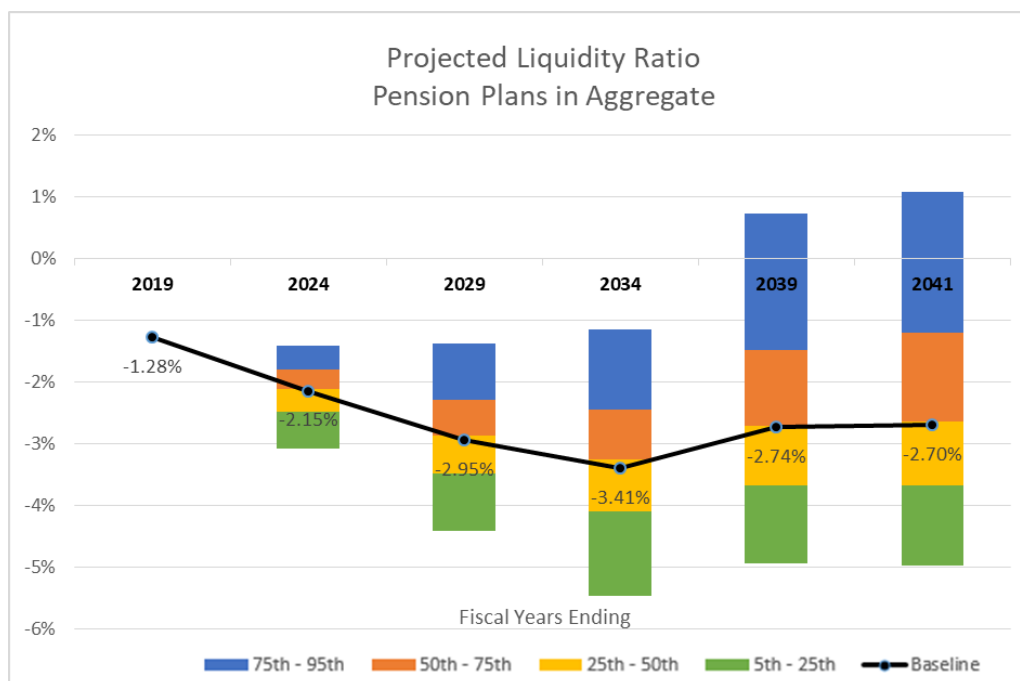
A negative liquidity-to-assets ratio indicates the pension plan requires additional money to maintain operations and make all benefit payments. The further the ratio is below

FUTURE RISK ANALYSIS

zero, the higher the percentage of assets that may have to be converted to cash. In a typical year, cash flows may be supplemented by realizing positive investment returns.

Currently VRS is targeting 1.0% of the portfolio to be held in cash and short-term investments to pay ongoing expenses. As of June 30, 2019 the liquidity to asset ratio for all VRS pension plans in aggregate was -1.28%. This means that in addition to the cash allocation of 1% of assets and member and employer contributions, an investment return of approximately 1.28% is required to generate enough funds to pay benefits and expenses without requiring further liquidation of investments. Exhibit 27 below shows the expected liquidity ratio for all VRS plans in aggregate over the next 30 years. Similar to the cash flow exhibits above, the liquidity ratios show increased reliance on investment returns over the next 10 to 15 years if contributions remain level and benefit payments continue to increase. Similar to what we see with the cash flow projections in Exhibits 25 and 26 above, by 2034 more reliance on investment returns will be required to keep the fund cash flow neutral due to increasing number of benefit payments being paid. This equates to a liquidity to asset ratio of -3.41% in 2034 before moderating as the asset base grows.

Exhibit 27

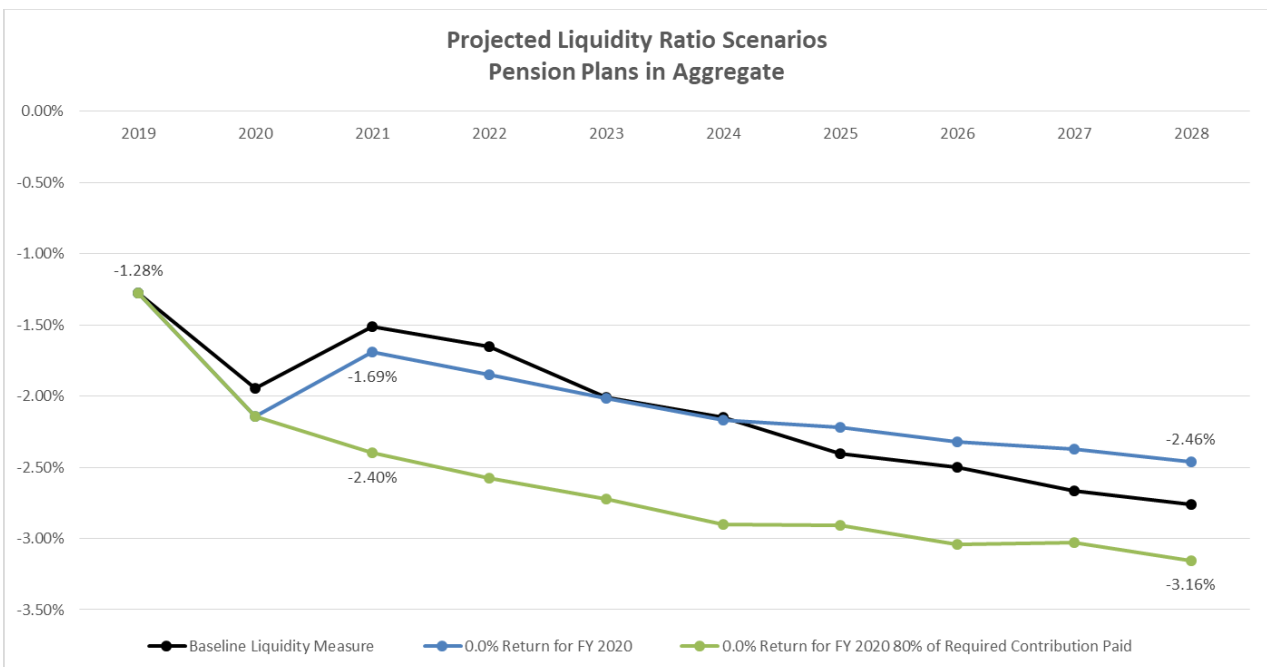


FUTURE RISK ANALYSIS

Given the current volatility in the markets, Exhibit 28 shows how negative returns can impact the liquidity ratio of the fund.

Since liquidity is impacted by contributions to the plan, volatility ratios often show improvement following investment losses if the assumption is that the full contributions continue to be made. This is due to increased contributions flowing into the plan. Exhibit 28 shows how after an initial drop in the liquidity ratio due to a 0.0% return, the liquidity recovers within a couple of years if the full contribution continues to be made. However, the green line shows that if only 80% of the required contributions are made following a market downturn the liquidity ratio can subsequently grow, which puts more pressure on investment returns to cover the cash flow requirements of the plans.

Exhibit 28



Contribution Risk

Following the Great Recession and subsequent economic fallout, there was renewed focus on financial reporting and funding of employer-sponsored benefit plans by rating and oversight agencies. Except for in limited cases, political subdivision plans are required by statute to contribute the full actuarial required contribution rate. This has

FUTURE RISK ANALYSIS

historically kept the political subdivision plans much better funded than the State-wide plans. As part of pension reforms the State committed to fully-funding the actuarial required contributions for State plans and demonstrated that commitment by achieving full funding of contributions earlier than required in the transition plan codified in § 51.1-145 of the *Code of Virginia* as part of the pension reform efforts in 2012. This cultural shift in full funding of actuarial required rates along with the additional focus provided by rating and oversight committees has helped to improve funding levels for benefit plans since the last recession.

Even with the positive changes that have been made it is necessary given the current economic environment to discuss contribution risk. Contribution risk is the possibility that actual future contributions deviate from what was expected. This type of risk is typically linked to investment performance, assumption changes, or changes in plan design that unexpectedly impact future plan rates. The COVID-19 crisis has highlighted another facet of contribution risk, the risk that the funding source is disrupted or impacted, causing the possibility of underfunded rates, which would lead to higher future costs for the plans

While economic shocks are able to be smoothed into the employer contribution rates to manage volatility, the budget impacts brought on by the COVID-19 shutdown have been harsh and immediate. The reduced revenue that the State and local employers are facing could be a bigger contributing factor to the risk of underfunding than the performance of the markets. The simulations previously shown assume that even when rates deviate from what is expected, employers are assumed to make the full actuarially determined contributions. However, there is risk that rates could increase to a level that would hinder employers from making the full contribution due to budgetary constraints. Due to impacts of COVID-19, there is an expectation that employers' contribution rates will trend higher over the next five years. While the rates for fiscal years 2021 and 2022 have already been set, the COVID-19 crisis will likely impact future rates, the level depending on what type of recovery takes place. While the prospect of deferring benefit costs in the near term may appear to provide budgetary flexibility, it will increase long-term pension costs and could impact the liquidity of the fund.

Using results from the stochastic models, Exhibit 29 compares the probabilities that State employer contribution rate levels will exceed certain thresholds during the next rate

FUTURE RISK ANALYSIS

setting cycle effective for fiscal year 2023. As an example, under the baseline economic scenario there was an estimated 21.2% chance that fund returns would cause a 5% increase in employer contribution rates. Under the V-shaped recovery economic scenario, the probability increases to more than 70% that fund returns will cause a 5% increase in employer contribution rates.

Exhibit 29 – Probability of Increased Employer Rates

| Scenario | 2023 | | |
|------------|---------------------|----------------------|----------------------|
| | 5% Increase In Rate | 10% Increase in Rate | 20% Increase in Rate |
| Baseline | 21.20% | 8.50% | 1.30% |
| V-Recovery | 70.60% | 17.30% | 5.10% |
| U-Recovery | 83.20% | 28.50% | 9.90% |
| L-Recovery | 87.20% | 36.90% | 14.30% |

Similar probabilities likely exist for other VRS-administered plans.

Additional Risks to Long-Term Funding

VRS is scheduled to perform the next quadrennial experience study in the spring of 2021. During that time the mortality tables will be updated to reflect the more recent tables published by the Society of Actuaries. The analysis below was performed during the prior stress test and sensitivity analysis report. VRS anticipates more robust analysis of longevity risk to the funds as part of the 2021 experience study.

Mortality/Longevity Risk

Mortality assumptions in use by public pension plans in the United States vary widely to reflect the variation in life expectancy across the country. The tables being used today by many public plans are based on mortality experience collected from the private sector. For larger public plans like VRS, these tables are typically adjusted to reflect observed experience of the plan members over time. Recently, the Retirement Plans Experience Committee (RPEC) and the Society of Actuaries (SOA) released the Pub-2010 Public

FUTURE RISK ANALYSIS

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 mortality 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 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.

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, but an increase in liabilities with the incorporation of new tables that generally reflect longer life expectancy appears probable. The SOA issued the Pub-2010 tables in January 2019. COVID-19 might have an impact on future longevity, but at this time it is too early to predict the existence or magnitude of any such impact.

Past updates to mortality tables have increased plan liabilities by approximately 1% to 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 how the Pub-2010 tables relate to actual VRS demographic experience.

FUTURE RISK ANALYSIS

Exhibit 30

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

Potential Strategies to Enhance Funding

VRS continues to support strategies to lower the legacy unfunded liabilities of the plans. While these various techniques could save employers money on future contributions, increasing contributions during a fiscal crisis, even in order to ultimately save money, might not be a practicable or realistic approach at this time. Nevertheless, when revenues and fiscal conditions improve, these alternatives may serve to reduce future employer expenditures and as a result are worth discussing here.

A decade of bull markets has shown that investment returns alone will not get rid of the legacy unfunded liabilities, which were in part the result of a failure to fund the certified contribution rates. The current crisis has shown that plans with greater unfunded liabilities will continue to be more vulnerable to market downturns. This suggests that a dedicated effort to pay down unfunded liabilities on a more accelerated basis may help to cushion any potential uncertainty that could occur with future market downturns.

Shorten Period for Amortization of Legacy Unfunded Liability

Although the current funding policy puts the plans on a path to full funding by 2044, 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 move from open to 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 in an increase in the principal balance of the loss.

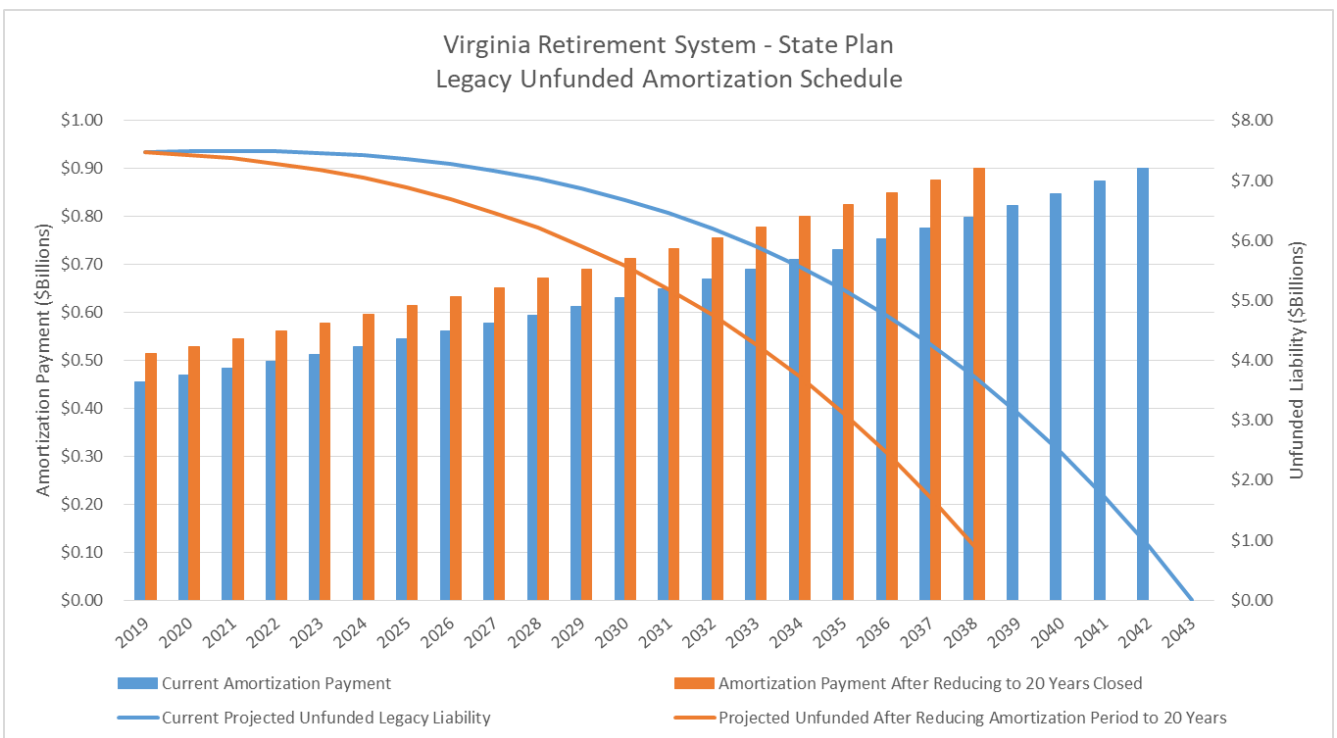
The legacy unfunded liability established as of 2013 was amortized over a 30-year closed period. This was done in an effort to moderate employer rates, which at the time were not being fully funded by the Governor and General Assembly. Using a shorter amortization period would have increased rates even 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.” This means that the outstanding balance actually

FUTURE RISK ANALYSIS

increases during the first eight or nine years of amortization as payments go toward interest rather than principal.

As of June 30, 2019, the State plan legacy unfunded liability has 24 years of the original 30 years remaining to be paid, with an outstanding balance of \$7.5 billion. Under the current amortization schedule, \$8.3 billion of interest will be paid over the next 24 years on the \$7.5 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 \$1.9 billion in interest payments. The shorter amortization period would increase employer rates by approximately 1.4% of covered payroll each year of the remaining amortization period.

Exhibit 31



Results based on June 30, 2019 actuarial valuation

FUTURE RISK ANALYSIS

Note that impacts of COVID-19 may result in flat or even declining workforce and/or payroll in the public sector, similar to what was seen after the Great Recession. To the extent that payroll does not increase at the assumed levels, contribution rates will likely increase in order to cover payments to the unfunded liability.

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 has been implemented by the VRS Board of Trustees for political subdivision plans for both pension and OPEB plans. It allows for alternative funding requirements that can be applied in situations to either improve or strengthen funding levels of political subdivision plans that are “at-risk” or poorly funded as determined by the Plan actuary.

Limitations on Benefit Enhancements

Another strategy adopted by the VRS Board of Trustees is to require political subdivision plans to meet specific funding measures in order to make modifications or enhancements to benefits. Plans are required to be at least 75% funded both before and after any plan changes, which could require the employer to make lump sum payments at the time of a plan change in order to maintain the plan funding level. This prevents employers from adding large liabilities to their plans that they may not be able to pay for in future years.

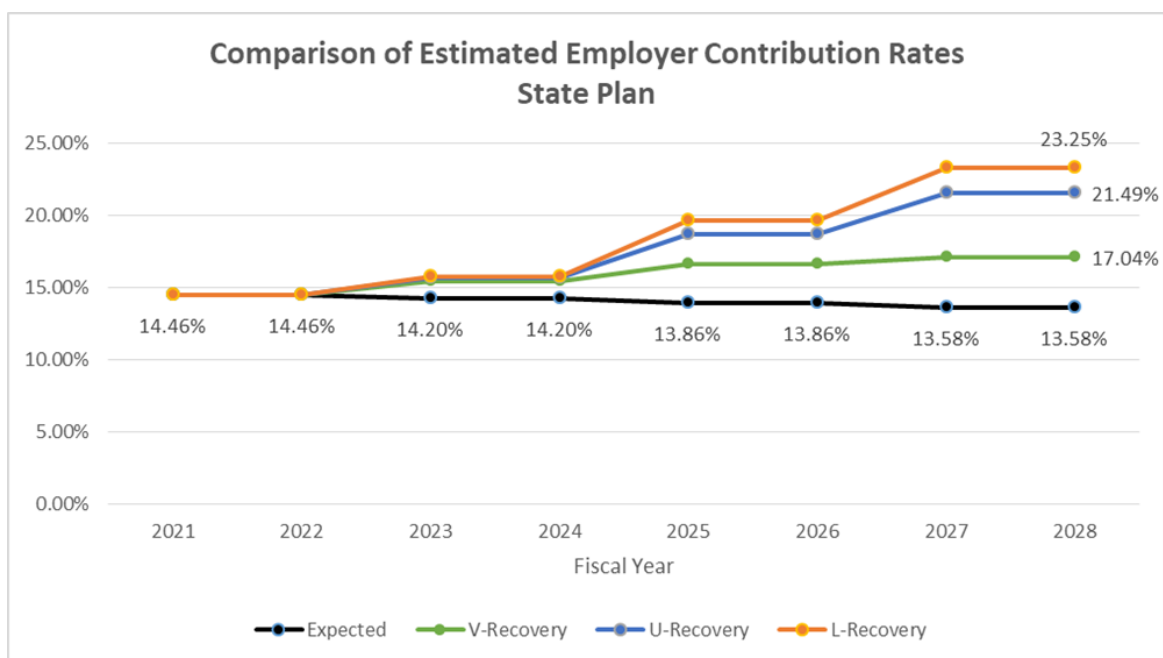
Legislatively mandated benefit expansions, however, must be provided by all employers despite the employer’s funded status. In addition, some benefit enhancements can create immediate liabilities. As benefits enhancements are considered, focus should not only be placed on the contribution rates required to fund the benefits, but also the unfunded liabilities generated.

FINDINGS AND CONCLUSIONS

Due to the uncertainty surrounding market forecasts and projections and the potential for a near-term recession, the VRS Board of Trustees lowered the plans' long-term investment rate of return effective July 1, 2019, and applied the new assumed rate of return to the 2019 actuarial valuations. Given the current COVID-19 crisis and the uncertainty surrounding the economic recovery, VRS is in a slightly better position than it would have been because it already increased contribution rates to reflect a lower expected rate of return going forward.

COVID-19 is going to present challenges related to plan funding for many employers over the next several years, with the full extent of the impacts still unknown at this time. Exhibit 32 shows the estimated employer contribution rates for the State plan under the various recovery scenarios discussed in this report. A best case scenario would be a slight investment loss for fiscal year 2020 with continued economic recovery in 2021 which would provide only a modest increase in employer rates during the next rate setting. A prolonged recovery or continued suppressed markets could compound the impacts over multiple budget cycles and cause employer rates to continue to increase while the funded status of the plans declines. As of this writing, the VRS trust fund is trending closest to the V-shaped recovery simulation.

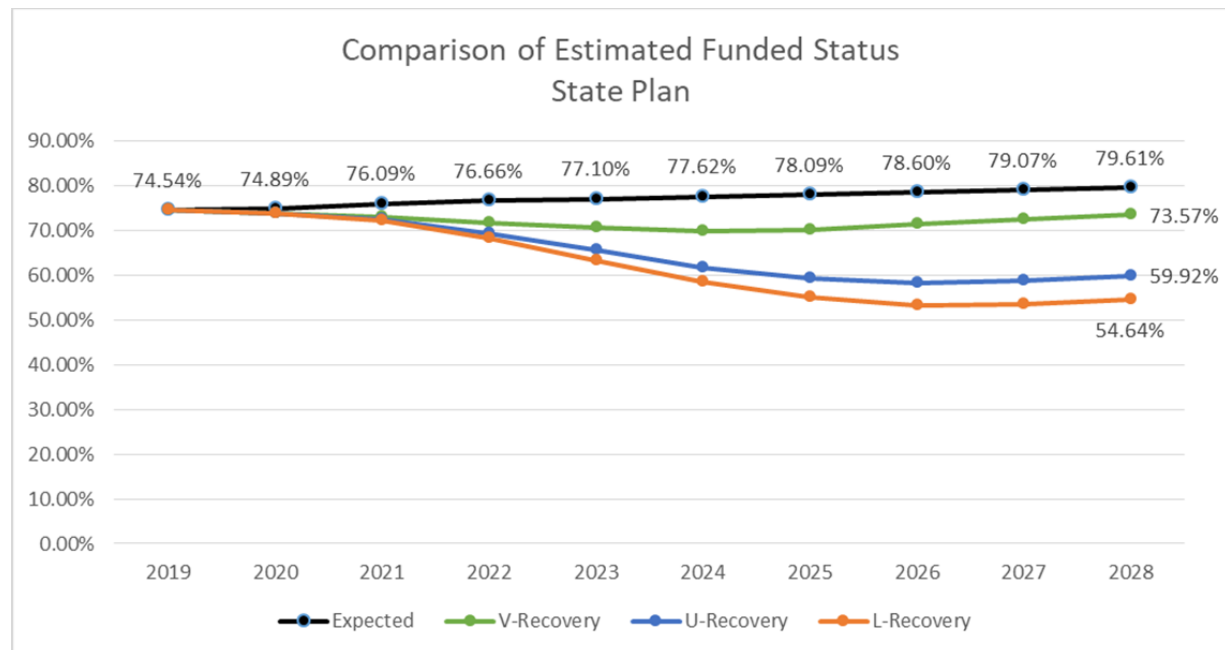
Exhibit 32



FINDINGS AND CONCLUSIONS

Exhibit 33 compares the State plan funded status under the various recovery scenarios.

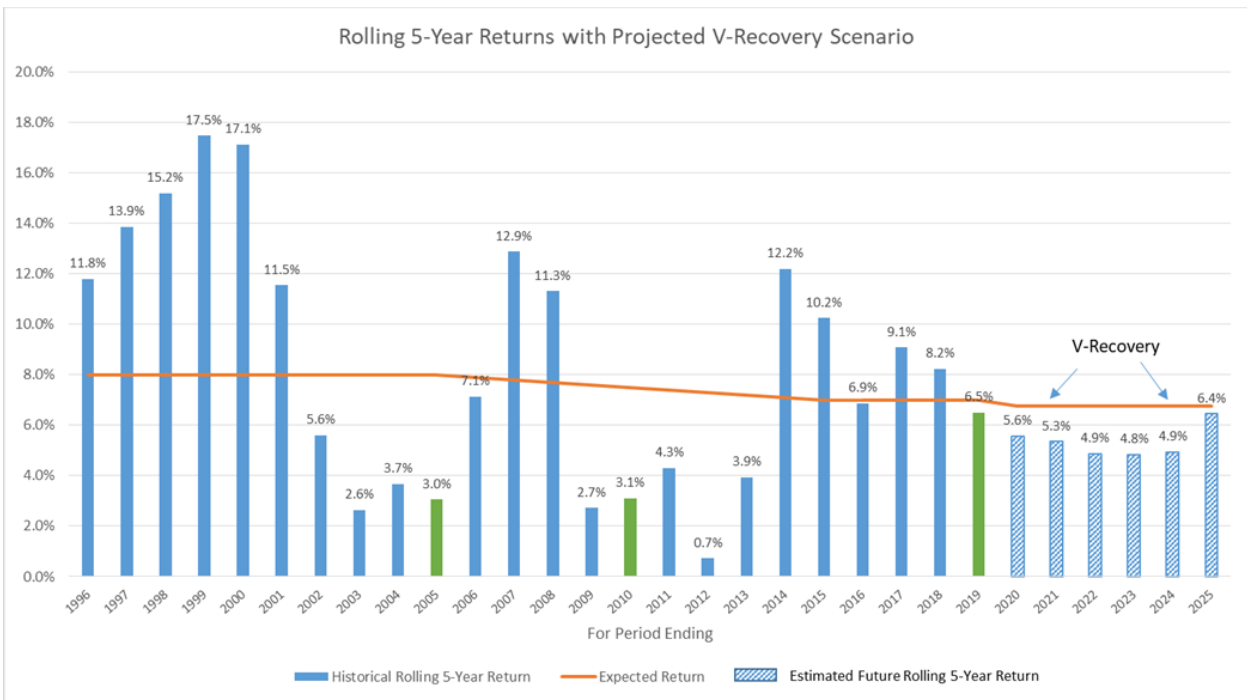
Exhibit 33



As of this writing, VRS is in a potentially better posture than after the tech bubble in the early 2000's and the global financial crisis in 2008, due to the market recovery that has occurred to date. Exhibit 34 shows how a V-shaped recovery scenario would provide for a milder recessionary period than experienced following the global financial crisis in 2008 when comparing the rolling 5-year returns.

FINDINGS AND CONCLUSIONS

Exhibit 34



In addition to market volatility, the budgetary impacts related to COVID-19 experienced by employers may create a parallel issue, especially in the near term.

Opportunities exist to proactively address some of these concerns and to better position the retirement plans to provide financial stability for current and future members of VRS. While likely not possible in the current economic climate, 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. As fiscal conditions improve, this could be achieved by any or a combination of the following:

- Reducing amortization periods for remaining legacy unfunded liability 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 the 2010-2012 deferred contributions for State and Teacher plans.

FINDINGS AND CONCLUSIONS

- Avoiding the expansion or enhancement of benefits, particularly those actions which generate immediate liabilities, while plans remain underfunded.

Next Steps

- Due to the uncertainty surrounding the COVID-19 recovery and the corresponding impacts on the economy at large, analysis of future impacts on the VRS fund will continue as new information becomes available.
- Preparation for quadrennial experience study in spring of 2021 with focus on plan mortality rates and longevity improvement.
- Ongoing communication with stakeholders regarding impacts on the plan related to COVID-19.

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.