To: **State of Michigan Investment Board**

From: Max Kotary, CFA

Stephen Cummings, CFA

Phil Kivarkis, FSA, CFA

John Sullivan

Tim McEnery, CFA

Date: June 11, 2020

Re: **MPSERS A/L Study – Executive Summary**

Overview and Summary

The purpose of this memorandum is to provide a review of the current Asset / Liability (A/L) profile of the Michigan Public School Employees' Retirement System (MPSERS) Defined Benefit Plan and summarize the conclusions that can be drawn from the Asset / Liability Study that Aon recently completed on the Plan. We also provide answers to frequently asked questions relating to our A/L Studies, for reference.

Current A/L Profile: State of Michigan Summary

The State of Michigan offers the following pension and OPEB plans, with asset/liability characteristics shown as of September 30, 2018[1] – the most recent actuarial valuation report available.

Figure 1

	Discount Rate	Market Value of Assets	Actuarial Liability	Funded Ratio	Liability Growth Rate	Asset Hurdle Rate
		(In $ millions)				
Pension						
- *Michigan Public Schools Employees' Retirement System*	6.80%	$50,343.5	$83,375.3	60.38%	7.81%	12.93%
- *Michigan State Employees' Retirement System*	6.70%	$12,398.0	$18,995.2	65.27%	6.97%	10.68%
- *Michigan State Police Retirement System*	6.80%	$1,492.4	$2,271.1	65.71%	7.96%	12.11%
- *Michigan Judges' Retirement System*	6.25%	$271.1	$280.9	96.51%	7.27%	7.54%
- *Military Retirement Provisions*	6.75%	$17.2	$56.8	30.30%	7.90%	26.08%
- *Total Pension*		$64,522.2	$104,979.4	61.46%	7.66%	12.46%
OPEB						
- *Michigan Public Schools Employees' Retiree Health Benefits*	6.95%	$6,111.2	$13,748.9	44.45%	7.35%	16.53%
- *Michigan State Employees' Retiree Health Benefits*	6.90%	$2,562.8	$10,630.3	24.11%	7.89%	32.72%
- *Michigan State Police Retiree Health Benefits*	6.90%	$191.0	$777.3	24.57%	8.13%	33.08%
- *Michigan Judges' Retiree Health Benefits*	7.00%	$1.1	$8.4	12.52%	9.82%	78.44%
- *Total OPEB*		$8,866.1	$25,164.9	35.23%	7.60%	21.57%

[1]September 30, 2018 represents the starting point of our analysis as it is the most recent actuarial liability detail available; for our projections, we have overlaid actual return experience through March 31, 2020 to allow our analysis to be as up-to-date as possible

As the MPSERS pension plan represents the majority of the total assets and liability for the State of Michigan, it will be the primary focus of our in-depth asset/liability analysis with specific attention to the Non-Hybrid plan, which is its largest component.

Key Conclusions of A/L Study

Below we summarize what we view to be the key takeaways from the A/L Study on the MPSERS Plan.

1) The MPSERS plan is currently underfunded (60.38% as of 9/30/2018) which suggests a growth-oriented investment portfolio is reasonable.

2) MPSERS' funding gap will be filled by a combination of plan contributions and investment returns.

   a. Contribution policy will take the plan to a fully funded state regardless of the investment strategy modeled due to the unique characteristics of the plan's funding policy. (These characteristics are explored in detail within the A/L Study and are addressed in summary fashion in the Q&A section of this memorandum.)

   b. The expected return for the Current asset allocation targets based on our current capital market assumptions exceeds the actuarial rate of return (6.80%); that margin will help to close the funding shortfall over time, alleviating some of the burden on future contributions.

3) MPSERS' mix of return-seeking asset classes aligns reasonably well with our best thinking for portfolio construction.

   a. In Figure 2, we compare MPSERS' existing asset allocation targets to Aon's Public Fund "Model Portfolios", scaled to MPSERS' current level of return-seeking assets. (I.e. 87.5% R-S.) Aon's Model Portfolios are designed to be representative of Aon's best thinking for Public Defined Benefit Plan asset allocation policy across a range of different plan circumstances. (By 'plan circumstances' we are referring to things such as internal staffing levels, tolerance for illiquidity, tolerance for complexity, etc.) Our Model Portfolios are not one-size fits all; rather, they are meant to be used as a starting point for asset allocation analysis and decision making.

      i. Efficiency Portfolio = Appropriate for public pension plans that prefer to access markets in a simple, low cost manner.

ii. Model 1 Portfolio = Appropriate for public pension plans with modest internal resources and a relatively low tolerance for complexity and illiquidity.

iii. Model 2 Portfolio = Appropriate for public pension plans with an average level of internal resources and tolerance for complexity and illiquidity.

iv. Model 3 Portfolio = Appropriate for public pension plans with deep internal resources and a high tolerance for complexity and illiquidity.

Figure 2

Risk/Reward Spectrum
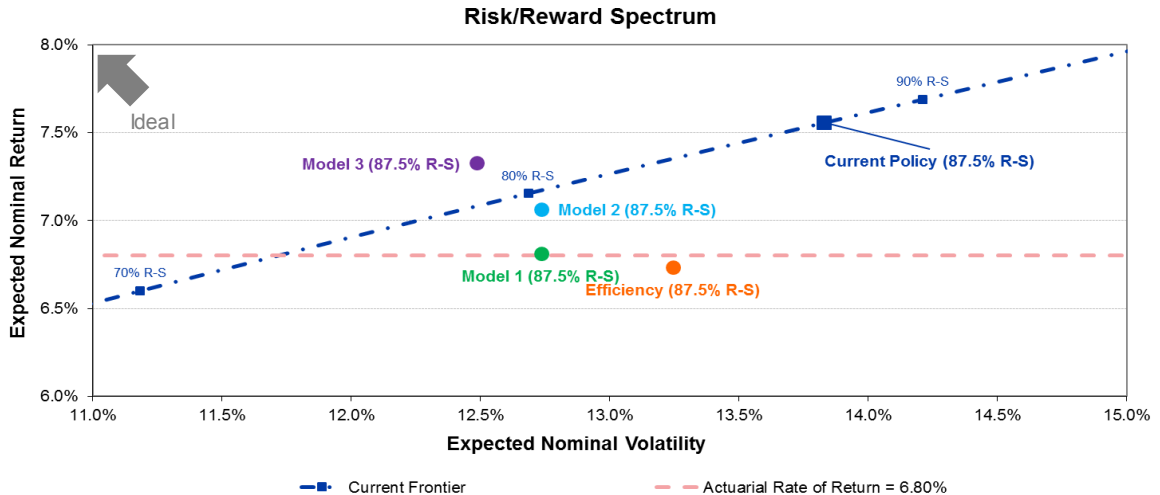
b. Key takeaways from Figure 2:

i. MPSERS' current policy has a higher long-term return forecast than any Aon Model Portfolio.

ii. MPSERS' current policy is more efficient than three of the four Aon Model Portfolios (I.e., its frontier plots above Aon Efficiency, Aon Model 1, and Aon Model 2.)

1. The dashed blue line is representative of MPSERS' existing policy scaled to different levels of return-seeking (R-S) assets.

iii. MPSERS' current policy models as more volatile (i.e., has a higher standard deviation of forecasted investment returns) than the Aon Model portfolios.

1. This is being driven, at least in part, by MPSERS' existing policy having a higher allocation to equities (public + private), particularly relative to Aon Model 3.

4) From an overall investment risk-posture standpoint, we find that:

   a. Higher risk asset allocation policies will be assumed to have lower plan contributions over time but with more volatility of contributions.

   b. Lower risk asset allocation policies will be assumed to have higher plan contributions over time but with less volatility of contributions.

Figure 3

Expected Return Distributions

Figure 4

Contribution Impact
(Max as a Multiple of FYE 2019 Total Contribution Dollars)

R-S%	30Y Expected Return	30Y Nominal Volatility	Sharpe Ratio	1Y Return (2 STD Down)
70.0%	6.60%	11.18%	0.49	-13.43%
72.5%	6.74%	11.55%	0.49	-13.88%
75.0%	6.88%	11.93%	0.48	-14.33%
77.5%	7.02%	12.31%	0.48	-14.78%
80.0%	7.15%	12.68%	0.48	-15.23%
82.5%	7.29%	13.06%	0.47	-15.68%
85.0%	7.42%	13.44%	0.47	-16.12%
87.5%	7.56%	13.83%	0.47	-16.57%
90.0%	7.69%	14.21%	0.46	-17.01%

R-S%	50th Percentile	95th Percentile	99th Percentile
70.0%	2.3	6.2	7.3
72.5%	2.1	6.2	7.3
75.0%	1.9	6.2	7.4
77.5%	1.9	6.2	7.4
80.0%	1.8	6.3	7.5
82.5%	1.8	6.3	7.6
85.0%	1.8	6.3	7.7
87.5%	1.7	6.4	7.8
90.0%	1.7	6.4	7.8

   c. The ideal investment allocation policy for MPSERS should consider the desired balance between funding, investment returns, and risk tolerance.

5) All else equal, we believe MPSERS could benefit from incrementally reducing its investment risk posture.

   a. Incremental efficiency gains. (I.e., increased return per unit of risk assumed / Sharpe Ratio.)

   b. Reduced severity of downside outcomes.

   c. More aligned with peer allocations / Aon Model Portfolios.

6) To reduce investment risk, MPSERS could:

a. Maintain current return-seeking asset mix, reduce allocation to return-seeking assets pro-rata, OR

b. Maintain current target allocation to return-seeking assets, but reduce allocation to equities and add to exposures in diversifying asset categories such as Absolute Return and Real Return and Opportunistic.

Figure 5

Risk/Reward Spectrum
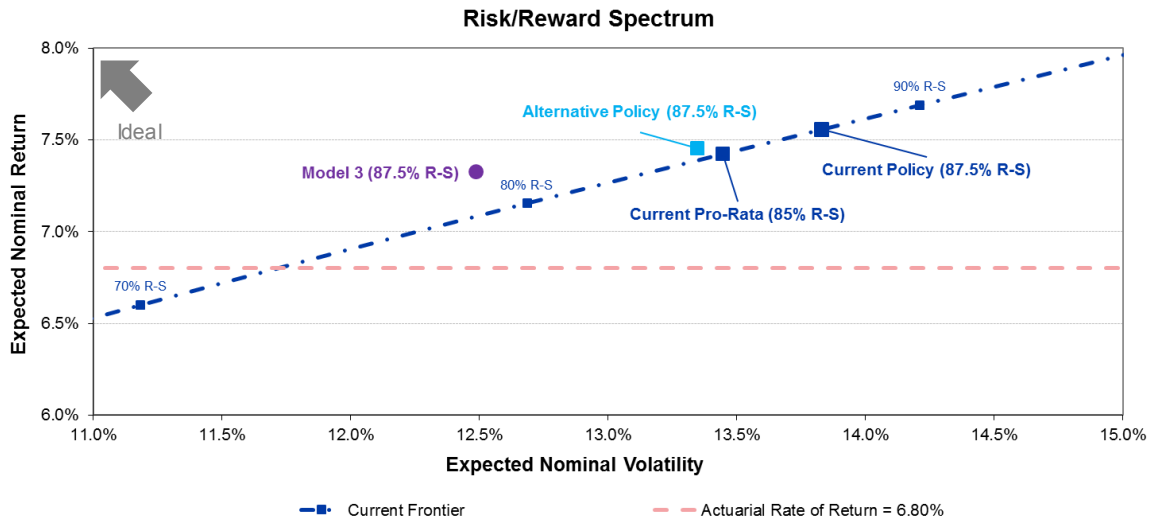
c. We find the latter approach more compelling, as it has a similar impact on forecasted volatility while retaining incrementally more upside.

  i. Please refer to Figure 5; "Alternative Policy (87.5% R-S)" is forecast to have modestly higher returns at a modestly lower level of volatility than simply moving incrementally down the Current Frontier. (E.g., "Current Pro-Rata (85% R-S).)

7) Figure 6 includes our recommended asset allocation targets for MPSERS; these targets are what is modeled as "Alternative Policy" in Figure 5.

a. We have also included recommendations for permissible ranges around these targets in Figure 6.

Figure 6

Asset Class	Current Target	Recommended Target	Difference	Current Range	Recommended Range
Domestic Equity	28.0%	25.0%	(3.0%)	20% - 35%	17% - 32%
International Equity	16.0	15.0	(1.0)	15 - 25	12 - 22
Private Equity	18.0	16.0	(2.0)	10 – 20	13 – 25
Long Term Fixed Income	10.5	10.5	--	10 – 20	8 – 18
Real Estate & Infrastructure	10.0	10.0	--	5 – 15	8 – 18
Real Return & Opportunistic	9.5	12.5	+3.0	5 - 15	8 – 18
Absolute Return	6.0	9.0	+3.0	3 – 9	5 – 11
Short Term Fixed Income	2.0	2.0	--	1 - 6	1 – 8
Total	100.0%	100.0%	--	100.0%	*100.0%*

8) While the focus of our analysis is on the MPSERS Non-Hybrid plan, the characteristics of MPSERS (i.e., funded ratio, liability growth rate, asset hurdle rate) are similar to those of all of Michigan's benefit plans, suggesting that the recommended asset allocation policy included in the table above is appropriate for them as well.

Frequently Asked Questions

Q: What is an A/L Study?

A: An asset/liability study is a comprehensive review of a pension/OPEB plan's assets and liabilities. Utilizing an A/L Study to assist in setting fund asset allocation policy is generally considered to be a best practice amongst public pension systems.

Q: What is the purpose of an A/L Study?

A: An A/L Study provides a toolkit for making decisions on a fund's asset allocation and level of investment risk to best align the plan's assets with the liabilities the fund supports. The study describes the balance between the potential variability of investment returns and the variability of cash flows (contributions) funding the plan. Aon believes optimal decisions regarding pension plan management are made when they are based on a clear understanding of the assets and liabilities of the plan(s) and how they interact. By conducting an A/L Study we can better ascertain the risk preferences of the plan sponsor to best achieve the plan's goals.

Q: How is the A/L Study put together?

A: Aon works with the plan's actuary, in this case GRS, to get a clear understanding of the current benefit structure and funding policy. (I.e., forecasted cash inflows and outflows.) We then use Aon's proprietary Asset/Liability Model to generate up to 5,000 economic scenarios over the next ten-to-thirty years using a Monte Carlo simulation process. Key variables we simulate for the liabilities include inflation, interest rates, and pay increases. We also simulate asset class returns. These simulations lead to a projection of assets and liabilities under all economic scenarios for various asset allocation policies, allowing us to illustrate expected risk-reward tradeoffs in terms of investment return, cash contributions, funded status, net outflow, and 'economic cost.' ('Economic cost' represents the present value of forecasted contributions + any funding shortfall at the end of the projection period.)

Q: How does one read the Study?

A: In its most basic sense, an A/L Study outlines risk/reward tradeoffs of various asset allocation policies. Instead of simply evaluating tradeoffs in terms of returns and volatility of returns, the A/L Study incorporates the liabilities to allow for the evaluation of risk/reward in terms of cash contributions, funded status, net outflow, and economic cost. The Study presents these tradeoffs in the form of a distribution of potential outcomes, highlighting the 95th, 75th, 50th, 25th, and 5th percentile outcomes for each asset allocation policy considered. To better illustrate risk vs. reward, the Study often contrasts the median outcome ("Expected") with the 95th or 5th percentile outcome ("Downside") for the various asset allocation policies considered.

Q: Does the Study rely on stochastic analysis or deterministic analysis?

A: We believe both types of analysis are important and incorporate both within our A/L Studies. Most of the forecasts presented in our A/L Study are stochastic in nature and are based on 5,000 economic scenarios that are generated using a Monte Carlo simulation process. These forecasts are designed to encompass the full range of potential economic outcomes over the period being analyzed. We also include deterministic analyses in our A/L Studies that help answer the question "What might the impact be on the plan's funded ratio, contribution policy, etc. if X environment were to occur?" Our deterministic analyses focus on downside scenarios (e.g., Recession, Depression) and are designed to help take the concept of downside risk out of the abstract and tie it to a tangible economic scenario.

Q: What are some limitations of asset/liability modeling?

A: Asset/liability studies are best-suited to determine the optimal mix of return-seeking (e.g., equity) and risk-reducing (e.g., fixed income) assets. Asset mix is the single most important investment decision for the plan sponsor; studies have found that more than 90% of the variability of a portfolio's return is determined by the asset allocation. Decisions regarding how to divide allocations among various sub-categories that are highly correlated and have similar risk profiles are less important in an asset/liability context. Additionally, asset/liability modelling can capture the likelihood of a strategy meeting the plan sponsor's objectives. It does not 'predict' the future; i.e., we cannot say which of the economic scenarios included in our modelling will actually occur. The results depend on the assumptions underlying the model and the structure of the model itself. There are also variables that cannot be modelled effectively and must be considered in addition to the results of any analysis – e.g., idiosyncratic manager risk, liquidity requirements, black swan events, etc.

Q: What are the key assumptions used in this Study?

A: On the asset side of the equation, we use assumptions for capital market returns, standard deviation of returns (volatility), and correlation of returns. These assumptions are developed and maintained by our capital markets modeling team and updated on a quarterly basis; detail on these assumptions can be found in the Appendix of the Study. On the liability side, our analysis relies on data from the plan actuary combined with Michigan's specific contribution policy – inclusive of closed amortization period, Dedicated Gains Policy, etc.

Of note, our Study assumes that existing contribution / benefits structure remains in place throughout the duration of our analysis.

Q: What is Michigan's Dedicated Gains Policy and how does it work?

A: Adopted in 2017, the Dedicated Gains Policy established a framework to systematically reduce the actuarial assumed rate of investment return used to measure the plan liability when actual investment returns exceed pre-determined actuarial increments. After periods of strong returns (i.e., actual returns exceeding assumed returns), the Dedicated Gains Policy will lower the actuarial return assumption, increase the plan liability, but maintain similar plan contribution levels both before and after the change to the assumed return. After periods of poor returns (i.e., actual returns lagging assumed returns), there would be no changes to the actuarial assumption and plan contributions would increase, re-setting the floor for how low contributions can go in the future. **Therefore, annual contributions are not projected to decline under the current contribution policy until the Dedicated Gains Policy exhausts and reaches its minimum thresholds or the plan reaches full funding.** The Dedicated Gains Policy, as written, includes no floor / minimum threshold for the actuarial assumed rate. However, we believe it is exceedingly unlikely that the policy would remain in place beyond a certain level of reduction to the assumed rate. For the purposes of our modeling, we have assumed a floor on the actuarial assumed rate of 6.0%. (I.e., the Dedicated Gains Policy cannot reduce the assumed rate below 6%.)

Q: What is the amortization policy for contributions?

A: Michigan utilizes a closed amortization approach whereby all unfunded liability is amortized over a specific number of years, reducing by one annually until immediate recognition of (gains)/losses. **Due to the specific point in time that the liability is expected to be fully funded, the forecasted volatility of contributions will increase significantly as that point in time approaches as there are fewer and fewer years across which to spread the cost of any remaining unfunded liability.**

Q: Does an A/L Study consider changes to contribution policy?

A: Most typically no, but on occasion we have employed our asset/liability model to analyze the impact of various changes in the benefit structure or funding policy to the future funded status of a plan. We note that in previous versions of this study, we modeled various iterations of MPSERS' Dedicated Gains Policy.

Q: How might changes to contribution policy impact the results of the study?

A: It is difficult to say and would depend upon the specifics of the changes. In very broad terms, we would comment that modifications to (or the removal of) the more unique aspects of MPSERS' contribution policy – i.e., the Dedicated Gains Policy and the closed amortization period – would alter the numerical calculations throughout the analysis but would be unlikely to impact the key messages of the study.

Q: What is the typical projection period of an A/L Study?

A: Our analysis typically covers time horizons of up to 30 years. For pension/OPEB funds, we believe asset allocation decisions should be made with a long-term view, consistent with the fact that the assets support liabilities that have a very long-time horizon. MPSERS' contribution policy, as it stands today, is designed to move the plan to full funded status over a finite period of time. The policy's applicability after that point comes into question, and it introduces a fair amount of noise into our analysis beyond the end of the amortization period. For this reason, we have truncated our projections in this Study to align more closely with the end of MPSERS' closed amortization period.

Q: Do the asset class return assumptions used in the Study represent asset class returns that are available in the market today?

A: Not necessarily. For A/L Studies, we are projecting the behavior of assets and liabilities over long-term time horizons; as such, we use our longest-term (i.e., 30 year) assumed rates of return for the capital markets. Current market conditions and valuations will impact our long-term return projections, but so will our view on long-term fair value for factors such interest rates, credit spreads, and equity market valuation. A simple example of our long-term assumptions not being reflective of current market conditions is our assumed rate of return on cash. Currently, the return on cash available in the market is ≈0%. But we do not believe that cash yields will be 0% for the next 30 years, hence our assumed rate of return on cash for the purposes of the A/L Study is > 0%.

Q: How often should an AL study be done?

We suggest conducting asset/liability studies every three-to-five years depending on client specifics, or more frequently should circumstances dictate. (Such circumstances might include material changes to the fund's liability profile or contribution policy.)

Q: What is an asset hurdle rate?

A: An asset hurdle rate is the growth needed from the assets, through both contributions and investment returns, to keep pace with the growth of the liability. It is calculated as the liability growth rate divided by the funded ratio.

Q: What is a liability growth rate?

A: Liability growth rate is the projected growth of the liability over the coming year as measured by the sum of the normal cost (i.e., new benefit accruals) and interest cost (i.e., one year of discounting).

Q: What is a funded ratio?
A: A Plan's funded ratio represents the value of plan assets (either the market value or actuarial value; the latter incorporates smoothing techniques) divided by the projected value of plan liabilities. A plan's funded ratio is an important metric, but it tells only a portion of the story. Of equal, or perhaps greater, importance to a pension/OPEB plan's financial health and long-term viability is the plan sponsor's willingness and ability to support future funding obligations.

Q: What are 'return-seeking' assets and 'risk-reducing' assets?
A: In general terms, our A/L Studies are designed to address two asset allocation-related questions: 1) What is an appropriate level of investment risk for a pension/OPEB plan, given its liability profile, and 2) what is the most optimal way to take that risk? Question 2) could be addressed without considering plan liabilities in a separate Asset Allocation Study, but since questions 1) and 2) are related we typically address them both within the framework of an Asset/Liability Study.

Question 1) is really the crux of an A/L Study. In order to simplify the analyses that address this question, our A/L studies bucket asset classes into one of two categories: "risk-reducing" – most typically cash and high-quality fixed income, and "return-seeking" – virtually all other classes of assets. We attempt to identify the most appropriate level of investment risk for a plan sponsor to assume by dialing the return-seeking and risk-reducing allocations up and down proportionally to illustrate risk-reward tradeoffs. Once we arrive at the most appropriate level of investment risk for the portfolio, the mix of underlying asset classes can be refined, and an asset allocation policy can be set that assigns target weightings to each individual asset class that is part of either the return-seeking or risk-reducing bucket.

Q: What if MPSERS put all of its portfolio in return-seeking assets?
A: This would result in a roughly $2.1 billion reduction in future contributions to the plan over the next 20 years relative to the current asset allocation policy, based on our modeling. But such a policy would come under intense scrutiny in a down market and is likely not sustainable. It could also lead to liquidity challenges. If such an asset allocation policy were adopted and then changed under the pressure of a down market, it could very well result in an increase in future contributions relative to the current asset allocation policy.

Figure 7

	Current Policy (87.5% Return-Seeking)	90% Return Seeking	100% Return Seeking
Forecasted Return	7.56%	7.69%	8.23%
Forecasted Volatility	13.83%	14.21%	15.76%
Sharpe Ratio	0.47	0.46	0.45
1 Year Return (2 Std Deviations Down)	-16.57%	-17.01%	-18.75%
Mark-to-Market Loss on a $50 billion portfolio (2 Std Dev)	$8.3 billion	$8.5 billion	$9.4 billion
Loss Relative to Current Policy	--	($0.2 billion)	($1.1 billion)

Q: What if MPSERS put all of its portfolio in risk-reducing assets?
A: This would result in much more certainty in future contributions, but it would also increase them dramatically. As illustrated in Figure 8 below, forecasted contributions under a 0% return-seeking (i.e., 100% risk-reducing) scenario would increase to more than 5X their FYE 2019 level over the forecast period in our median outcome. The distribution of potential contribution outcomes becomes much narrower, but with a tremendous increase to average cost.

Contribution Impact

Figure 8   *(Max as a Multiple of FYE 2019 Total Contribution Dollars)*

Asset Allocation	50th Percentile	95th Percentile	99th Percentile
Current Policy 87.5% R-S	1.7	6.4	7.8
0% R-S*	5.3	6.2	6.5

*0% Return-Seeking = 100% Risk-Reducing

Q: So what is the right asset allocation policy for MPSERS, based on the results of this Study?
A: If only it were that simple! A/L Studies are not necessarily prescriptive, and unfortunately rarely point to an obvious "right" answer. What we can say based on this Study, however, is:

1) A relatively high allocation to return-seeking assets is supportable, given the nature of MPSERS' liabilities. MPSERS is currently underfunded (≈60% as of 9/30/2018), and its current contribution policy forces full funding at the end of its closed amortization period. This contribution policy results

in a pretty heavy projected future contribution burden. Reducing the allocation to return-seeking assets would only add to this burden.

2) <u>Further increasing the allocation to return-seeking assets has diminishing marginal benefits.</u> The current target allocation (i.e., 87.5% in return-seeking assets) places a heavy emphasis on return-seeking assets. Increasing this allocation further would lead to reduced returns per unit of risk assumed (i.e., lower Sharpe Ratio), and would also lead to increasingly dire outcomes during market corrections. The latter could have implications for liquidity and the System's ability to make benefit payments under the most draconian market scenarios.

3) <u>MPSERS Current Policy allocation generally aligns well with our best thinking for portfolio construction.</u> MPSERS Current Policy plots as more efficient (i.e., more return per unit of risk assumed) than three of our four Model Portfolios. It also has a higher long-term return expectation than any of our Model Portfolios.

4) <u>Reducing equity risk and increasing exposure to diversifying asset categories (E.g., Absolute Return, Real Return & Opportunistic) could improve the efficiency of the MPSERS portfolio, at least at the margin.</u> Taking these actions will improve forecasted downside outcomes without meaningfully reducing forecasted average outcomes. It will also bring the risk posture of the MPSERS portfolio more in line with that of our Model Portfolios. The impact would be similar to incrementally reducing the allocation to return-seeking assets under the current asset allocation policy, but with modestly more upside.