

Defined Benefit Plan Financial Management Strategy
UM

At the March 25, 2022, joint meeting of the Finance and the Governance, Compensation and Human Resources Committees, management will present for Board information and feedback a comprehensive review of the University's Retirement, Disability and Death Benefit Plan ("the Plan"), inclusive of actuarial assumptions, investment strategy, and funding policy.

Based on Board feedback, the following items may be presented for Board action at the April Board meeting:

- Approve changes to the Plan's asset allocation targets - CRR 140.015 *Investment Policy for Retirement, Disability and Death Benefit Plan*
- Adopt new financial management policy for the Plan - CRR 530.020 *Retirement, Disability and Death Benefit Plan Financial Management Policy*
- Accept changes to the Plan's actuarial assumptions as recommended by Segal's *Report on Actuarial Valuation Assumptions Study*

Management will also present additional information to the Board in April with respect to options for reducing Plan liabilities through voluntary buyouts or conversions.

Defined Benefit Plan Financial Management Strategy



\$19 billion



**Total Projected Benefit
Payments Through 2110**

32,000



**Total Retirement
Plan Membership**

\$4.9 billion

Pension Liability at Current
7.25% Discount Rate (GASB)



\$315 million
Unfunded Pension Liability

\$8.2 billion

Pension Liability at 2.8% Discount
Rate (Corporate/Moody's)



\$3.6 billion
Unfunded Pension Liability

Main Objective

Protect the University's operating budget – to the extent possible – from defined benefit plan cost volatility.

These efforts have been ongoing since 2010:

- 2009 – added employee contribution requirement
- 2009 – established stabilization reserve
- 2012 – transition to 50% DB benefit in hybrid plan
- 2019 – transition to 100% defined contribution plan
- **2022 – proposing a disciplined approach to cost stabilization and risk management appropriate for a closed defined benefit plan.**
- **2022 - review options for voluntary conversions**

Agenda

- 1) Overview of defined benefit plan
- 2) Proposed changes to Retirement Plan asset allocation
- 3) Proposed Financial Management Policy (CRR)
- 4) Proposed changes to Retirement Plan actuarial assumptions

Defined Benefit Plan Overview



Current State of Pension

- Pension remains the largest liability in total value for the University
 - Credit Challenge from Moody's: "Substantial \$2.9bn three-year average adjusted net pension liability, with funding status exacerbated by financial market declines."
 - Standard & Poor's: "In our view, management remains very proactive in managing its pension plan, which is 82% funded based on new accounting standards."
- Previous plan closure limits active participants, and those participants are fewer than expected with COVID-related job eliminations.
- Positive investment returns in 2021 have significantly closed previous unfunded gap, but risk around total liability remains.
- Current low-interest rate environment poses a significant return challenge for the plan on a forward basis.

The Pension Equation

$$\text{Contributions} + \text{Investment Income} = \text{Benefit Payments}$$

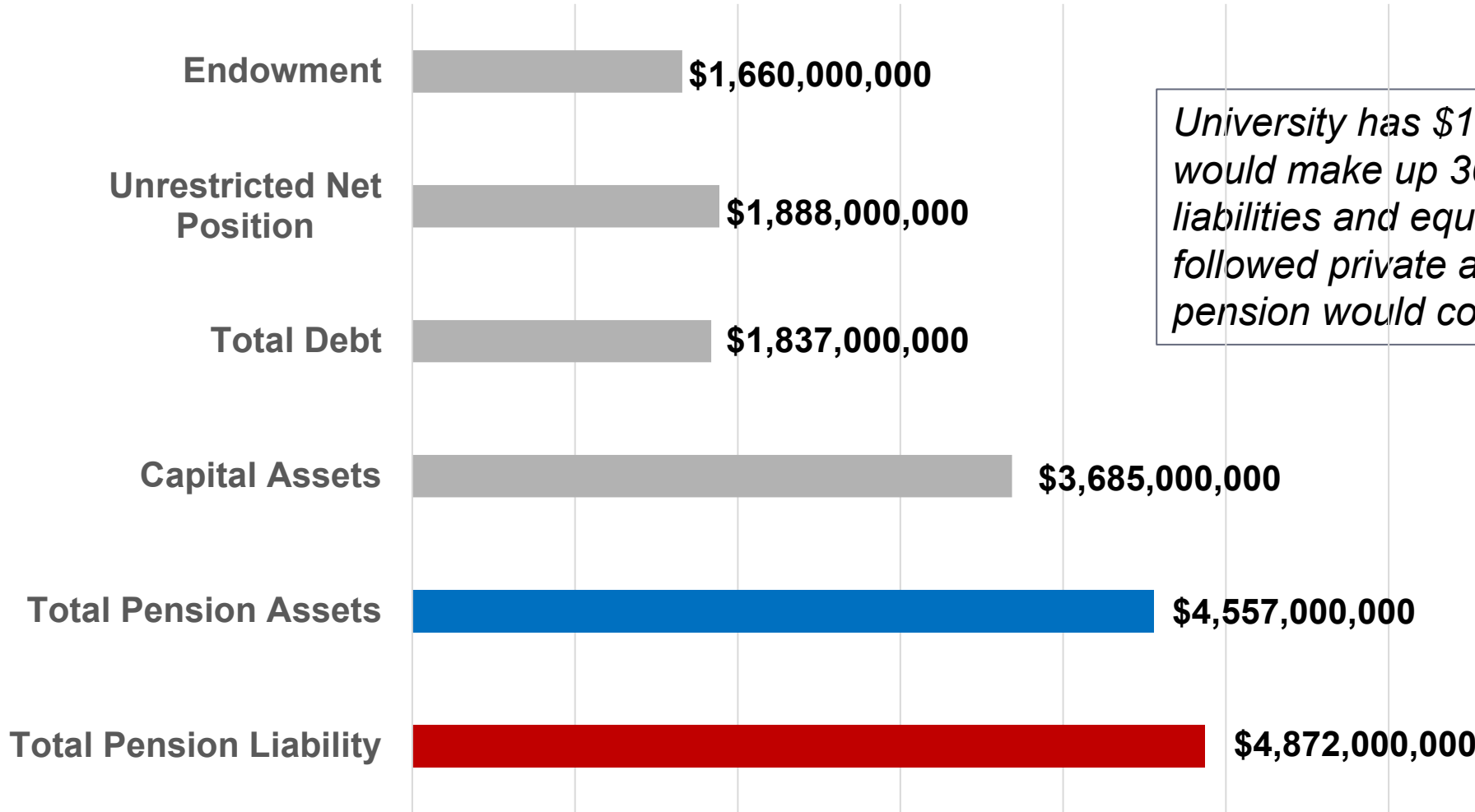
Contribution policy is established by the University and should balance current vs future funding requirements.

Desired investment risk / return must be weighed against the University's ability to manage potentially significant contribution increases due to market volatility.

Known contractual obligations of the University

Regardless of assumptions used for Contributions and Investment Income, Benefit Payments will be funded at actual cost. Given the time value of money and longevity of Plan liabilities, underfunding of contributions in the near term can result in significantly higher contributions in the future.

Pension is the largest item on the balance sheet



University has \$10.4 billion in assets; pension would make up 30% of assets and 33% of liabilities and equity if included. If the University followed private accounting standards, the pension would compose 72% of liabilities.

Rating Agency / Peer Perspective

	Univ. of Mo	Penn State	Utah	Colorado	Iowa
Reported Funded Ratio	76.7%	97.6%	95%	60.3	84.5
Adjusted Funded Ratio	44.9%	60.1%	59.7%	40.3	56.5
Reported Pension Liability	1,110	73	61	1,130	99
Adjusted Pension Liability	3,496	2,184	688	2,594	360
Total Adjusted Debt	5,323	5,725	2,220	4,402	2,706
Pension as % of Total Debt	66%	38%	31%	59%	13%

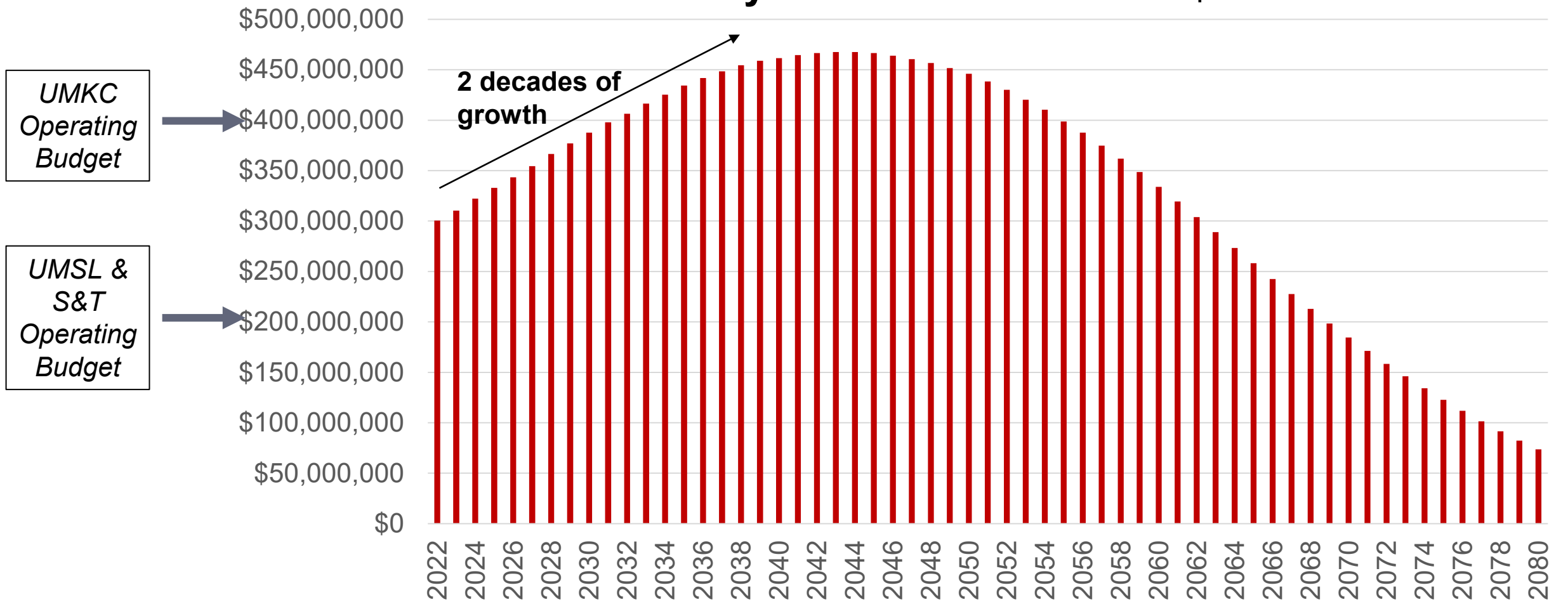
- UM is one of the only higher ed institutions running its own defined benefit plan for both faculty and staff. Most peer faculty have DC plans, with staff in state plans
- **Moody's**: “Substantial . . . adjusted net pension liability, with funding status exacerbated by financial market declines.”
- **Standard & Poor's**: “In our view, management remains very proactive in managing its pension plan . . . Significant financial risk remains, even with plan closure.”

Benefit Payments



Cash outflows grow through 2044

Benefit Payments to Pensioners: \$19 Billion



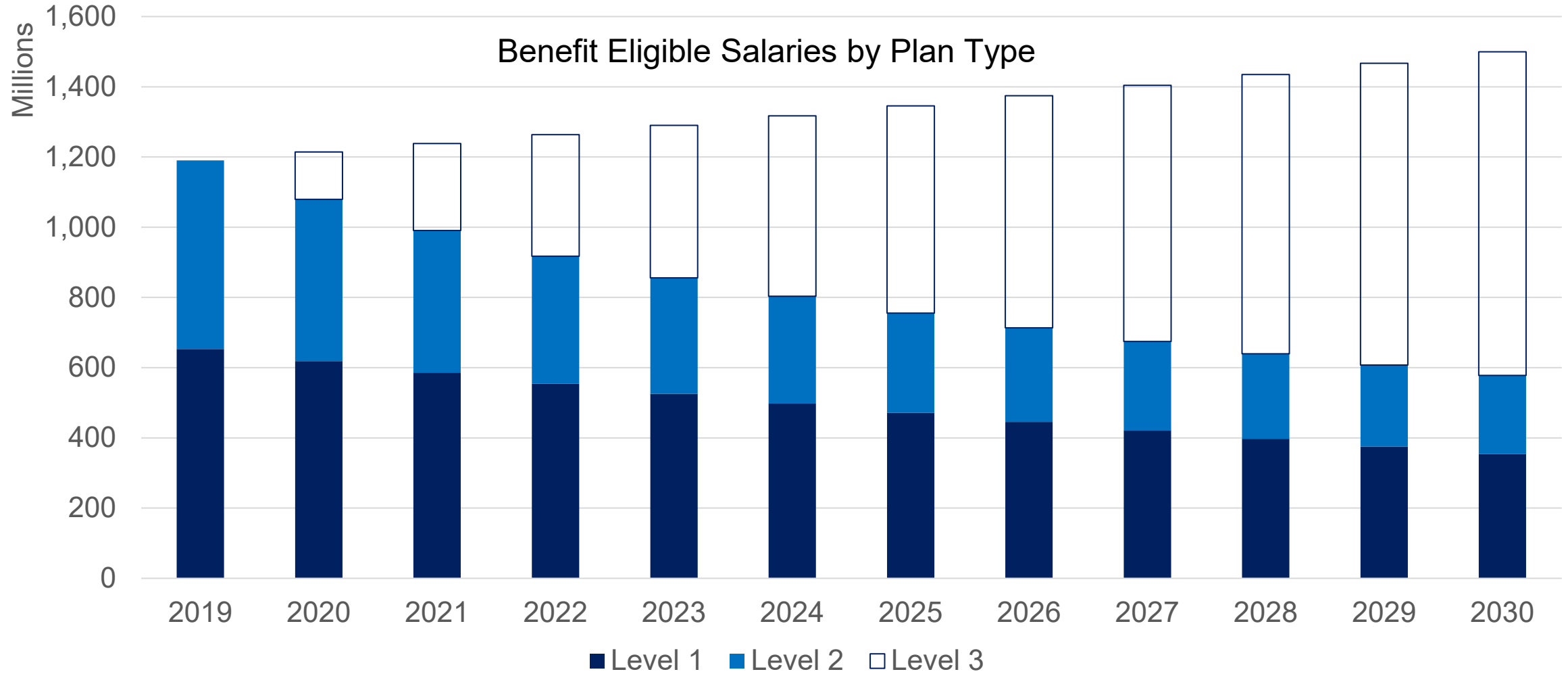
How to impact future benefit payments

- DB Plan benefit reduced 50% for new participants (Hybrid Plan - 2012)
- DB Plan closed to new participants – 2019
- DB benefits cannot be reduced for existing participants – many benefits explored.
- Potential Liability Reduction Measures
 - Cash out option for vested terms
 - DB Plan opt-outs with a lump sum DC conversion
 - Both are possible areas to explore; projected financial benefit limited
- Proposed CRR will prohibit any benefit increases (primarily impacts potential for discretionary cost-of-living adjustments, which were common in the 90's but discontinued in the last decade)

Contributions



Employee mix changing quickly; DC only participants projected majority in 2027



FY21 Plan Contributions

	Employee Contribution	Employer Contribution
Level 1 Full DB	1.36% employee pension (\$8M) <hr/> 1.36% total employee (\$8M)	5.67% normal (\$34M) <u>6.34% underfunding (\$38M)</u> 12.01% total employer (\$72M)
Level 2 Hybrid	1.25% employee pension (\$6M) <u>3% matchable DC (\$15M)</u> 4.25% total employee (\$21M)	2.07% normal (\$10M) 6.34% underfunding (\$32M) <u>4.42% DC less forfeitures (\$22M)</u> 12.83% total employer (\$64M)
Level 3 Full DC	8% matchable DC (\$12M)	6.14% DC less forfeitures (\$9M)

At current rates, underfunding contributions of \$70M outstrips normal cost of \$44M on the defined benefit plans (level 1 and level 2). Continuing underfunding contributions is key to maintaining plan position

Employee Contributions

- Doubling current employee contributions only generates \$14M, and would be difficult to implement for Level 2 participants
- Impact of any increase dissipates quickly as actives become retired and plan is closed to new entrance.
- This compares to the \$115M contributed by the employer in FY21

Recommendation:

- Utilize lower cost of new DC plan to lever additional funding into the defined benefit plan to close the gap
- Explore increasing employee contributions only in concert with a strategy that reduces the DC benefit, likely in response to underfunding from broader economic event

Investments

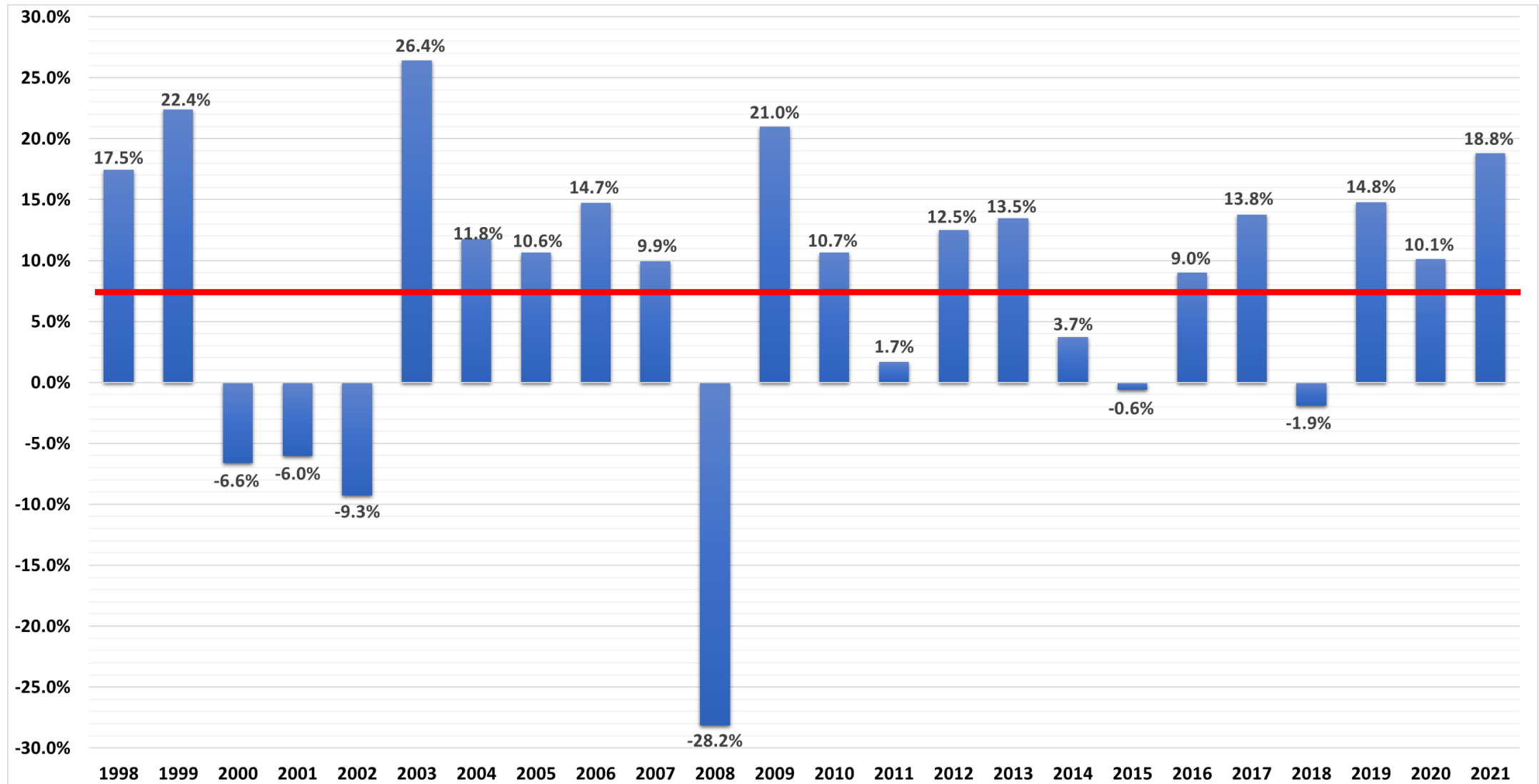


Background

The proposed investment mix that follows is the result of extensive discussions with the Investment Advisory Committee at three previous meetings:

- December 21, 2021
- January 26, 2022
- February 25, 2022

Investment return volatility is expected



Impact of Investment Losses on Operating Budgets

- Investment losses (relative to the expected return) can drive large increases in required contributions as the unfunded liability grows and amortization payments increase.
- Examples within the past 20 years:
 - 2000-01 Internet stock bubble burst: \$80M contribution moves to \$130M within three years
 - 2014-15 “benign” underperformance: \$80M contribution moves to \$95M within three years
 - 2008-09 financial crisis: \$80M contribution moves to \$180M within two years

The Math of Investment Losses

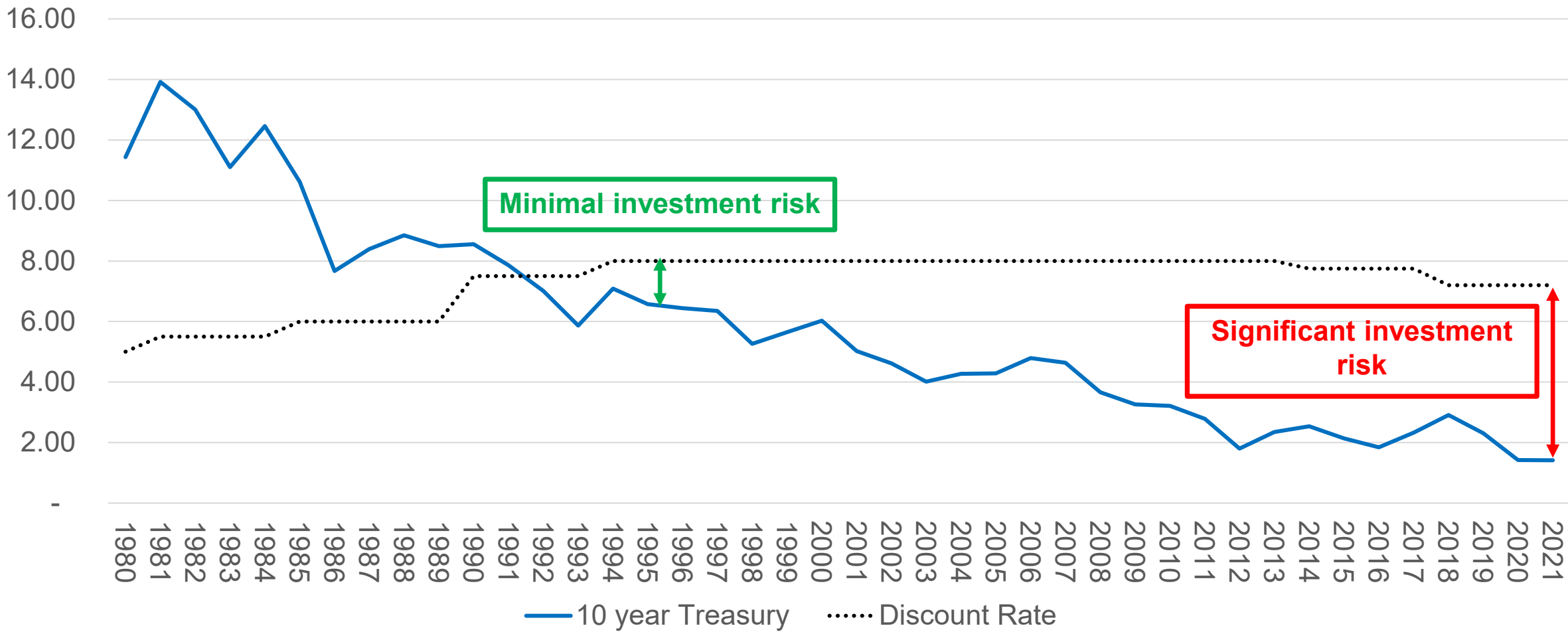
	Baseline (\$ millions)		Scenario A (\$ millions)		Scenario B (\$ millions)	
Beginning Balance	\$4,600		\$4,600		\$4,600	
Return – Year 1	322	7%	(230)	(5%)	(230)	(5%)
Benefits, Net of Contributions	(150)		(150)		(150)	
Balance – End of Year 1	4,772		4,220		4,220	
Return – Year 2	334	7%	295	7%	886	21%
Benefits, Net of Contributions	(160)		(160)		(160)	
Balance – End of Year 2	\$4,946		\$4,355		\$4,946	

Benefit payments, net of contributions will continue to grow each year. By 2030, net payments will be \$100 million higher than today, with less contributions to offset.

When the plan has a negative return, assets must be liquidated to pay benefits.

A 21% return would be needed in the year following a 5% loss to “catch up” to the expected baseline.

Investment risk increases as the risk-free rate declines - a 40-year trend



Proposed Changes to Investment Mix

	Current Policy	Proposed Policy
Expected Return Contribution		
Public Markets	3.6%	3.6%
Private Markets	2.6%	3.1%
Alpha Portfolio	0.6%	0.6%
Total Expected Return	6.9%	7.3%
Verus Inflation Assumption	(2.5%)	(2.5%)
Expected Real Return	4.4%	4.8%
Actuarial Inflation Assumption	2.2%	2.2%
Actuarial Return Assumption	6.6%	7.0%*

A reconciliation between the Expected Return and Actuarial Return Assumption is necessary due to differences in inflation assumptions. Verus expected inflation assumes a 10-year time horizon; actuarial expected inflation time horizon is the remaining life of the plan (80+ years).

** Current Actuarial Return Assumption is 7.20%; given the Expected Return for investments, we are recommending a decrease in the Actuarial Return Assumption from 7.20% to 7.0%.*

Proposed Changes to Investment Mix

	Expected Returns	Current Policy	Proposed Policy	Proposed Change
Public Equity	6.0%	35%	34%	(1%)
Private Equity	9.5%	12%	13%	1%
Real Estate	8.5%	10%	13%	3%
Private Debt	8.0%	6%	6%	-
Treasuries	1.5%	10%	8%	(2%)
TIPS	1.7%	10%	9%	(1%)
Risk Balanced 12 Vol	6.2%	12%	-	(12%)
Risk Balanced 14 Vol	7.1%	-	12%	12%
Commodities	3.4%	5%	5%	-
Portable Alpha	3.4%	22%	22%	-
Total Allocations		122%	122%	-

Shift from public to private equity; higher expected return, lower expected realized volatility, liquidity tradeoff.

Shift from public to private markets; higher expected return, diversifying exposures, liquidity tradeoff.

Shift into higher volatility implementation, with higher expected return.

Private Markets – How We Invest

Real Estate

More: Industrial / distribution / supply chain, multi-family

Less: Hotels, office, retail

Private Equity

Target: Venture Capital – biotech, information technology
Middle market funds that invest to create and build business

Avoid: Mega funds that generate returns largely through financial engineering

Investment Mix Considerations

- Increasing the Real Estate allocation has potential to help dampen portfolio volatility and enhance diversification, while still generating long-term returns similar to public equity
- In our own experience, realized volatility of Private Equity and Real Estate tends to be much lower than modeled volatility of the asset classes.
- Current investment team (inclusive of our partners) has a successful 10+ year track record implementing Real Estate and Private Equity
- Our size is an advantage in private markets; large enough for scale and meaningful manager relationships, small enough to be nimble and avoid the mega-funds crowded by large public pension funds

Investment Mix Considerations

- Shift to private markets impacts liquidity
Manageable at this point; unlikely we could sustain additional allocation to private markets in the future
- Shift to private markets requires more staff/consultant resources
Investment office costs represent less than 0.02% of assets under management
- Shift to private markets will increase investment management fees
All modeling, analysis and performance reporting is always presented net of investment management fees

Impact on Management Fees

	Change in Mix	Mgt Fees	\$ Impact
Public Equity	(1%)	0.28%	(\$132,000)
Private Equity	1%	1.61%	756,000
Real Estate	3%	1.71%	2,406,000
Treasuries	(2%)	0.07%	(68,000)
TIPS	(1%)	0.04%	(16,000)
Risk Balanced 12 Vol	(12%)	0.46%	(2,578,000)
Risk Balanced 14 Vol	12%	0.54%	3,017,000
Estimated Net Fee Increase		0.07%	\$3,385,000

It is more costly to access private markets; however, expectations of returns (net of fees) are higher.

Over the past 10 years, annualized outperformance of our own private equity vs public equity portfolios has been 4.2%. Based on current balances, that equals about \$20 million per year in excess return.

Proposed CRR

Defined Benefit Plan Financial Management Policy



Objectives of Policy

- Recognize the Plan's total pension liability as a significant debt of the University which must be managed accordingly.
- Prioritize and protect University funding for Plan contributions needed to achieve and maintain full funding of the Plan, utilizing actuarial assumptions and risk levels appropriate for a closed plan.
- Provide cost stabilization provisions to protect the University's operating budget - to the extent possible – from volatility in Plan contributions.
- Provide full transparency to internal and external constituents of the Plan and University.

Policy Key Concepts

- Establishes a methodical framework to de-risk the Plan over time.
- Prevents existing amortization contributions from dropping below current levels, until the plan is fully funded at appropriate levels of risk.
- Implements measures to provide additional cost stabilization to Plan contributions.
- Provides clear guidance that benefits offered by the Plan will not increase above current levels (primarily impacts potential discretionary cost of living adjustments).

Practical Impact - Operating Budget

- Volatility in investment returns drives volatility in required contributions. As such, efforts to minimize investment risk will help minimize volatility of required contributions, which protects budgets.
- Operating under the policy guidance, our objective would be to hold the internal benefit rate for retirement contributions flat for at least the next five years – assuming no significant investment losses.
- To the extent realized investment losses cause an increase in required contributions above what's budgeted, the Plan's Stabilization Fund would be fully utilized first to fill the gap.
- Maintaining a consistent retirement benefit rate allows campus focus on other investments rather than risk of rising retirement cost.

Plan Actuarial Assumptions



Background – Assumptions Study

- The University engages its independent actuary (Segal) to perform a thorough review of all assumptions used in the actuarial valuation of the defined benefit plan (“Report on Actuarial Valuation Assumptions Study”). The review is performed every five years; the last review occurred in 2017.
- Segal has reviewed five years of economic and demographic experiences and worked with UM to recommend changes in actuarial assumptions that best reflect emerging experience.
- *Changes in assumptions will not change actual (ultimate) plan cost but do impact the amount and timing of contributions*

Key Assumptions in the University's Plan

Key Drivers:

- Interest Rate (Investment Return Assumption) – increases contributions
- Mortality – increases contributions
- Severance – decreases contributions
- Retirement Rate and Age – increases contributions

Smaller Changes:

- Salary Increases
- Disability
- Summer Load

Investment Return Assumption

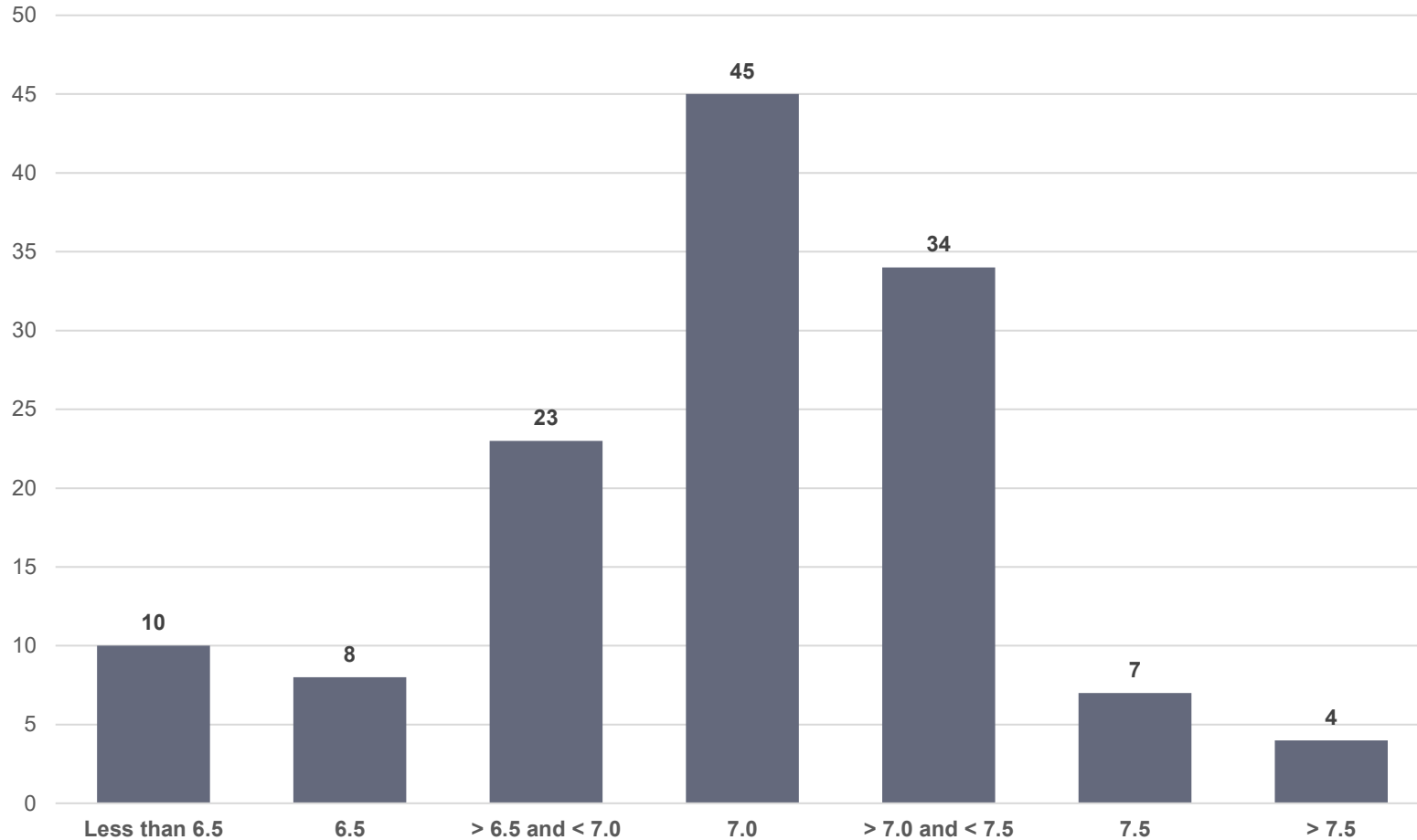
- Represents the expected rate of return on Plan assets. This rate is also used to calculate the net present value of the Plan's liabilities.
- Based on the Plan's most recent asset allocation modeling exercise, the recommendation is to lower the investment return assumption from 7.2% to 7.0%.
- Because the Plan is now closed to new participants, reducing investment risk (which generally results in a lower return expectation) - when possible from a budget perspective - will become a key aspect of managing Plan solvency.

Assumption Study pg.7

Peer Investment Return Assumptions

Investment Return Assumptions - State Pension Plans

(source: National Association of State Retirement Administrators)



Indiana Public Retirement System recently lowered its return assumption from 6.75% to 6.25%.

Major Missouri Plans

- MOSERS 6.95%
- MO LAGERS 7.00%
- MPERS 7.00%
- PSRS/PEERS 7.30%

Mortality Rates

- Mortality Rates estimate the age at which a member will pass away. Decreasing mortality (i.e., individuals living longer) will result in increased liabilities.
- The University's pension population experienced better than expected longevity, meaning that mortality dropped.
- To further evaluate mortality and ensure the changes were predictive, the University engaged Club Vita to further validate the work of the actuary.
 - Club Vita maintains life expectancy based upon geolocation data
 - Models updated based upon experience from participating plans
 - Model proved to be within 1% of UM's actuarial recommendation
- The net impact of the improvement in longevity increases the plan liability by \$102M

Severance Rates

- Severance rates estimate the amount of turnover the University will experience.
- Increases in severance improve the liability, as participants cannot re-enter the plan once separated based upon the Board's 2019 plan closure.
- Observed turnover rates are higher than prior assumed rates, generating a liability reduction of \$31M.

Retirement Rates

- Retirement rates estimate the age at which plan participants retire from the University.
- Through the study period, the University's retirements increased at the key dates of benefit eligibility, which increases the liability and related contributions.
- Retirements were adjusted for the impact of any early retirement incentives.
- Assumptions are recommended to change to mirror the experience from the past five years.
- Recommended retirement rate assumptions increases unfunded liability by \$48M.

Financial Impact of Recommended Assumptions

Change due to:	Normal Cost	Unfunded Liability	Net Employer Contribution Amount	Level 1% of Pay	Level 2% of Pay
10/1/2020 Valuation:	\$59,384,616	\$899,503,574	\$123,154,799	12.66%	9.11%
Interest Rate	\$2,863,621	\$111,541,581	\$11,197,366	1.08%	0.91%
Salary Scale	663,412	10,141,624	1,535,478	0.16%	0.11%
Severance Rates	-4,643,115	-31,340,225	-7,338,022	-0.81%	-0.48%
Disability Rates	126,347	2,648,702	354,105	0.04%	0.03%
Summer Employment Load	-524,205	-18,525,746	-2,117,211	-0.20%	-0.17%
Retirement Rates	804,102	47,609,999	4,898,026	0.46%	0.41%
Mortality Rates	1,422,174	101,773,654	10,173,564	0.95%	0.87%
Total Changes	<u>\$712,336</u>	<u>\$223,849,589</u>	<u>\$18,703,306</u>	1.68%	1.68%
Total Recommended Assumptions	\$60,096,952	\$1,123,353,163	\$141,858,105	14.34%	10.79%

Potential Board Action - April

- Approve changes to Retirement Plan asset allocation targets
CRR 140.015 Investment Policy for Retirement, Disability and Death Benefit Plan
- Adopt new financial management policy for Retirement Plan
CRR 530.020 Retirement, Disability and Death Benefit Plan Financial Management Policy
- Accept changes to Retirement Plan actuarial assumptions as recommended by Segal's *Report on Actuarial Valuation Assumptions Study*
- Review options for voluntary buyouts and recommended approaches

530.020 Retirement, Disability and Death Benefit Plan Financial Management Policy

A. Introduction - This policy establishes principles for the prudent financial management of the University's Retirement, Disability and Death Benefit Plan ("the Plan").

B. Policy Objectives

1. Recognize the Plan's total pension liability as a significant debt of the University which must be managed accordingly.
2. Prioritize and protect University funding for Plan contributions needed to achieve and maintain full funding of the Plan, utilizing actuarial assumptions and risk levels appropriate for a closed plan.
3. Provide cost stabilization provisions to protect the University's operating budget - to the extent possible - from volatility in Plan contributions.
4. Provide full transparency to internal and external constituents of the Plan and University.

C. Financial Management Principles

While closed to new participants since October 2019, annual benefit payments under the Plan are projected to continue growing through 2043; based on current mortality assumptions, benefit payments by the Plan will continue well past 2090. At the time this policy was adopted, total remaining benefit payments over the life of the Plan were projected to be more than \$19 billion. Given the magnitude and longevity of the Plan's liabilities, the following principles have been established:

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1. Expected Investment Return / Liability Discount Rate - Current governmental accounting standards utilize the same actuarial assumption for both the expected rate of return on the Plan's investments and the discount rate applied to the Plan's benefit liabilities. This creates tension when managing risk, particularly for closed plans. A higher discount rate results in a lower pension liability with lower required contributions, while the same higher expected investment return often results in a higher level of risk within the Plan's investment portfolio. A lower discount rate results in a higher pension liability with higher required contributions, while the same lower expected investment return often results in a lower level of risk within the Plan's investment portfolio.

With a pension plan closed to new participants, annual contributions going into the plan will decline over time, leaving a closed plan increasingly reliant on investment income and, ultimately, plan assets to fund the plan's liabilities. As such, reducing the risk and volatility of the plan's investments becomes increasingly important as the plan matures in closure. This represents the ultimate tradeoff in managing a pension plan under current governmental accounting standards – balancing an acceptable level of investment risk against the strain of pension contributions on operating budgets.

Regardless of the actuarial assumptions used by the Plan, the University remains responsible for the actual benefit payment obligations under the Plan. Any differences between what is assumed and what actually occurs will flow through to impact required Plan contributions, with corresponding impact to the University's operating budgets. As an example, while a higher expected investment return may result in lower Plan contributions initially, if the Plan's realized investment returns are lower than what was expected, future contributions must necessarily

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increase to cover the shortfall. Given the time value of money and the longevity of the Plan's liabilities, any underfunding of contributions in the near term will almost always lead to significantly higher required contributions over time.

Consistent with each of the objectives noted above, the following principle should govern the management of the Plan's actuarial expected investment return / liability discount rate:

- a. When the actuarially determined funded status of the Plan exceeds 95%, the Executive Vice President for Finance and Operations, in consultation with the Board Finance Committee, should work with the Plan's actuary to evaluate the feasibility of lowering the Plan's expected investment return / liability discount rate by an amount that brings the funded status of the Plan back down to 95%, to the extent this can be accomplished without causing an increase in contributions already being paid into the Plan. As the expected investment return / liability discount rate is lowered, the investment risk of the Plan's investments should be lowered concurrently.
 - b. At minimum, this practice should remain in place until the expected investment return / liability discount rate drops to a level equal to the FTSE Pension Index + 2%. The FTSE Pension Index is commonly used by corporate plan sponsors and actuaries to establish discount rates used to value private pension liabilities in compliance with SEC and FASB requirements. The University may substitute another standard liability index in accordance with any shifts in common practice of valuing pension liabilities.
2. Plan Contributions – The Actuarially Determined Contribution (ADC) for the Plan is equal to the normal cost payment plus an amortization

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payment on the unfunded actuarial accrued liability (if applicable). In determining the ADC, the University will follow standard actuarial practices, working in conjunction with the Plan's independent actuary. Differences between actual and expected experience and their related impact on the amortization payment must be amortized on a closed basis. For purposes of this policy, regardless of actuarial determination, the amortization payment component of the ADC shall not be lowered below the level in existence when this policy was adopted until the Plan is fully funded on an actuarial basis utilizing an expected investment return / liability discount rate as prescribed by Section C.1.b. "*Expected Investment Return / Liability Discount Rate.*" With the inclusion of this special provision for amortization payments, the University's required Plan contribution shall be referred to as the Minimum Actuarially Determined Contribution (MADC). The University shall make the MADC into the Plan on an annual basis.

3. Cost Stabilization – Until depleted, the Plan's Stabilization Fund is intended to be the primary means to provide cost stabilization to Plan contributions. The Stabilization Fund can be used to help fund year over year increases to the MADC (as applicable).

As another means of cost stabilization, it is possible that the provisions of Section C.2. "*Plan Contributions*" may result in Plan contributions in certain years being higher than what is actuarially required (years in which the MADC is greater than the ADC). Given the objective to help provide cost stabilization for the Plan, it is the explicit intent of this policy that excess contributions in one year (the amount by which the MADC exceeds the ADC) may be used to help offset other years in which the MADC exceeds the level of the prior year MADC. The University can only utilize unused excess contributions from the previous five years towards the current year contribution.

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This policy explicitly acknowledges that efforts to provide cost stabilization may not be effective during periods of financial markets duress. To the extent this (or any other factors) cause the actuarially determined funded status of the Plan to fall below 75%, the Executive Vice President for Finance and Operations should develop formal recommendations for the Board Finance Committee to improve the funded status of the Plan, which should include a review of investment risk, required contributions and the management of the Plan's liabilities.

4. Plan Benefits – given the magnitude of the Plan's liabilities and the additional risks inherent in managing a closed plan, under no circumstances shall Plan benefits be increased above levels in place at the time of this policy's adoption.

5. Actuarial Review / Transparency – The University shall continue to engage an independent actuary to prepare an annual valuation of the Plan, as well determine the Plan's annual ADC/MADC requirement. The Plan's independent actuary shall also conduct a formal review of the Plan's actuarial assumptions not less than every five years. Actuarial reports shall be made available to the Board on an annual basis as well as other internal and external constituents of the Plan and University.

D. Other Matters

The Board of Curators delegates to the Executive Vice President for Finance and Operations of the University the following responsibilities with respect to the Plan:

1. Recommend contributions to the Plan.

2. Recommend annuity, mortality and other tables as may be useful in actuarial determination.

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3. Recommend actuarial valuations made by experts retained for that purpose.
4. Maintain data necessary for actuarial valuations of the assets of the Plan.
5. Maintain accurate records for the Plan.

(NOTE: Section D - Other Matters is currently contained within the Investment Policy for the Retirement Plan (CRR 140.015). These items are being relocated to this new policy.)

University of Missouri Retirement, Disability and Death Benefit Plan

**Report on Actuarial Valuation Assumptions Study
Based on 2016–2020 Actuarial Experience**



This report has been prepared at the request of the Board of Curators to assist in administering the Plan. This report may not otherwise be copied or reproduced in any form without the consent of the Board of Curators and may only be provided to other parties in its entirety. The measurements shown in this report may not be applicable for other purposes.

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Segal
March 25, 2022



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March 15, 2022

Ryan Rapp
Executive Vice President for Finance & Operations
University of Missouri System
Jesse Hall 311
Columbia, Missouri 65211-3020

Dear Mr. Rapp:

We are pleased to present this comprehensive actuarial valuation assumptions study of the University of Missouri Retirement, Disability and Death Benefit Plan.

The report provides a complete review of all actuarial valuation assumptions and our recommendations in light of prevailing economic trends and the University's own actuarial experience patterns observed during the 2016 through 2020 quinquennium.

We look forward to reviewing this report with you and to answering any questions you may have.

Sincerely,

Segal

By:

A handwritten signature in black ink that reads "Joshua Kaplan". The signature is written in a cursive style and is positioned above a horizontal line.

Joshua Kaplan, FSA, MAAA, EA, FCA
Vice President and Consulting Actuary

March 25, 2022

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Section 1: Summary

The Actuarial Process

It is the primary intent of an actuarial valuation to compare, as of a given date, the value of actuarial liabilities (present value of future pension payments) with the value of the plan's assets so as to measure the current funded status of the program's actuarial liabilities and there from, future annual cost requirements for plan liability funding.

The valuation of actuarial liabilities is based on the sex, age, service, job classification, and pay level characteristics of the plan's participants as well as assumptions as to future actuarial experience.

In other words, when attempting to quantify the current value of pension payments that, for some active employees, will not be made until many years in the future, the actuary directly incorporates the current actuarial characteristics of the participants and then applies projection factors to reflect anticipated future trends.

Such projection factors represent the actuary's best estimate of the future experience of the plan's participants and are based on both observed historical patterns and judgments (including those of University officials) as to current and predicted demographic and related economic trends which are likely to be of influence in the future.

For example, in the valuation of plan assets, the actuary must assign a value to the current assets which will best reflect both their current and ultimate worth when such assets will be required to fund pension payments. The actuary must also make an assumption as to the average rate of growth that current assets and future contributions will achieve in future years. For the University's pension plan, estimates of such future trends are developed, in part, by means of a retrospective five-year study of its own demographic and financial experience which this report describes in detail.

Section 1: Summary

Purpose of an Actuarial Experience Study

The purpose of this study is to develop actuarial assumptions that will best reflect emerging experience. These assumptions will then be used for the future funding of the University of Missouri Retirement, Disability and Death Benefit Plan. Of course, the new results observed in this actuarial experience study cannot be directly factored into the actuarial valuation process. Rather, to the extent that past experience appears to predict intrinsic future demographic trends of the employee group, new actuarial assumptions based on such trends are developed for use in the actuarial valuation in order to produce a stable pattern of future annual cost requirements.

In order to fund for current and future retirement benefits, it is not only important to understand past experience but to also make informed judgments as to the relevance of such experience for the future. The significance of this long range planning is apparent when one considers that an employee now aged twenty-five will probably retire more than forty years from now and will be in receipt of benefits for another twenty years or so, for a total covered period of about sixty years under the plan. Thus, while the retirement for which we are funding will not occur, in this case, for more than forty years from now, the University is now making plan contributions on behalf of the participant in order to build up a sufficient reserve to meet the obligation of providing for this employee's retirement pension.

Therefore, in order to predict future experience, the actuary must develop a set of actuarial assumptions as to future mortality, termination of employment, probabilities of retirement at specific ages, increases in salary and the investment performance of the fund. While the unique future employment pattern of each particular plan participant cannot be predicted, it is the intention of the experience study to develop a set of average future parameters that, subject to periodic adjustments will ultimately prove to be accurate in the aggregate. As explained below, the actuary is seeking "statistically credible" data on which to base his assumptions.

Credibility

Credibility is the trustworthiness or reliability of a statistical result being obtained from a statistical investigation. The larger the group, the smaller the probability that the surveyed experience is a random fluctuation and hence, the more credible are the results. Therefore, only relatively large pension plans will justify experience studies, since, for smaller pension plans, the results do not have a sufficiently high statistical confidence limit. This is also the reason why the University's experience study is performed quinquennially, i.e., so that a sufficiently large experience is measured. This tends to smooth statistical aberrations and make the results more credible.

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Section 1: Summary

Historical Consistency

As noted above, experience during the quinquennium is being reviewed in this report as one of the tools for predicting future experience of the Retirement Plan. However, credible past experience alone is insufficient for the actuary to directly apply in developing his future actuarial assumptions under the Retirement Plan. Therefore, an actuary needs to review related professional research to project credible experience into the future. These studies, known as secular trend studies, are very important to the prediction of certain events such as expected future retirement and mortality rates. Therefore, the following sections of this report will discuss such projected secular trends as they relate to the results of the quinquennial experience study.

Plan Provisions

The experience during the quinquennium reflects the actual plan provisions in effect during this period, which, for purposes of this study, were materially the same. If the plan provisions are significantly changed, past experience alone may not be appropriate to project experience in the future. For example, if eligibility for retirement is significantly changed, then future retirement experience may be different than that of prior experience. The only change in plan provisions during this study period was the closing of the plan effective October 1 2019. We do not anticipate that this change will have any effect on future demographic experience of the current member group.

Section 2: Annual Investment Return Assumption and Asset Valuation Method

Objective

As indicated in Section 1 of this report, the actuarial valuation process compares the present value of future pension liabilities with the plan's current assets and thereby develops annual contribution requirements to fully fund any unfunded liabilities over prescribed periods of time.

This process requires the actuary to assign a value to the current assets which will reflect their ultimate worth when such assets will be required to fund pension payments, and to make an assumption as to the average rate of growth that current assets and future contributions will achieve in future years.

Asset Valuation

For actuarial valuation purposes, the market value of the Plan's assets are not used. In lieu of using market value of assets, an "actuarial" value of assets is employed. Originally, the actuarial value of assets used in the actuarial valuation of the University Plan was book value. Effective with the October 1, 2001 actuarial valuation, the University adopted a new asset valuation methodology referred to as the Expected Return Asset Valuation Method using five-year smoothing.

Under this methodology, the actuarial value of assets are valued at market value less unrecognized returns in each of the prior five years. Unrecognized return is equal to the difference between the actual market return and the expected market return, and is recognized over a five-year period. The actuarial value is further adjusted, if necessary, to be within 20% of the market value.

The table on the next page shows the actuarial and market value of assets as well as the ratio of the two over the past 19 years.

Section 2: Annual Investment Return Assumption and Asset Valuation Method

Valuation Date October 1,	Actuarial Value of Assets	Market Value	Ratio of Actuarial Value to Market Value
2002	\$1,949,793,833	\$1,624,828,194	120.0% ¹
2003	2,067,727,548	1,875,784,774	110.2
2004	2,075,032,000	2,059,391,310	100.8
2005	2,125,656,340	2,366,280,626	89.8
2006	2,325,263,899	2,578,022,645	90.2
2007	2,651,534,668	2,983,628,277	88.9
2008	2,808,125,912	2,427,134,469	115.7
2009	2,843,422,463	2,369,518,719	120.0 ¹
2010	2,851,957,127	2,518,673,108	113.2
2011	2,828,696,693	2,504,265,310	113.0
2012	2,790,622,385	2,788,322,126	100.1
2013	2,950,555,185	3,051,916,429	96.7
2014	3,160,999,182	3,244,105,034	97.4
2015	3,289,215,768	3,109,173,461	105.8
2016	3,433,435,252	3,303,240,367	103.9
2017	3,572,150,725	3,572,074,894	100.0
2018	3,668,671,608	3,684,544,817	99.6
2019	3,763,641,862	3,735,404,966	100.8

¹ Limited to 120% of market value

Section 2: Annual Investment Return Assumption and Asset Valuation Method

Valuation Date October 1,	Actuarial Value of Assets	Market Value	Ratio of Actuarial Value to Market Value
2020	3,888,025,089	3,792,152,115	102.5

Market values are prone to volatility from year to year due to changes in prevailing economic conditions. Fluctuations in market value cause the annual contribution requirements to fluctuate in a reverse fashion, i.e., inflated market values would produce smaller contribution requirements and vice versa. Because of the long term nature of the plan's obligations, the University determined that it would be beneficial to not have the University's cost oscillate with short-term and volatile market swings. However, a 20% corridor around market value (i.e. 80% - 120%) is employed to control the differential between actuarial value and market value.

The Expected Return Asset Valuation Method for purposes of determining actuarial value of assets is now the most widely used methodology by both governmental and private sector pension plans. We recommend that the University continue the use of the current method.

Assumed Rate of Average Future Investment Return

The economic assumptions have a significant impact on the development of plan liabilities. Changes to these assumptions can substantially alter the results determined by the actuary. The goal of our analysis is to produce a consistent set of economic assumptions that appropriately reflect expected future economic trends.

The primary economic assumptions that affect the System's funding are:

- Investment return
- Salary increases

The Actuarial Standards Board (ASB) has adopted Actuarial Standard of Practice No. 27 (ASOP 27), Selection of Economic Assumptions for Measuring Pension Obligations, to provide actuaries guidance in developing economic assumptions. A key feature of the ASB's guidance is the "building block" approach in developing economic assumptions. This approach requires the actuary to consider the key component parts of major assumptions and determine reasonable best-estimates for each component.

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Section 2: Annual Investment Return Assumption and Asset Valuation Method

Under this approach, we consider the investment rate of return assumption as the combination of an inflation component and a real rate of return component. The components of the salary increase assumption are inflation and productivity. The inflation component is included in all economic assumptions, and therefore is key to developing a consistent set of actuarial assumptions.

In developing a recommendation for the assumed inflation component, we reviewed a commonly referenced historical measure of inflation, the Consumer Price Index for all urban consumers (CPI-U). The table below shows how recent inflation experience is below the longer-term average rate.

Average Annual Change in CPI-U (periods ended September 30, 2020)

Past 5 Years	1.8%
Past 10 Years	1.8%
Past 20 Years	2.0%
Past 30 Years	2.3%

The average annual rate of increase in the CPI-U over the five years ended September 30, 2020 is 1.8%. Historical trend is a less important consideration for the assumed rate of inflation, but assists in determining the reasonable bounds of expected inflation.

As another basis for estimating the future expected inflation, we reference the 2020 Annual Report of the Board of Trustees of the Federal Old-Age and Survivors Insurance and Disability Insurance Trust Funds (2020 OASDI Trustees Report). The range of inflation rates in this report was 3.0% for low-cost projection, 2.4% for the intermediate and 1.8% for high-cost projection.

Yet another source is the Survey of Professional Forecasters published by the Federal Reserve Bank of Philadelphia. The 10-year forecast from the Third Quarter 2020 report is 2.03%. The Philadelphia Fed also publishes the Livingston Survey, which shows a median 2.00% projected long-term inflation assumption in the June 2020 survey.

Another important source for inflation forecasting is the 10-year breakeven inflation rate, which is the implied expected inflation rate in the difference in yields between 10-year Treasury securities and 10-year TIPS. This is an important metric because it measures the actual inflation expectations of the market. As of the most recent pension valuation date, October 1, 2020, the 10-year expected inflation based on this metric is 1.63%

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Section 2: Annual Investment Return Assumption and Asset Valuation Method

After reviewing and considering the range of future inflation, we determine the specific point in the range which is to be the estimate of long-term future inflation rates. Because we find no compelling reasons to favor either the high or low end of the range of the various forecasts, we determined that the current 2.2% inflation rate assumption is a reasonable estimate for the future annual rate of inflation for purposes of the building block approach in developing the investment return assumption and the salary increase assumptions.

The investment rate of return assumption is developed using the “building block” approach as outlined in ASOP 27. Under this approach, the investment rate of return assumption is made up of two components; the inflation component and the real investment rate of return component. The inflation component determined above is combined with the reasonable real rate of return component. This total return is then evaluated and refined. The final recommendation is then made.

For purposes of developing the range of real rates of return, we reviewed the 10-year capital market assumptions used by the University’s investment consultant, Verus. We have also reviewed the 10-year capital market assumptions for 2021 from Segal Marco Advisors (SMA). These capital market assumptions were based on total return. Therefore, to arrive at the real rates of return, the expected inflation component was subtracted from the total return to derive the real rate of return by class.

Based on the Plan’s current target allocation and real rate of return assumptions by asset class, the expected real rate of return on an arithmetic basis per Verus is 5.57% on a 10-year horizon. Based on SMA assumptions, the expected real rate of return on an arithmetic basis is 5.60% on a 10-year horizon. The development of the total rates of return and the corresponding returns on a geometric basis are shown on the next page:

Section 2: Annual Investment Return Assumption and Asset Valuation Method

Asset Category	Target Allocation	Expected Real Rate of Return		Contribution to Total Real Rate of Return	
		Verus	SMA	Verus	SMA
US Large	16.90%	3.96%	5.66%	0.67%	0.96%
International Developed	11.30%	5.09%	6.41%	0.58%	0.72%
Emerging Markets	5.80%	6.44%	8.31%	0.37%	0.48%
Private Equity	13.00%	9.89%	9.66%	1.29%	1.26%
US TIPS	10.00%	-0.71%	-0.49%	-0.06%	-0.04%
US Treasury	9.00%	-0.78%	-0.49%	-0.06%	-0.04%
Commodities	3.30%	1.65%	2.71%	0.05%	0.09%
Real Estate	13.0%	7.22%	6.91%	0.94%	0.90%
Precious Metals	1.70%	2.70%	2.71%	0.05%	0.05%
Risk Parity	12.00%	5.50%	4.70%	0.66%	0.56%
Private Debt	6.00%	7.00%	4.21%	0.42%	0.25%
Portable Alpha Overlay	22.00%	1.00%	1.25%	0.22%	0.28%
Cash	-22.00%	-2.08%	-1.09%	0.46%	0.24%
Total expected real rate of return:				5.57%	5.60%
Assumed rate of inflation:				2.20%	2.20%
Total expected investment return (arithmetic):				7.77%	7.80%
Volatility drag:				0.82%	0.72%
Expected net investment return (geometric):				6.95%	7.08%

Actuarial Standard of Practice No. 27, Selection of Economic Assumptions for Measuring Pension Obligations, contains the following discussion on the use of geometric or arithmetic returns:

The use of a forward looking expected geometric return as a discount rate will produce a present value that generally converges to the median present value as the time horizon lengthens (i.e., if the actuary determines a funding obligation using the forward looking expected geometric return to discount the obligation to produce a present value, it is expected that in the limiting case there will be

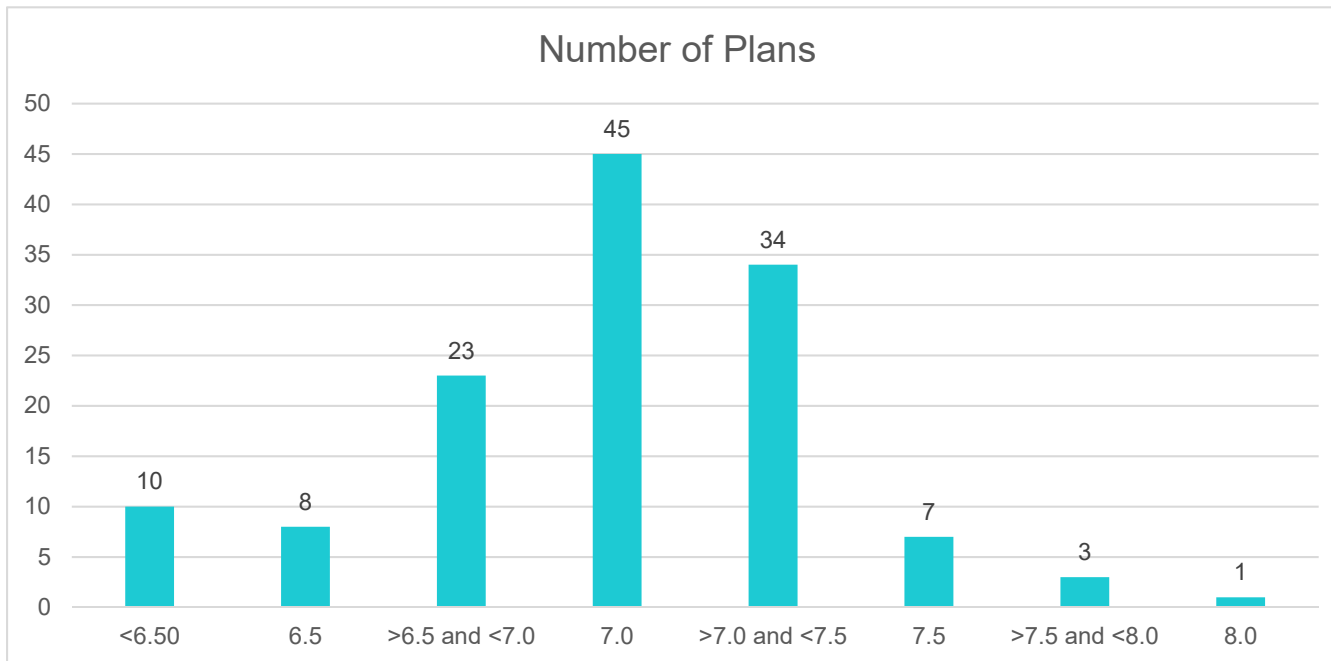
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Section 2: Annual Investment Return Assumption and Asset Valuation Method

enough money to fund the obligation 50% of the time). The use of a forward looking expected arithmetic return as a discount rate will generally produce a mean present value (i.e., there will be no expected actuarial gains and/or losses).

Based on the above analysis, we recommend a change to the assumed rate of investment return from the current assumption of 7.20% to 7.00%.

A review of 131 state and local government retirement plans contained in the 2021 Public Fund Survey presented by the National Association of State Administrators (NASRA) reveals only 44 have an investment return assumption higher than 7.00%, that nearly three-fourths have reduced their investment return assumption since fiscal year 2017, and that all but 5 plans (96%) have reduced their investment return assumption since fiscal year 2010. The average investment return assumption is 6.99% and the median return is 7.00%. The graph below shows the results of the most recent Survey results presented by NASRA.



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Section 3: Salary Progression Trends

Objective

Under the University of Missouri Retirement, Disability and Death Benefit Plan, the annual pension payable at normal retirement age is computed by multiplying the number of years of an employee's service by 2.2% (1.0% for members hired on or after October 1, 2012) of their final average compensation base (average annual salary for the five highest consecutive years of employment).

The actuarial process requires that a projection of compensation base at retirement or termination be made in order to compute expected future pension payments and the current actuarial value of such payments. In order to make this compensation projection, the actuary must develop an assumed salary progression scale based on the relative average salary levels of employees at various points in their careers.

The salary increase assumption consists of two components — one representing inflation and one that represents increases for promotion and longevity. The inflation component is considered in Section 2 of this report.

Methodology

Salary experience during the five-year period from September 30, 2015 through September 30, 2020 has been analyzed for purposes of evaluating the promotion and longevity component of the salary increase assumption. We compiled salary increase experience separately for the Academic and Administrative employees and the Clerical and Service employees by age, for all members included in any two consecutive valuations during the 2015–2020 period, weighted by salary. The results are shown in the tables at the end of this section.

Results of Salary Progression Rates Study

In reviewing the total salary increases shown in the tables, we have observed the inflation component of the increases to be an average of 1.8% over the five-year period. The remainder of the observed salary increase represents the promotion and longevity components of the increases.

Section 3: Salary Progression Trends

The results of the salary increase study reveal the following:

- There continues to be differences between the results of Academic and Administrative personnel and those of Clerical and Service.
- Academic and Administrative personnel averaged approximately 0.4% higher annual increase than Clerical and Service.
- Therefore, we are proposing continuing different salary progression rates for Academic and Administrative personnel than for Clerical and Service employees.

Observed Average Annual Rate of Pay Increases (Weighted By Salary)¹

Period	Academic & Administrative	Clerical & Service
10/1/2015 – 9/30/2016	2.5%	3.1%
10/1/2016 – 9/30/2017	2.5%	1.4%
10/1/2017 – 9/30/2018	4.8%	5.4%
10/1/2018 – 9/30/2019	4.4%	4.1%
10/1/2019 – 9/30/2020	2.9%	1.2%
Average Rate Observed Over Quinquennium	3.4%	3.0%

Based on these results, we recommend that the current salary increase scale be modified as indicated in the following tables. The overall rates of promotion and longevity increase proposed for Academic and Administrative are slightly increased with a few small exceptions at certain ages. For Clerical and Service, the proposed promotion and longevity rates of salary progression are overall relatively steady with slight increases and decreases at various ages. The assumed inflation component of the salary increases remained at 2.2% at all ages.

¹ Total salary increases of which 1.8% represented the average observed basic inflation component over the five-year period

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Section 3: Salary Progression Trends

Academic and Administrative Employees Experience Study 5-Year Period Ended September 30, 2020

Rates of Promotion and Longevity Pay Increases¹

Age	Actual Total Salary Increase (%)	Expected Increase (%)	Proposed Rate (%)
20	9.8	8.5	8.5
21	11.5	8.0	8.0
22	9.2	7.5	7.5
23	8.6	7.0	7.0
24	4.8	6.5	6.5
25	5.0	6.0	6.0
26	5.0	5.5	5.5
27	4.3	5.0	4.5
28	4.9	4.5	4.2
29	3.6	4.0	3.9
30	3.4	3.5	3.6
31	3.5	3.0	3.3
32	2.7	2.8	3.0
33	2.8	2.7	2.8
34	3.0	2.6	2.7

¹ Excludes the basic inflation component, which was assumed to be 2.2% per annum but was observed to be a 1.8% across the board increase over the 5-year period and is expected to be 1.9% in future years.

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Section 3: Salary Progression Trends

Academic and Administrative Employees Experience Study 5-Year Period Ended September 30, 2020

Rates of Promotion and Longevity Pay Increases¹

Age	Actual Total Salary Increase (%)	Expected Increase (%)	Proposed Rate (%)
35	2.5	2.5	2.6
36	2.8	2.4	2.5
37	2.5	2.3	2.4
38	2.7	2.3	2.3
39	1.7	2.2	2.2
40	2.4	2.1	2.1
41	2.3	2.0	2.0
42	1.3	1.9	1.9
43	1.8	1.9	1.9
44	2.7	1.8	1.8
45	1.4	1.7	1.8
46	1.8	1.6	1.7
47	1.6	1.5	1.7
48	1.9	1.4	1.6
49	1.9	1.3	1.6
50	1.5	1.3	1.4
51	1.6	1.3	1.4

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Section 3: Salary Progression Trends

Academic and Administrative Employees Experience Study 5-Year Period Ended September 30, 2020

Rates of Promotion and Longevity Pay Increases¹

Age	Actual Total Salary Increase (%)	Expected Increase (%)	Proposed Rate (%)
52	1.0	1.2	1.2
53	1.2	1.0	1.0
54	0.5	0.8	0.9
55	0.8	0.6	0.8
56	1.0	0.5	0.7
57	1.1	0.4	0.6
58	0.0	0.3	0.5
59	0.7	0.2	0.4
60	0.1	0.1	0.3
61	0.8	0.1	0.2
62	0.1	0.1	0.1
63	-0.4	0.1	0.1
64	0.1	0.1	0.1
65	-0.4	0.0	0.0

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Section 3: Salary Progression Trends

Clerical and Service Employees Experience Study 5-Year Period Ended September 30, 2020

Rates of Promotion and Longevity Pay Increases¹

Age	Actual Total Salary Increase (%)	Expected Increase (%)	Proposed Rate (%)
20	3.0	6.1	6.1
21	4.0	5.5	5.5
22	4.7	5.0	5.0
23	3.6	4.0	4.0
24	3.4	3.5	3.5
25	3.6	3.0	3.1
26	3.4	2.8	2.9
27	2.3	2.7	2.7
28	2.4	2.6	2.5
29	1.8	2.5	2.3
30	2.1	2.4	2.2
31	2.0	2.3	2.1
32	1.9	2.2	2.0
33	2.0	2.1	1.9
34	1.4	2.0	1.8

¹ Excludes the basic inflation component, which was assumed to be 2.2% per annum but was observed to be a 1.8% across the board increase over the 5-year period and is expected to be 1.9% in future years.

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Section 3: Salary Progression Trends

Clerical and Service Employees Experience Study 5-Year Period Ended September 30, 2020

Rates of Promotion and Longevity Pay Increases¹

Age	Actual Total Salary Increase (%)	Expected Increase (%)	Proposed Rate (%)
35	0.9	1.9	1.8
36	1.9	1.8	1.7
37	1.9	1.7	1.7
38	1.4	1.6	1.6
39	1.4	1.5	1.5
40	1.5	1.4	1.4
41	1.5	1.3	1.3
42	1.2	1.2	1.3
43	1.0	1.1	1.2
44	1.7	1.0	1.1
45	0.7	0.9	1.0
46	1.1	0.8	0.9
47	1.3	0.7	0.9
48	0.7	0.6	0.8
49	0.9	0.6	0.8
50	1.0	0.6	0.7
51	0.8	0.6	0.7

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Section 3: Salary Progression Trends

Clerical and Service Employees Experience Study 5-Year Period Ended September 30, 2020

Rates of Promotion and Longevity Pay Increases¹

Age	Actual Total Salary Increase (%)	Expected Increase (%)	Proposed Rate (%)
52	1.0	0.5	0.6
53	0.6	0.5	0.6
54	0.5	0.5	0.5
55	0.5	0.5	0.5
56	0.6	0.4	0.4
57	0.4	0.4	0.4
58	0.6	0.3	0.3
59	0.2	0.2	0.3
60	0.2	0.1	0.2
61	0.2	0.1	0.2
62	0.2	0.1	0.1
63	0.4	0.1	0.1
64	0.2	0.1	0.1
65	0.0	0.0	0.0

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Section 4: Severance of Employment

Objective

Our primary objective in this section of the report is to make as accurate a prediction as possible of the future rate of employment termination exclusive of the retirement and mortality causes which are discussed in Sections 5 and 7, respectively, of this report.

Based on such predictions, the actuary will perform periodic actuarial valuations and will (based on mathematical formulae) calculate how many employees of the current University staff will remain in employ long enough to qualify for retirement benefits. The Actuary will also compute how many of the remaining employees will be vested in a pension at the time of employment termination and in what amount, which is dependent upon length of service at such vested termination. These calculations then undergo further refinement due to other factors in order to arrive at a value of actuarial liabilities used in developing annual University contribution requirements.

Methodology

We have measured the rates of employment severance experienced among those persons who were employed by the University at the beginning of the quinquennium on October 1, 2015 and those persons who were subsequently employed during the quinquennium and then terminated employment during the quinquennium (ended September 30, 2020). Severance of employment from causes other than retirement, mortality, and disability, which were studied separately, was considered.

The resulting severance was studied separately by employment category (Academic and Administrative or Clerical and Service). Within each of the groupings, severance was plotted in comparison with the attained years of service with the University at the time of severance.

Results of Severance Investigation

The results of our analysis of the exhibited severance during the quinquennium may be summarized as follows:

- Due to the closure of the plan effective October 1, 2020, we have generally focused this investigation on mid-high service employees as the exposure as low service will decline to zero over time.
- Set forth on the table is the observed rate of termination during this quinquennium (except for mortality, retirement, or disability) for the grouping and completed years of service shown per one thousand active participants at the beginning of that year of service. For comparative purposes, we are also showing our current assumed rates of severance.

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Section 4: Severance of Employment

- Observed rates of severance were in general slightly higher than the prior assumed rates and therefore, we have increased the assumed rates at various ages for both the Academic and Administrative and Clerical and Service groups. Those changes are highlighted below.
- In addition, the prior assumed rates ended at 20 years of service but as we have observed continued severance after 20 years of service, the proposed new assumed rates have been extended by five years through 25 years of service.

Section 4: Severance of Employment

Rates of Employment Severance (%) – Academic and Administrative

Years of Service	Observed 2016-2020	Current Assumption	Proposed Assumption
0	22.45	21.50	21.50
1	19.32	21.00	21.00
2	18.24	18.50	18.50
3	16.05	17.00	17.00
4	14.45	13.00	15.00
5	14.13	13.50	14.00
6	13.81	12.00	13.00
7	10.96	10.00	12.00
8	9.99	9.00	11.00
9	7.85	8.50	10.00
10	8.78	7.50	9.00
11	7.57	7.00	8.00
12	7.74	6.00	7.00
13	7.20	5.50	6.00
14	6.26	5.00	5.00
15	4.54	5.00	5.00
16	5.32	4.50	5.00
17	6.54	4.00	5.00
18	5.64	4.00	5.00
19	4.20	3.50	5.00
20	3.69	0.00	4.00

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Section 4: Severance of Employment

Rates of Employment Severance (%) – Academic and Administrative

Years of Service	Observed 2016-2020	Current Assumption	Proposed Assumption
21	5.65	0.00	4.00
22	5.63	0.00	4.00
23	2.86	0.00	4.00
24	3.23	0.00	4.00

Section 4: Severance of Employment

Rates of Employment Severance (%) – Clerical and Service

Years of Service	Observed 2016-2020	Current Assumption	Proposed Assumption
0	32.73	31.00	31.00
1	27.91	23.00	23.00
2	22.73	19.50	19.50
3	20.01	17.50	17.50
4	14.31	13.50	13.50
5	14.52	13.50	13.50
6	11.49	11.50	11.50
7	12.32	10.50	11.00
8	11.43	10.00	11.00
9	9.61	9.00	11.00
10	13.48	8.50	10.00
11	9.23	7.50	9.00
12	8.43	7.00	8.00
13	7.82	6.50	7.00
14	7.08	6.00	6.00
15	7.62	5.00	5.00
16	6.87	4.50	5.00
17	5.75	4.00	5.00
18	5.03	4.00	5.00
19	5.21	4.00	5.00
20	2.87	0.00	5.00

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Section 4: Severance of Employment

Rates of Employment Severance (%) – Clerical and Service

Years of Service	Observed 2016-2020	Current Assumption	Proposed Assumption
21	3.14	0.00	5.00
22	6.13	0.00	5.00
23	6.02	0.00	5.00
24	3.95	0.00	5.00

Section 5: Disability Rates

Objective

The University offers a Long Term Disability (LTD) program. Although this Plan does not pay LTD benefits, the Plan does provide that the retirement benefit is determined reflecting service credit during the period of disability. Since those members who sever employment due to disability are treated differently under the Plan than members who sever employment due to other reasons, the actuary will need to project the number of members that will become disabled and the number among those who will survive to collect a retirement benefit.

Methodology

We have measured the rates of disability severance experienced among those persons who were employed by the University at the beginning of the quinquennium on October 1, 2016 and those persons who were subsequently employed during the quinquennium and then became disabled during the quinquennium (ended September 30, 2020).

Results of Disability Rates Study

The results of our analysis of the exhibited disablement during the quinquennium may be summarized as follows:

- Set forth on the table is the observed number of those who became disabled during the quinquennium compared with the number expected to become disabled.
- Disablement observed was much lower than expected. A much more modest reduction was observed in the prior quinquennium.
- Although the number of disability retirements at each age is too small to credibly evaluate the specific rate at each age, the pattern of lower disablements over this study period and the prior period leads us to recommending reducing the current incidence of disability assumption by 20% at each age.

Section 5: Disability Rates

Incidence of Disability

Period	Expected Number of Disableds	Actual Number of Disableds
10/1/2015 – 9/30/2016	41	22
10/1/2016 – 9/30/2017	41	13
10/1/2017 – 9/30/2018	42	17
10/1/2018 – 9/30/2019	43	17
10/1/2019 – 9/30/2020	44	11
Total	211	80

Section 6: Summer Employment

Objective

Under the University of Missouri Retirement, Disability and Death Benefit Plan, there is a separate benefit added to normal pension for participants receiving 9-month appointments designated as summer service. This benefit is calculated at normal retirement age and computed by multiplying the total number of summer appointments by 2.2% (1.0% for members hired on or after October 1, 2012) of their compensation base (average of the 5 consecutive highest summer salaries earned during the summers worked). Summer salary may not exceed 3/9 of regular compensation.

The actuarial process requires a projection of both the number of future summer appointments and the future compensation base used in this additional benefit in order to compute future expected pension payments and their current actuarial value. The additional benefit for summer appointment is valued as a load on the actuarial liability and normal cost of academic and administrative participants. This load is based on the ratio of summer appointment salaries to total salaries for all academic and administrative employees. The current assumed load is 3.3%

Methodology

The ratio of summer salaries (with 3/9 of regular compensation adjustment) to total salary for academic and administrative employees receiving a summer appointment was evaluated for each year of the 2016–2020 quinquennium.

Results of Summer Employment Study

The results of our analysis of summer employment during the quinquennium may be summarized as follows:

- Set forth on the table is the observed ratio of total limited summer salaries to total regular compensation for academic and administrative active members.
- Over the 2016–2020 quinquennium, summer employment salaries/appointments were lower than expected. Based on these findings, we recommend lowering the assumption to a load of 2.20%.

Section 6: Summer Employment

Proportion of Summer Appointments/Salaries

Period	Total Academic and Administrative Payroll	Total Limited Summer Salaries	Ratio
10/1/2015 – 9/30/2016	\$915,115,659	\$20,089,112	2.20%
10/1/2016 – 9/30/2017	922,852,864	20,387,714	2.21%
10/1/2017 – 9/30/2018	961,369,925	20,377,397	2.12%
10/1/2018 – 9/30/2019	992,947,048	20,698,082	2.08%
10/1/2019 – 9/30/2020	920,259,842	20,154,583	2.19%
Total	\$4,712,545,338	\$101,706,888	2.16%

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Section 7: Retirement Rates

Objective

Another key facet of our experience study relates to the determination of the age at which plan participants retire from the University. There are two different types of retirement under the University's Retirement Plan. The two different types of retirement are, first, normal retirement (i.e., retirement at or after attaining age 65) and early retirement (i.e., retirement prior to attaining age 65).

All employees who retired during the quinquennium were analyzed to determine the frequency of retirement at each attained age. Separate frequency analyses were then done by attained age at retirement within the subsets of employment classification (Academic and Administrative or Clerical and Service) and by service.

With regard to those plan participants who retire at or after normal retirement age, it is important to determine the frequency of plan participants who retire when first eligible (age 65) in comparison with those plan participants who defer retirement beyond age 65. This is relevant since, for example, a plan participant retiring at age 67 will be receiving an increased pension due to two additional years of pension service credit and an increased final average salary. However, such a plan participant will receive pension payments for a shorter duration since the retiree commenced receiving payments later in life. Therefore, whether deferring retirement beyond age 65 will result in an increase or decrease in contribution requirements, in comparison with the contribution requirements if the plan participant would retire at age 65, depends upon the specific compensation, service and other data of the particular plan participant.

In the case of plan participants who retire early, we must again ascertain the frequency of retirement at each age. This is important in that early retirement benefits are subsidized, especially for those with 25 years of service, i.e., the reductions which apply to the pension otherwise payable at normal retirement to ascertain the smaller pension payable commencing upon early retirement date do not fully reflect the additional cost inherent for disbursing this benefit for a longer expected future lifetime. Because subsidized early retirement benefits provide an "actuarial reward" for employees who may wish to retire prior to age 65, there can be a significant cost involved in such a program.

Results of Retirement Age Examination

- Set forth below are the observed rates of retirement during the quinquennium by age, separately by category of employment and by service. As in the prior study, we have presented the experience separately for those who had less than 25 years of service and those who had 25 or more years of service at retirement. For ages 65 and older, all years of service were aggregated in the study due to a lack of an early retirement subsidy at those ages.

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Section 7: Retirement Rates

- We continue to find a difference in the probability of retiring at a given attained age at retirement by employment category (Academic and Administrative or Clerical and Service). Therefore, we recommend that the probabilities of retirement by attained age continue to be applied separately for the Academic and Administrative or Clerical and Service subsets.
- There was a tenured faculty buyout in the 2018–2019 plan year, so the retirement experience for that year was excluded from the experience study for Academic and Administrative members.
- We have found a sufficient analysis basis within each of the subsets so that the pattern of retirement at most retirement ages forms a credible basis for examination at such ages. At very early and very late retirement ages there was statistically less data to provide totally credible results and mathematical techniques of graduation were applied to determine consistent probabilities of retirement at those ages free of statistical aberration.
- We recommend the rate of retirement shown in the “proposed retirement” columns of the below tables be utilized for actuarial valuation purposes.

Section 7: Retirement Rates

Retirement Rates (%) - Academic and Administrative Employees

Age	Under 25 Years of Service			25+ Years of Service		
	Actual Retirement Rate ¹	Expected Retirement Rate	Proposed Retirement Rate	Actual Retirement Rate ¹	Expected Retirement Rate	Proposed Retirement Rate
55	5.4	4.0	5.0	9.7	6.0	8.0
56	2.3	3.0	3.0	5.4	4.0	4.0
57	2.9	3.0	3.0	4.1	4.0	4.0
58	5.6	3.0	3.0	3.7	4.0	4.0
59	5.0	3.0	3.0	6.9	4.0	4.0
60	6.1	5.0	5.0	8.1	7.0	8.0
61	4.5	5.0	5.0	11.5	7.0	12.0
62	14.1	10.0	10.0	24.2	20.0	25.0
63	9.4	10.0	10.0	13.4	12.0	12.0
64	12.4	10.0	10.0	13.6	12.0	12.0

¹ Weighted by member salary

Section 7: Retirement Rates

Retirement Rates (%) - Academic and Administrative Employees

Age	Actual Retirement Rate ¹	Expected Retirement Rate	Proposed Retirement Rate
65	24.5	20.0	25.0
66	24.2	20.0	25.0
67	20.2	15.0	20.0
68	17.6	15.0	20.0
69	23.1	15.0	20.0
70	23.6	20.0	20.0
71	14.8	20.0	20.0
72	23.0	20.0	20.0
73	24.2	20.0	20.0
74	14.1	20.0	20.0
75	22.4	20.0	20.0
76	15.2	20.0	20.0
77	28.9	20.0	20.0
78	31.7	20.0	20.0
79	32.7	20.0	20.0
80	21.4	100.0	100.0

¹ Weighted by member salary

Section 7: Retirement Rates

Retirement Rates (%) – Clerical and Service Employees

Age	Under 25 Years of Service			25+ Years of Service		
	Actual Retirement Rate ¹	Expected Retirement Rate	Proposed Retirement Rate (%)	Actual Retirement Rate ¹	Expected Retirement Rate	Proposed Retirement Rate (%)
55	5.7	7.0	7.0	12.4	9.0	12.0
56	5.0	5.0	5.0	4.6	6.0	6.0
57	5.5	5.0	5.0	7.5	6.0	6.0
58	3.2	5.0	5.0	7.4	6.0	6.0
59	4.0	5.0	5.0	11.4	6.0	12.0
60	6.7	10.0	10.0	17.3	12.0	18.0
61	12.7	10.0	10.0	24.7	12.0	24.0
62	19.1	20.0	20.0	54.1	35.0	50.0
63	12.5	14.0	15.0	25.3	19.0	30.0
64	19.4	14.0	15.0	32.0	19.0	30.0

¹ Weighted by member salary

Section 7: Retirement Rates

Retirement Rates (%) – Clerical and Service Employees

Age	Actual Retirement Rate ¹	Expected Retirement Rate	Proposed Retirement Rate
65	40.7	35.0	40.0
66	46.2	35.0	40.0
67	37.5	25.0	35.0
68	30.4	25.0	35.0
69	24.2	25.0	35.0
70	39.0	25.0	35.0
71	25.6	25.0	35.0
72	42.1	25.0	35.0
73	28.7	25.0	35.0
74	24.5	25.0	35.0
75	34.4	25.0	35.0
76	49.3	25.0	35.0
77	36.8	25.0	35.0
78	60.1	25.0	35.0
79	45.8	25.0	35.0
80	22.6	100.0	100.0

¹ Weighted by member salary

Section 8: Mortality Experience

Objective

As actuaries, we have studied mortality rates for various occupational segments of the U.S. population and the trends relative thereto. The following two subsections will explain the importance of the mortality assumption in a pension plan valuation:

- **Retired Participants** - One of the most profound effects of mortality experience in a pension plan is with regard to the mortality experience of pensioners after their retirement. In order to accurately gauge the amount of reserves necessary to provide pensions for the lifetime of the covered employees, we must first determine how long the pensioners will be collecting their monthly benefit checks. However, the mortality effect does not stop merely at this point. Some pensioners will have, upon their deaths, reduced pensions payable to their surviving spouses for the spouses' remaining lifetimes.

Additionally, mortality experience can vary significantly among subsets such as academic and administrative members versus clerical and service members as well as disabled versus non-disabled retirees.

- **Active Participants** - In addition to projecting the mortality rates of pensioners, we must also make assumptions as to the probability of employees dying prior to retirement, since the death of active employees prior to their meeting the eligibility requirements for retirement pensions and pre-retirement death benefits reduces the cost of the plan.

Thus, we must distinguish the following probabilities of active employees: (1) dying in-service prior to meeting the eligibility requirements for any plan benefits, (2) becoming eligible for pre-retirement death benefits under the plan, and (3) surviving to the retirement age specified in the plan.

Methodology

To analyze the assumption of future mortality of plan participants, we must look to published reports and studies of various segments of the national population. Since the probability of death at any age between 25 and 65 is rather small (averaging approximately 0.2%, a statistical analysis of the University's active population of 15,900 members should find approximately 32 active deaths per year). As of September 30, 2020, there were approximately 11,000 retirees and beneficiaries in pay status. Given the University's retiree age distribution, the probability of death in a year for the retiree population is approximately 3.0% (approximately 330 retiree deaths per year). Given these facts and the comparatively small number of deaths at each age relative to the amount needed for full credibility mathematically, the University's data is too small to develop a fully credible mortality table.

We therefore turn to published studies of mortality performed with larger groups that do present credible information. Mortality rates in the United States have continued to improve. The mortality assumption used in valuing liabilities under the University's pension

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Section 8: Mortality Rates

plan for the prior quinquennium has been the RP-2014 Employee, Healthy Annuitant, and Disabled Retiree Tables with generational projection using Scale MP-2017.

For this experience study we believe that the Pub-2010 Public Plans Mortality Tables published by the Society of Actuaries are the most appropriate tables for this plan. Previously we had used a combined table for all members. However, the Pub-2010 tables are published for separate subgroups and there is no combined table. Therefore, we believe that the Teachers table is appropriate for the academic and administrative group and the General table is appropriate for the clerical and service group.

Although the University's statistical data on mortality is not sufficient to determine a fully credible mortality table, actual mortality experience for the University's retirees were determined. This experience is partially credible and was taken into account when setting the mortality assumption. Shown below is a comparison of the assumed healthy mortality rates with the actual rates at selected ages.

Section 8: Mortality Rates

Benefit-Weighted Mortality Rates – Academic and Administrative Retirees

Age	Male			Female		
	Current Mortality Table ¹	Proposed Table ²	Actual	Current Mortality Table ¹	Proposed Table ²	Actual
55 – 59	0.69	0.27	0.67	0.44	0.26	0.27
60 – 64	0.94	0.46	0.11	0.65	0.37	0.20
65 – 69	1.32	0.72	0.45	0.96	0.54	0.71
70 – 74	1.98	1.25	1.06	1.49	0.93	1.10
75 – 79	3.19	2.34	1.69	2.46	1.83	1.89
80 – 84	5.31	4.34	5.26	4.10	3.50	3.64
85 – 89	9.28	8.21	8.15	7.35	6.78	6.98
90 – 94	15.60	14.40	13.97	12.49	12.15	10.68
95 – 99	23.44	22.60	26.91	19.70	20.24	20.65
Actual Deaths to Expected	74.8%			78.4%		

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¹ RP-2014 Mortality Table for Healthy Annuitants with generational projection using scale MP-2017

² Pub-2010 Teacher Healthy Retiree Amount-Weighted Table, weighted 95% for males and 103% for females, with generational projection using Scale MP-2020

Section 8: Mortality Rates

Benefit-Weighted Mortality Rates – Clerical and Service Retirees

Age	Male			Female		
	Current Mortality Table ¹	Proposed Table ²	Actual	Current Mortality Table ¹	Proposed Table ²	Actual
55 – 59	0.65	0.61	3.59	0.43	0.41	0.52
60 – 64	0.94	0.96	1.36	0.65	0.54	0.53
65 – 69	1.30	1.36	2.05	0.95	0.81	0.80
70 – 74	1.93	2.17	3.35	1.49	1.37	1.64
75 – 79	3.19	3.91	4.55	2.47	2.47	2.95
80 – 84	5.36	6.98	7.41	4.16	4.52	5.05
85 – 89	8.99	12.04	14.73	7.37	8.51	8.44
90 – 94	15.63	20.31	24.11	12.45	14.70	18.24
95 – 99	23.48	30.30	44.70	19.59	22.97	37.50
Actual Deaths to Expected	160.2%			115.2%		

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¹ RP-2014 Mortality Table for Healthy Annuitants with generational projection using scale MP-2017

² Pub-2010 General Healthy Retiree Amount-Weighted Table, weighted 124% for males and 112% for females, with generational projection using Scale MP-2020

Section 8: Mortality Rates

The actual mortality rates in each age grouping are volatile because of the relatively small number of deaths. While the actual experience rates are not credible to determine a mortality table, they do show that during the quinquennium, more deaths occurred among retirees than were assumed for clerical and service retirees and fewer deaths than assumed for academic and administrative retirees. The results also bear out that the mortality experience for the academic and administrative group was significantly different than for the clerical and service group as expected due to the significantly different demographics of these groups.

In order to blend the University’s partially credible experience with the standardized tables published by the Society of Actuaries, we have utilized what is termed “the limited fluctuation credibility procedure” to determine the appropriate scaling factor of the base tables for each gender and each member classification.

The table below shows the derivation of the weighting factors, adjusted for credibility, for each gender and member classification. The “Z-Factor” referenced below is a measure of the credibility of each group based on a 90% confidence interval and a 5% margin of error and the “Best Fit Ratio” is the benefits weighted ratio of actual to expected deaths. The “Final Scale Factor” is then determined as the weighted average of the “Best Fit” and 100% based on the Z-Factor.

Academic and Administrative Versus Pub-2010 Teacher Healthy Retiree Amount-Weighted Table

	Best Fit Ratio	Z-Factor	Final Scale Factor
Males	91.6%	55.8%	95%
Females	108.5%	36.9%	103%

Clerical and Service Versus Pub-2010 General Healthy Retiree Amount-Weighted Table

	Best Fit Ratio	Z-Factor	Final Scale Factor
Males	166.8%	35.7%	124%
Females	127.4%	44.7%	112%

The experience reported above is for healthy retired members. The mortality experience for active members, beneficiaries, and disabled members is either not available or the available sample was too small to be credible. However, we propose the follow changes to those assumptions based on the most recently available, appropriate, standardized tables and the adjustment factors for the healthy retiree mortality rates. Additionally, the beneficiary proposed assumption is based on the approximate distribution of pensioner benefits between the academic and administrative group and the clerical and service group.

All of the proposed mortality tables include a projection of future mortality improvement based on the MP-2020 generational projection scale published by the Society of Actuaries.

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Section 8: Mortality Rates

Disabled Retirees: 95% of the Pub-2010 Non-Safety Disabled Retiree Amount-Weighted Tables (sex specific)

Beneficiaries: 80% of the Pub-2010 Teacher Contingent Survivor Amount-Weighted Tables and 20% of the Pub-2010 General Contingent Survivor Amount-Weighted Tables (sex specific)

Academic and Administrative Active and Inactive Members: Pub-2010 Teacher Employee Amount-Weighted Table (sex specific), weighted 95% for males and 103% for females

Clerical and Service Active and Inactive Members: Pub-2010 General Employee Amount-Weighted Table (sex specific), weighted 124% for males and 112% for females

The University also engaged the services of Club Vita, which is a company that has its own proprietary longevity model for projecting member mortality. The Club Vita model produced liabilities that were very close to those generated by the above assumptions, and therefore provided and independent validation on the proposed assumptions.

Section 8: Mortality Rates

Annual Mortality Rates for Male Non-Retired Participants (%)

Age	Current Rate ¹	Proposed Rate (A&A) ²	Proposed Rate (C&S) ³	Age	Current Rate ¹	Proposed Rate (A&A) ²	Proposed Rate (C&S) ³	Age	Current Rate ¹	Proposed Rate (A&A) ²	Proposed Rate (C&S) ³
25	0.05	0.01	0.03	44	0.09	0.05	0.10	63	0.66	0.34	0.51
26	0.05	0.02	0.04	45	0.10	0.06	0.11	64	0.74	0.37	0.54
27	0.05	0.02	0.04	46	0.11	0.06	0.12	65	0.83	0.41	0.58
28	0.04	0.02	0.04	47	0.12	0.07	0.13	66	0.92	0.45	0.62
29	0.05	0.02	0.04	48	0.13	0.08	0.14	67	1.01	0.49	0.66
30	0.05	0.02	0.05	49	0.15	0.09	0.16	68	1.12	0.53	0.71
31	0.05	0.02	0.05	50	0.16	0.10	0.17	69	1.23	0.58	0.76
32	0.05	0.03	0.05	51	0.18	0.11	0.19	70	1.36	0.63	0.82
33	0.05	0.03	0.06	52	0.20	0.12	0.20	71	1.50	0.69	0.89
34	0.05	0.03	0.06	53	0.22	0.13	0.22	72	1.66	0.75	0.96
35	0.05	0.03	0.06	54	0.25	0.15	0.24	73	1.84	0.81	1.06
36	0.06	0.03	0.07	55	0.27	0.16	0.27	74	2.04	0.87	1.16
37	0.06	0.03	0.07	56	0.30	0.18	0.29	75	2.26	0.95	1.26
38	0.06	0.04	0.07	57	0.34	0.19	0.32	76	2.49	1.08	1.38
39	0.06	0.04	0.08	58	0.38	0.21	0.35	77	2.77	1.24	1.51
40	0.06	0.04	0.08	59	0.42	0.23	0.37	78	3.07	1.43	1.67
41	0.07	0.04	0.09	60	0.47	0.26	0.41	79	3.40	1.64	1.78
42	0.07	0.05	0.09	61	0.53	0.28	0.44	80	3.77	1.88	2.03
43	0.08	0.05	0.10	62	0.59	0.31	0.47				

¹ RP-2014 Employee Tables projected generationally with Scale MP-2017

² 95% of Pub-2010 Teacher Employee Amount-Weighted Table projected generationally with Scale MP-2020

³ 124% of Pub-2010 General Employee Amount-Weighted Table projected generationally with Scale MP-2020

Section 8: Mortality Rates

Annual Mortality Rates for Female Non-Retired Participants (%)

Age	Current Rate ¹	Proposed Rate (A&A) ²	Proposed Rate (C&S) ³	Age	Current Rate ¹	Proposed Rate (A&A) ²	Proposed Rate (C&S) ³	Age	Current Rate ¹	Proposed Rate (A&A) ²	Proposed Rate (C&S) ³
25	0.02	0.01	0.01	44	0.06	0.04	0.05	63	0.31	0.22	0.27
26	0.02	0.01	0.01	45	0.06	0.05	0.06	64	0.34	0.24	0.29
27	0.02	0.01	0.01	46	0.07	0.05	0.06	65	0.37	0.26	0.32
28	0.02	0.01	0.01	47	0.08	0.06	0.07	66	0.40	0.29	0.35
29	0.02	0.01	0.02	48	0.09	0.06	0.07	67	0.45	0.32	0.38
30	0.02	0.02	0.02	49	0.10	0.07	0.08	68	0.50	0.36	0.42
31	0.02	0.02	0.02	50	0.11	0.07	0.09	69	0.55	0.41	0.46
32	0.03	0.02	0.02	51	0.12	0.08	0.10	70	0.61	0.46	0.50
33	0.03	0.02	0.02	52	0.13	0.09	0.11	71	0.68	0.52	0.56
34	0.03	0.02	0.03	53	0.14	0.10	0.12	72	0.76	0.59	0.62
35	0.03	0.02	0.03	54	0.16	0.10	0.13	73	0.84	0.68	0.69
36	0.03	0.02	0.03	55	0.17	0.11	0.14	74	0.94	0.78	0.76
37	0.03	0.03	0.03	56	0.18	0.12	0.16	75	1.05	0.88	0.85
38	0.04	0.03	0.04	57	0.20	0.13	0.17	76	1.16	1.02	0.95
39	0.04	0.03	0.04	58	0.21	0.15	0.18	77	1.29	1.17	1.04
40	0.04	0.03	0.04	59	0.23	0.16	0.20	78	1.45	1.35	1.15
41	0.04	0.04	0.05	60	0.25	0.17	0.21	79	1.62	1.56	1.30
42	0.05	0.04	0.05	61	0.27	0.18	0.23	80	1.81	1.88	1.43
43	0.05	0.04	0.05	62	0.29	0.20	0.25				

¹ RP-2014 Employee Tables projected generationally with Scale MP-2017

² 95% of Pub-2010 Teacher Employee Amount-Weighted Table projected generationally with Scale MP-2020

³ 124% of Pub-2010 General Employee Amount-Weighted Table projected generationally with Scale MP-2020

Section 9: Summary of Actuarial Funding Assumptions

Set forth below is a summary of the recommended actuarial standards developed for use in the computation of annual contribution requirements during this quinquennium:

Net Investment Return: 7.00%.

Inflation 2.20%

Salary Increases at Selected Ages :	Age	Academic & Administrative Rate (%)	Clerical & Service Rate (%)
	25	8.2	5.3
	30	5.8	4.4
	35	4.8	4.0
	40	4.3	3.6
	45	4.0	3.2
	50	3.6	2.9
	55	3.0	2.7
	60	2.5	2.4

Salary increases include an assumed inflation rate of 2.2%.

Mortality Rates:

Academic & Administrative Members:

Healthy: Pub-2010 Teacher Healthy Annuitant Mortality Table, weighted 95% for males and 103% for females, with generational projection using Scale MP-2020

Disabled: Pub-2010 Non-Safety Disabled Annuitant Mortality Table, weighted 95% for males and females, with generational projection using Scale MP-2020

Non-Annuitant: Pub-2010 Teacher Employee Mortality Table, weighted 95% for males and 103% for females, with generational projection using Scale MP-2020

Surviving Spouse: 80% of the Pub-2010 Teacher Contingent Survivor Amount-Weighted Tables and 20% of the Pub-2010 General Contingent Survivor Amount-Weighted Tables projected generationally with Scale MP-2020

Section 9: Summary of Actuarial Funding Assumptions

Clerical & Service Members:

Healthy: Pub-2010 General Healthy Annuitant Mortality Table, weighted 124% for males and 112% for females with generational projection using Scale MP-2020

Disabled: Pub-2010 Non-Safety Disabled Annuitant Mortality Table, weighted 95% for males and females, with generational projection using Scale MP-2020

Non-Annuitant: Pub-2010 General Employee Mortality Table, weighted 124% for males and 112% for females, with generational projection using Scale MP-2020

Surviving Spouse: 80% of the Pub-2010 Teacher Contingent Survivor Amount-Weighted Tables and 20% of the Pub-2010 General Contingent Survivor Amount-Weighted Tables projected generationally with Scale MP-2020

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Section 9: Summary of Actuarial Funding Assumptions

Termination Rates Before Retirement:

Withdrawal Rate¹ (%)

Years of Service	Academic & Administrative	Clerical & Service
0	21.5	31.0
1	21.0	23.0
2	18.5	19.5
4	15.0	13.5
6	13.0	11.5
8	11.0	11.0
10	9.0	10.0
12	7.0	8.0
14	5.0	6.0
16	5.0	5.0
18	5.0	5.0
20	4.0	5.0
22	4.0	5.0
24	4.0	5.0

¹ Withdrawal rates do not apply at or beyond early retirement or 25 years of service

Age	Disability Rates (%)
40	0.04
45	0.10
50	0.19
55	0.37
60	0.61

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Section 9: Summary of Actuarial Funding Assumptions

Retirement Rates:

Age	Academic & Administrative		Clerical & Service	
	Under 25 Years of Service	Over 25 Years of Service	Under 25 Years of Service	Over 25 Years of Service
55	5%	8%	7%	12%
56 - 58	3	4	5	6
59	3	4	5	12
60	5	8	10	18
61	5	12	10	24
62	10	25	20	50
63 - 64	10	12	15	30
65 - 66	25	25	40	40
67 - 79	20	20	35	35
80	100	100	100	100

Load for Summer Appointments

2.20% of Academic & Administrative active member liability and normal cost

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Section 10: Impact of Recommended Assumptions on Actuarial Valuation Results

The recommended changes in the assumptions will impact the results of the actuarial valuation as follows:

	Net Employer Contribution				
	Normal Cost	Unfunded Liability	Amount	Level 1 % of Pay	Level 2 % of Pay
October 1, 2020 Valuation	\$59,384,616	\$899,503,574	\$123,154,799	12.66%	9.11%
Change due to:					
• Interest Rate	\$2,863,621	\$111,541,581	\$11,197,366	1.08%	0.91%
• Salary Scale	663,412	10,141,624	1,535,478	0.16%	0.11%
• Severance Rates	-4,643,115	-31,340,225	-7,338,022	-0.81%	-0.48%
• Disability Rates	126,347	2,648,702	354,105	0.04%	0.03%
• Summer Employment Load	-524,205	-18,525,746	-2,117,211	-0.20%	-0.17%
• Retirement Rates	804,102	47,609,999	4,898,026	0.46%	0.41%
• Mortality Rates	1,422,174	101,773,654	10,173,564	0.95%	0.87%
Total Changes	\$712,336	\$223,849,589	18,703,306	1.68%	1.68%
Total Recommended Assumptions	\$60,096,952	\$1,123,353,163	\$141,858,105	14.34%	10.79%

Section 10: Impact of Recommended Assumptions on Actuarial Valuation Results

Based on the October 1, 2020 Actuarial Valuation

Contribution Requirements	Current Assumptions			Recommended Assumptions		
	Total Plan	Level One % of Projected Payroll	Level Two % of Projected Payroll	Total Plan	Level One % of Projected Payroll	Level Two % of Projected Payroll
1. Normal cost	\$59,384,616	6.99%	3.35%	\$60,096,952	7.05%	3.41%
2. 23-year amortization of unfunded liability	78,604,764	7.04%	7.04%	96,595,735	8.65%	8.65%
3. Expected employee contribution	<u>-14,834,581</u>	<u>-1.37%</u>	<u>-1.28%</u>	<u>-14,834,581</u>	<u>-1.37%</u>	<u>-1.28%</u>
4. Net employer contribution	\$123,154,799	12.66%	9.11%	\$141,858,105	14.34%	10.79%

Funding Status

Actuarial liability	\$4,787,528,662	\$5,011,378,251
Actuarial value of assets	3,888,025,088	3,888,025,088
Unfunded liability	899,503,574	1,123,353,163

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Section 11: Funding Policy

The actuarial assumptions determine the total projected future cost of the plan. Once this total future cost is determined the funding method determines how this total cost is allocated to future time periods. This plan uses the Entry Age Normal Cost method to allocate plan costs. This method determines for each member a level annual cost, as a percent of salary, from hire until termination or retirement that is projected to fully fund their retirement benefit. The Entry Age method provides the most level and predictable cost of any funding method. It is also the method that is required to be used for calculation for GASB 67 and 68 accounting. For these reasons, we would not recommend any change in the underlying funding method.

Any projected plan costs that are not covered by either current plan assets or projected future normal costs are unfunded liabilities that must be amortized. The amortization policy has been a level-dollar amortization amount over a closed 30-year period that commenced as of October 1, 2013 (22 years remaining on amortization period as of October 1, 2021).

Actuarial Standard of Practice No. 4 gives guidance of the selection of the amortization period, noting that it should take into account the duration of the actuarial accrued liability and the average remaining service lifetime of active plan participants. The plan was closed to new members effective October 1, 2019. As a result, both the liability duration and the average future service have been declining and are projected to continue to decline in the future.

The Government Finance Officers Association (GFOA) offers best practices in their document *Core Elements of a Funding Policy*. In that document they state that “[a]mortization of the unfunded actuarial accrued liability should ... [n]ever exceed 25 years, but ideally fall in the 15–20 year range”. Furthermore, the GFOA states that “[f]or closed plans that still have active members ... amortization periods should be shorter.”

We recommend that the current amortization period be shortened to no more than 20 years as of October 1, 2021. It would be inappropriate to maintain a longer amortization period as this would extend the payment period far beyond the average future working lifetime of current plan members. This would push the burden of funding the plan costs onto a future cohort of members that do not even participate in the defined benefit plan and threaten the benefit security of current plan members.

In order to maintain stability in future amortization payments, we recommend that the funding policy be amended to provide for separate amortization schedules for future liability changes that arise due to future gains or losses, or future assumption changes. We recommend that future actuarial losses be amortized over a period of 15 to 20 years. Similarly, we recommend that future actuarial gains be amortized over a period of 20 to 25 years. Finally, we recommend that the assumption changes in this report and any future assumption changes be amortized over 20 years. Thus, all liabilities in the October 1, 2021 valuation would be amortized over a closed 20-year period.