

# Stress Testing



## Public Pension Management and Asset Investment Review Commission Hearing

July 30, 2018

Kenneth A. Kent, FSA, FCA, MAAA, EA  
Principal Consulting Actuary

# Topics for Discussion



**Background**

**Stress Testing?**

**How Does It Work?**

**Why is it important?**

**Show me!**

# Background- The Pension Landscape



**TAX**



'My benefits have cut



# Background – Who's Talking About It



ACTUARIAL STANDARDS BOARD

# Background – What is Missing



TABLE I-1  
SUMMARY OF PRINCIPAL RESULTS

	1/1/2016	1/1/2017	Change
<b>Participant Counts</b>			
Actives	10,007	9,068	( 9.4%)
Terminated Vesteds	11,569	11,719	1.3%
In Pay Status	6,768	7,202	6.4%
Total	28,344	27,989	( 1.3%)
<b>Financial Information</b>			
Market Value of Assets	\$ 811,196,890	\$ 852,950,933	5.1%
Actuarial Value of Assets	808,789,046	854,711,912	5.7%
Present Value of Future Benefits	\$ 1,083,650,064	\$ 1,116,899,660	3.1%
Actuarial / PPA Liability	\$ 980,555,899	\$ 1,018,756,653	3.9%
Surplus / (Unfunded) based on Actuarial Value of Assets	(171,766,853)	(164,044,741)	( 4.5%)
Funded Ratio based on Actuarial Value of Assets	82.5%		
Funded Ratio based on Market Value of Assets	82.7%		
Present Value of Vested Benefits for Withdrawal Liability	\$ 1,465,060,430	\$	
Surplus / (Unfunded) based on Market Value of Assets	(653,863,540)		
<b>Gain / (Loss), Minimum Funding, and Cash Flows</b>			
Actuarial Investment Gain / (Loss)	\$ 5,647,769	\$	
Liability Gain / (Loss)	(5,812,620)		
Minimum Required Contribution (before Credit Balance)	35,499,289 *		
Credit Balance	10,897,907		
Prior Year Contributions (net from all sources)	\$ 33,879,790	\$	
Prior Year Benefit Payouts	41,343,465		
Prior Year Administrative Expenses	3,158,567		
Prior Year Total Investment Income (Net)	20,730,005		





## Insurance Industry

- Require Solvency Testing Using *Dynamic Financial Analysis since 1980 to forecast ruin probabilities*

## Banking Industry

- Dodd-Frank - established stress tests as a key component for regulators to gauge the banking industry health

## Social Security Trustees Report

- Optimistic, pessimistic and best estimate

# Stress Testing ?



It is NOT a solution

It is a measurement

It is NOT a decision

It is information necessary to  
make better decisions

It is NOT a risk

It is a visualization of the potential  
outcome of risk



Stress testing measures the risk of a financial system's ability to meet future obligations

For Pension plans the risk emanates from two typical structures:

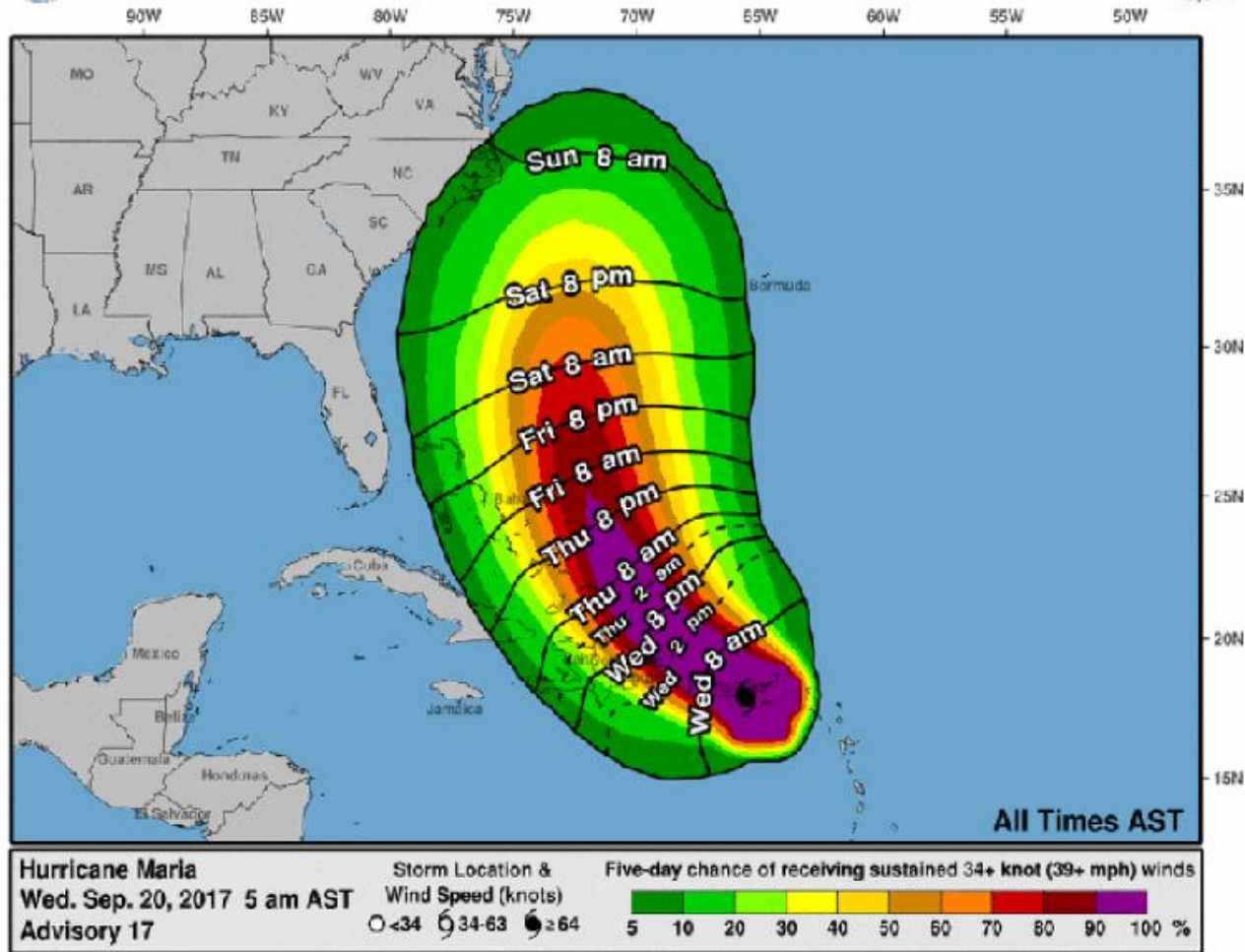
- If contributions can vary - the risk of sustainability
- If contributions are fixed - the risk of insolvency



# Why is Stress Testing Important



## Earliest Reasonable Arrival Time of Tropical-Storm-Force Winds

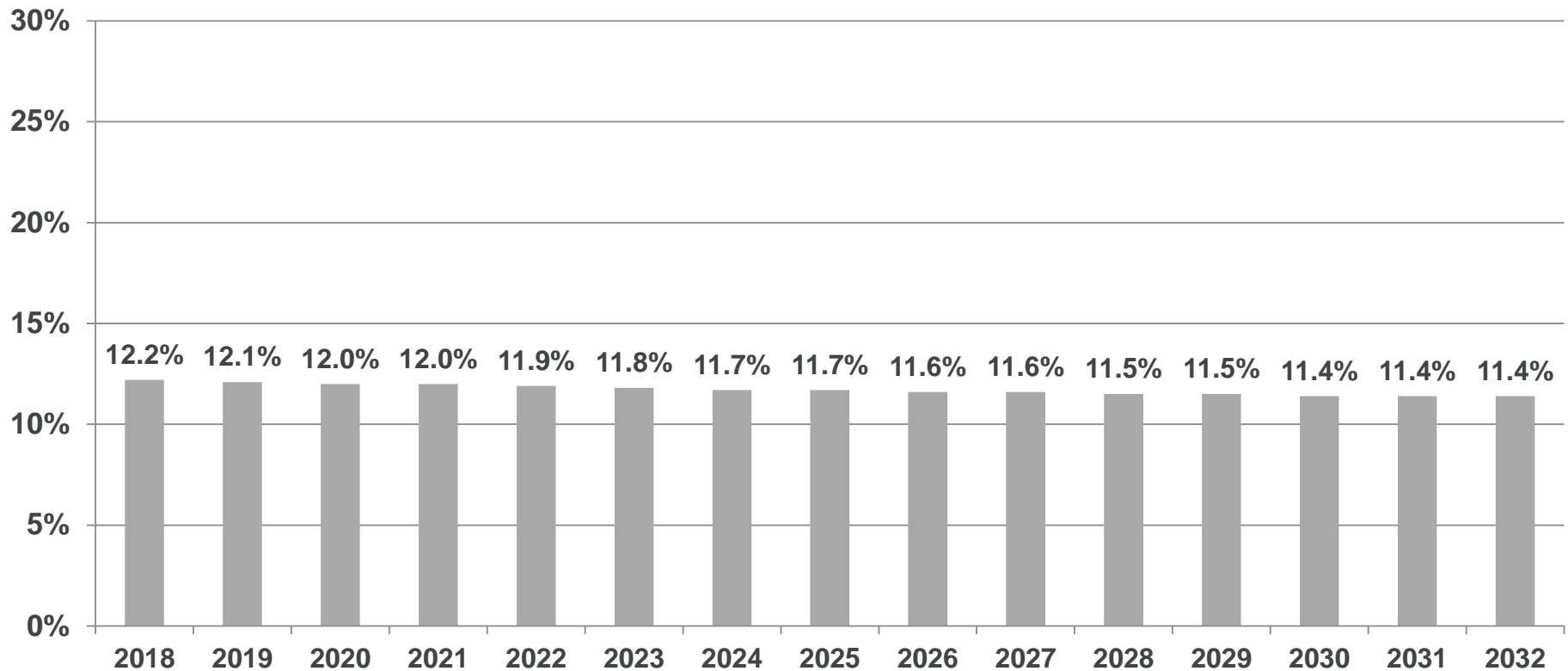


# Baseline Projection: Not A Stress Test



You start with a projection of expected results (best estimate actuarial assumptions)

State Contribution Rate as a % of Payroll

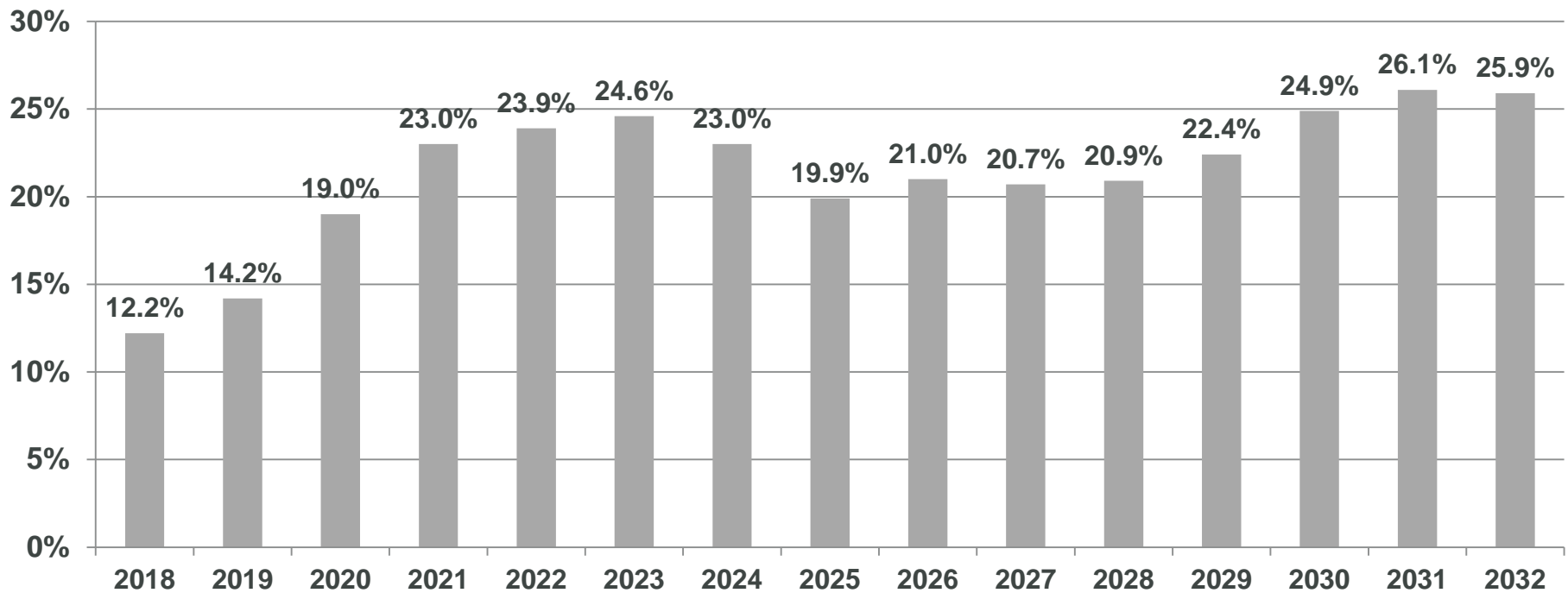


# A Simple Stress Test



Then test what happens if your expectations are off (project out alternative results within expected ranges)

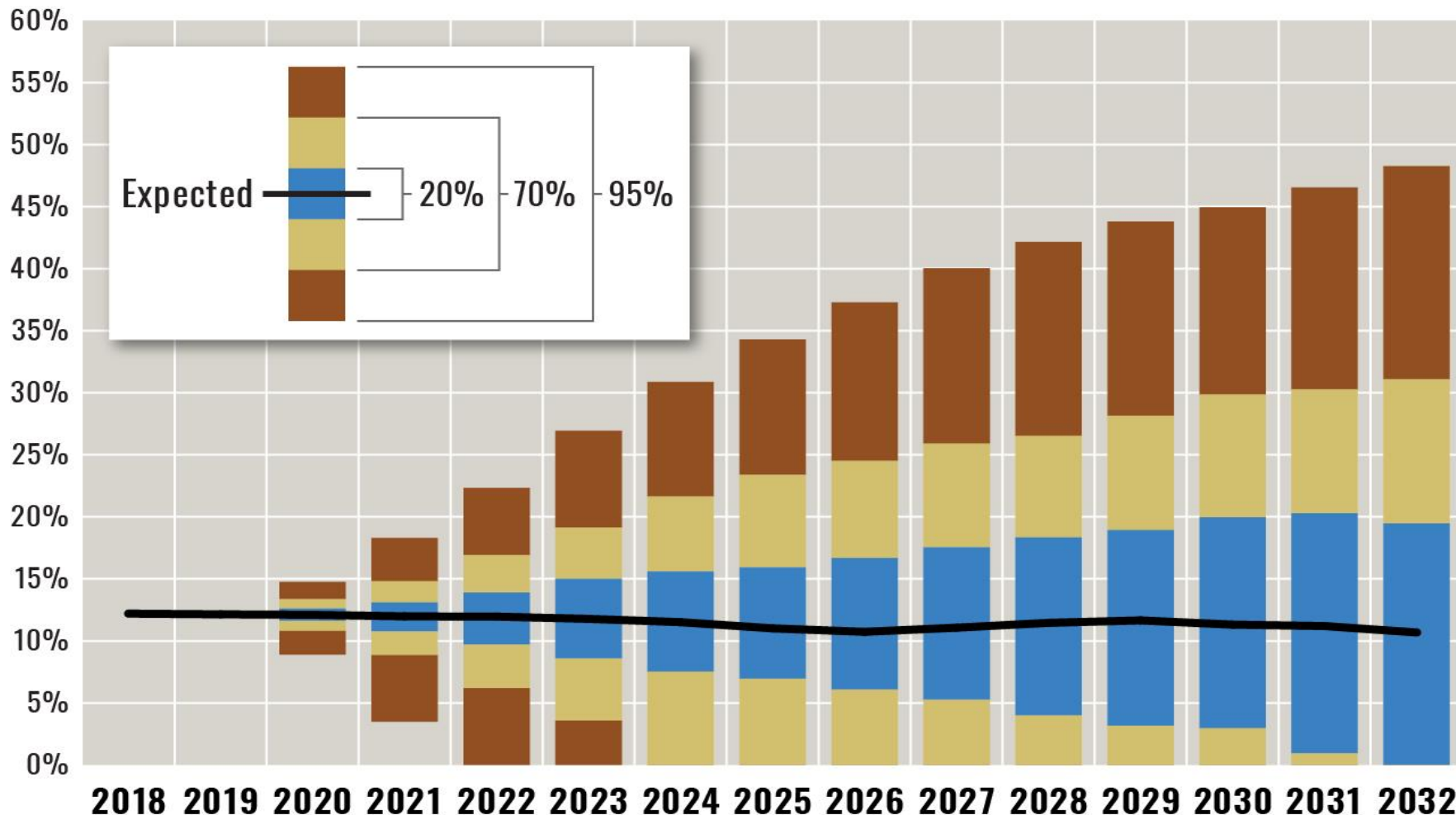
State Contribution Rate as a % of Payroll



# Stress Testing- An Illustration



**Figure 4** Plan sponsor contribution as a percent of payroll

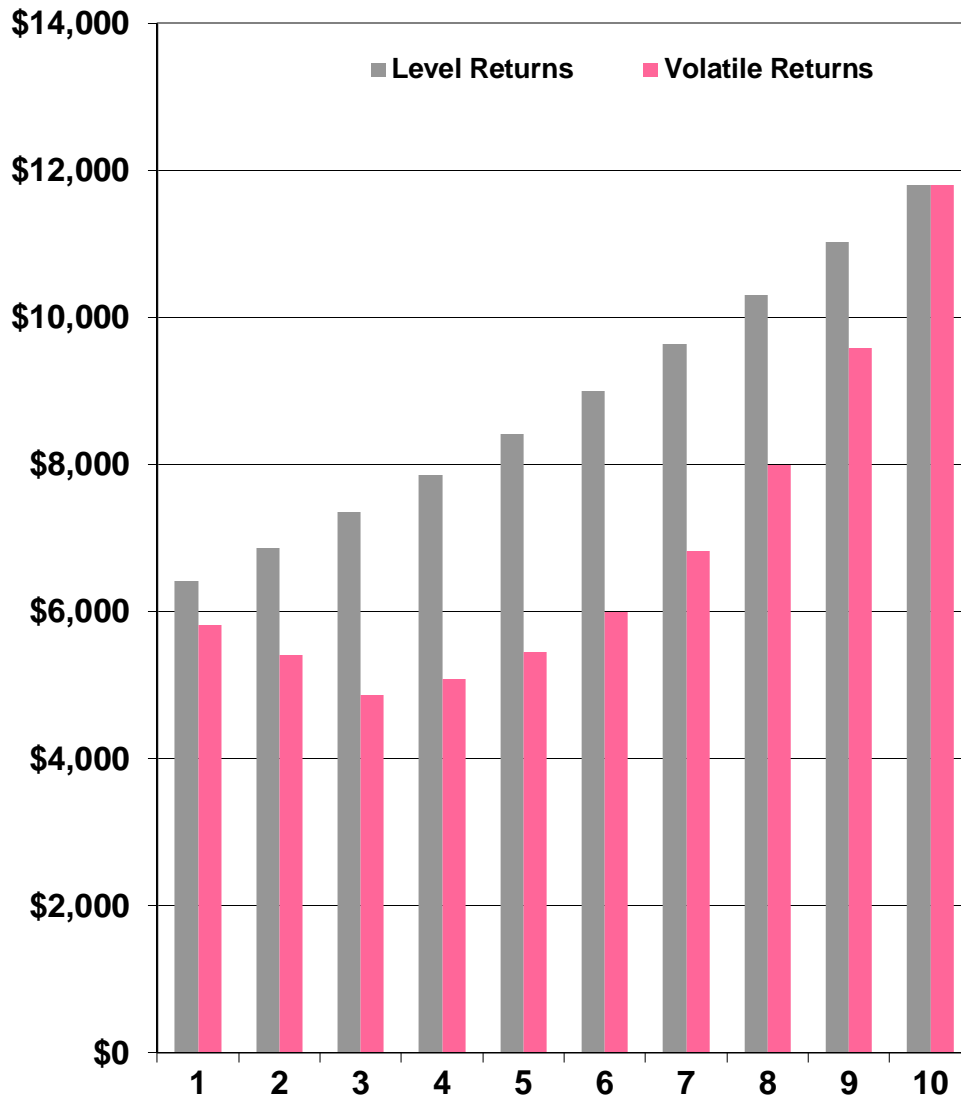


# Net Cash Flow Is Zero



Starting Assets **\$ 6,000** Net Cash Flow Growth **0.0%**  
 Net Cash Flow **0.0%** Market Cycle **downup**

Year	New Cash Flow	Level Returns	Volatile Returns	ASSETS	
				level	volatile
1	\$ -	7.0%	-3.0%	\$6,420	\$5,820
2	\$ -	7.0%	-7.0%	\$6,869	\$5,413
3	\$ -	7.0%	-10.0%	\$7,350	\$4,871
4	\$ -	7.0%	4.5%	\$7,865	\$5,091
5	\$ -	7.0%	7.0%	\$8,415	\$5,448
6	\$ -	7.0%	10.0%	\$9,004	\$5,992
7	\$ -	7.0%	14.0%	\$9,635	\$6,831
8	\$ -	7.0%	17.0%	\$10,309	\$7,993
9	\$ -	7.0%	20.0%	\$11,031	\$9,591
10	\$ -	7.0%	23.1%	\$11,803	\$11,803



reported return = **7.00%** **7.00%** *time weighted returns*

actual return = **7.00%** **7.00%** *dollar weighted returns*

Asset Loss/(Gain) **\$0** or **0%**

July 30, 2018

# Negative Cash Flows – Down/Up Markets



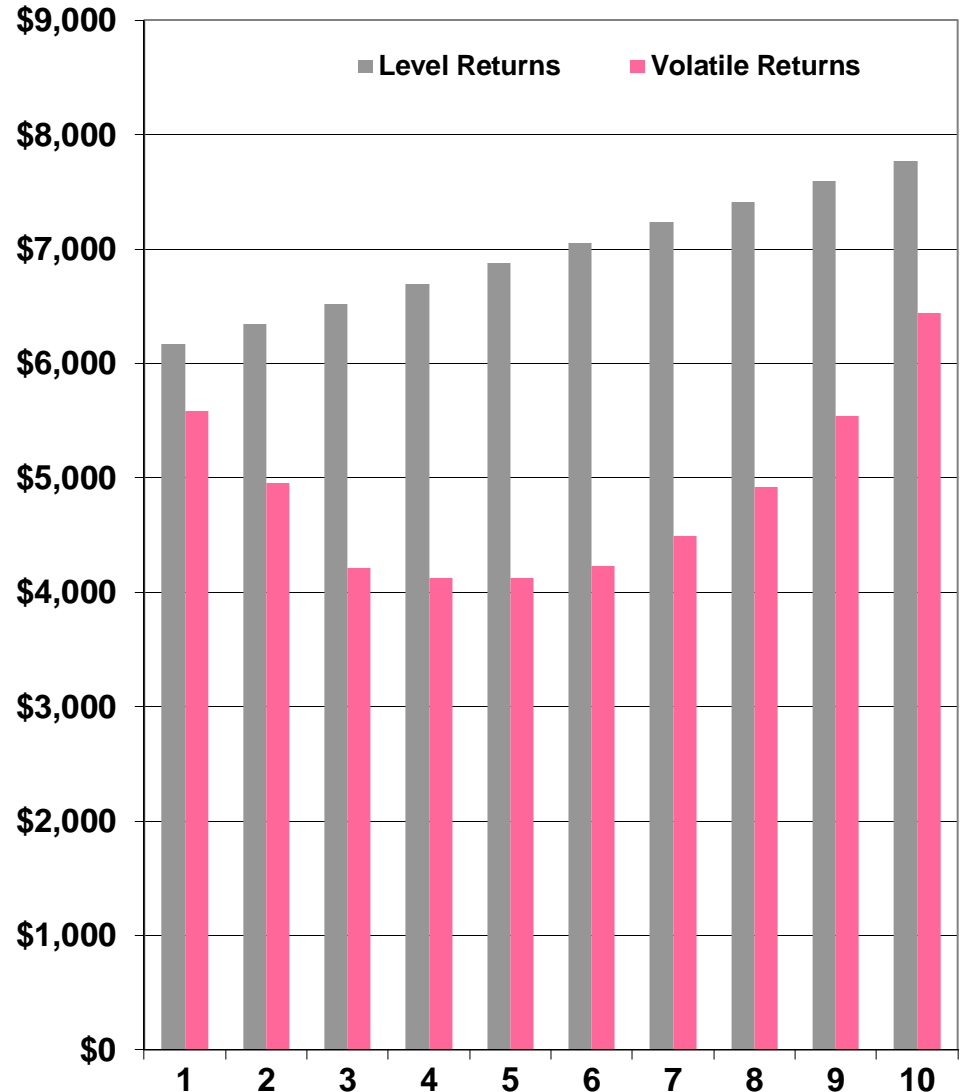
Starting Assets **\$ 6,000** Net Cash Flow Growth **4.0%**  
 Net Cash Flow **-4.0%** Market Cycle **downup**

Year	New Cash Flow	Level Returns	Volatile Returns	ASSETS	
				level	volatile
1	\$ (240.0)	7.0%	-3.0%	\$6,172	\$5,584
2	\$ (249.6)	7.0%	-7.0%	\$6,346	\$4,952
3	\$ (259.6)	7.0%	-10.0%	\$6,521	\$4,211
4	\$ (270.0)	7.0%	4.5%	\$6,698	\$4,125
5	\$ (280.8)	7.0%	7.0%	\$6,877	\$4,123
6	\$ (292.0)	7.0%	10.0%	\$7,056	\$4,229
7	\$ (303.7)	7.0%	14.0%	\$7,236	\$4,497
8	\$ (315.8)	7.0%	17.0%	\$7,416	\$4,920
9	\$ (328.5)	7.0%	20.0%	\$7,595	\$5,544
10	\$ (341.6)	7.0%	23.1%	\$7,774	\$6,443

reported return = **7.00%** **7.00%** *time weighted returns*

actual return = **7.00%** **5.42%** *dollar weighted returns*

Asset Loss/(Gain) **\$1,330** or **-17%**

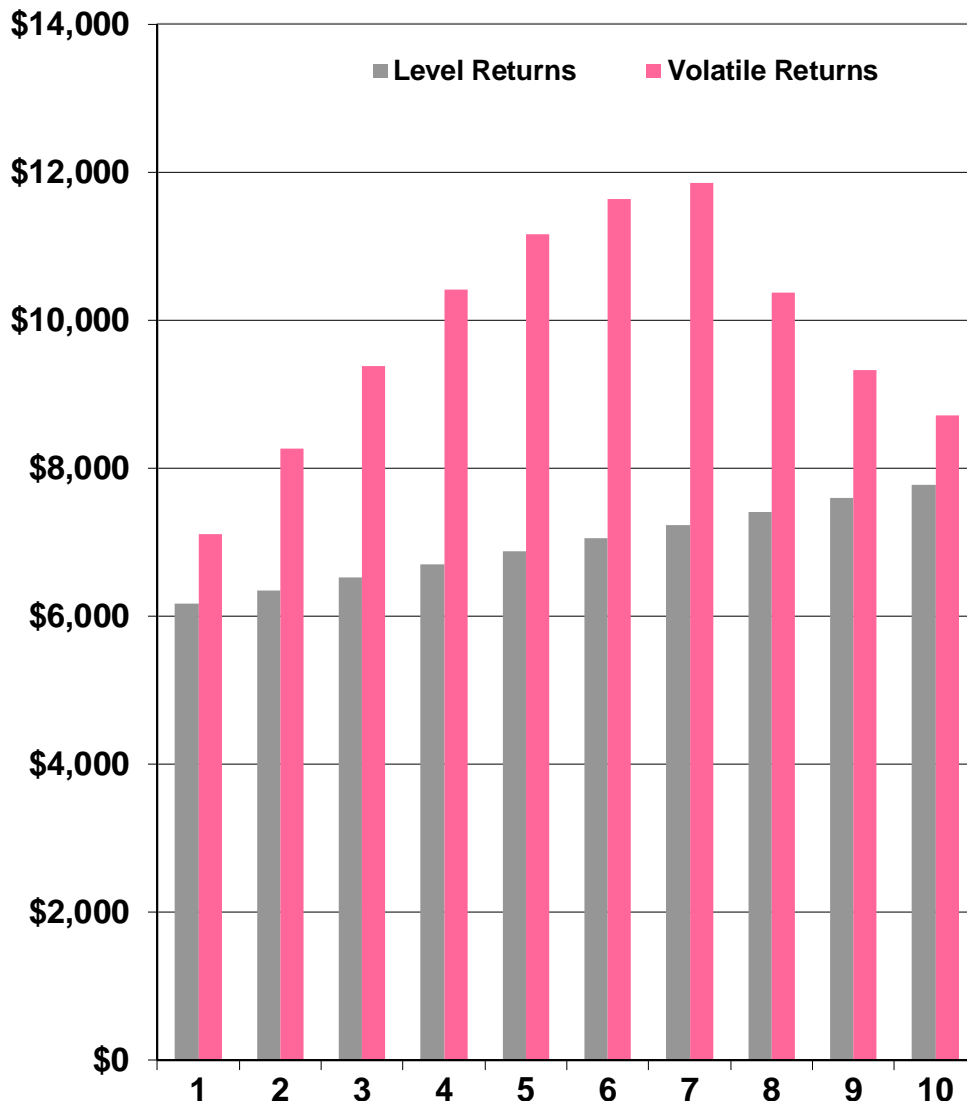


# Negative Cash Flow – Up/Down Returns



Starting Assets **\$ 6,000** Net Cash Flow Growth **4.0%**  
 Net Cash Flow **-4.0%** Market Cycle **updown**

Year	New Cash Flow	Level Returns	Volatile Returns	ASSETS	
				level	volatile
1	\$ (240.0)	7.0%	23.0%	\$6,172	\$7,114
2	\$ (249.6)	7.0%	20.0%	\$6,346	\$8,263
3	\$ (259.6)	7.0%	17.0%	\$6,521	\$9,387
4	\$ (270.0)	7.0%	14.0%	\$6,698	\$10,413
5	\$ (280.8)	7.0%	10.0%	\$6,877	\$11,160
6	\$ (292.0)	7.0%	7.0%	\$7,056	\$11,639
7	\$ (303.7)	7.0%	4.5%	\$7,236	\$11,854
8	\$ (315.8)	7.0%	-10.0%	\$7,416	\$10,369
9	\$ (328.5)	7.0%	-7.0%	\$7,595	\$9,326
10	\$ (341.6)	7.0%	-3.0%	\$7,774	\$8,715



reported return = **7.00%** **7.00%** *time weighted returns*

actual return = **7.00%** **7.99%** *dollar weighted returns*

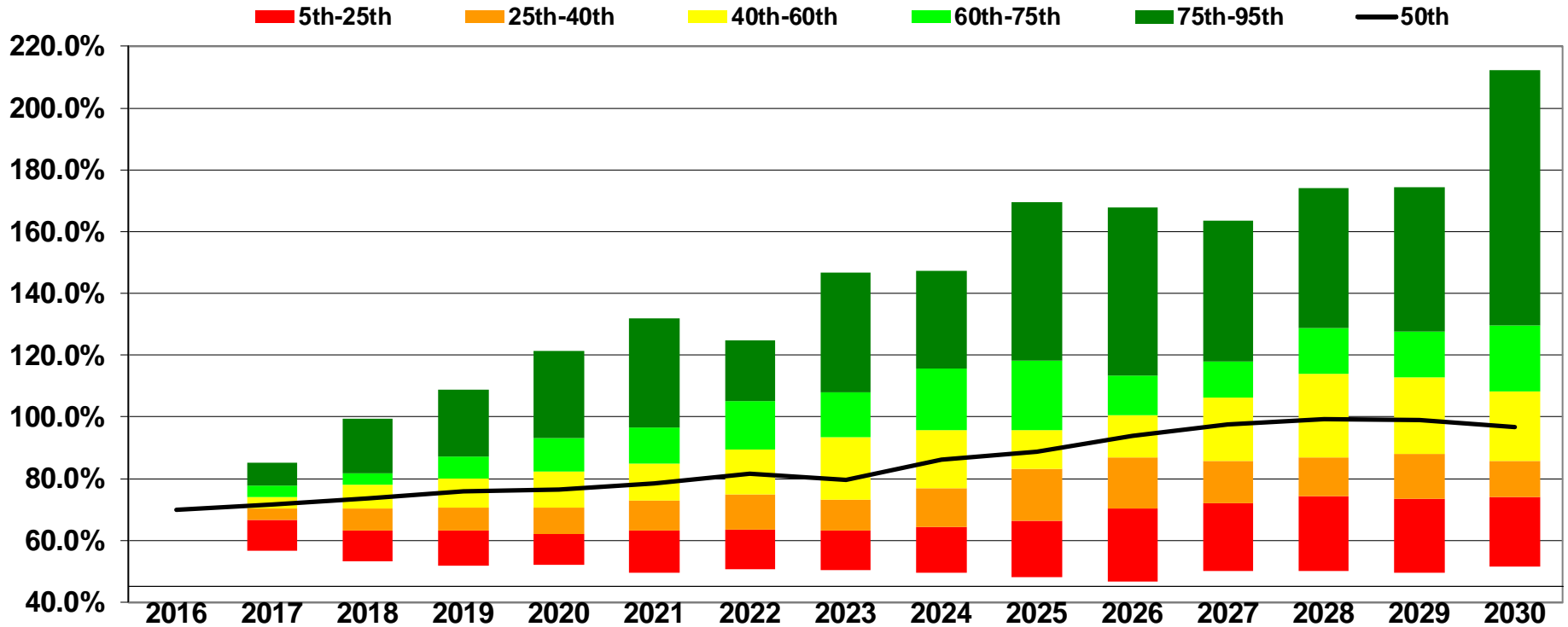
Asset Loss/(Gain) **(\$941)** or **12%**

July 30, 2018

# Why is Stress Testing Important



## MVA Funding Ratio



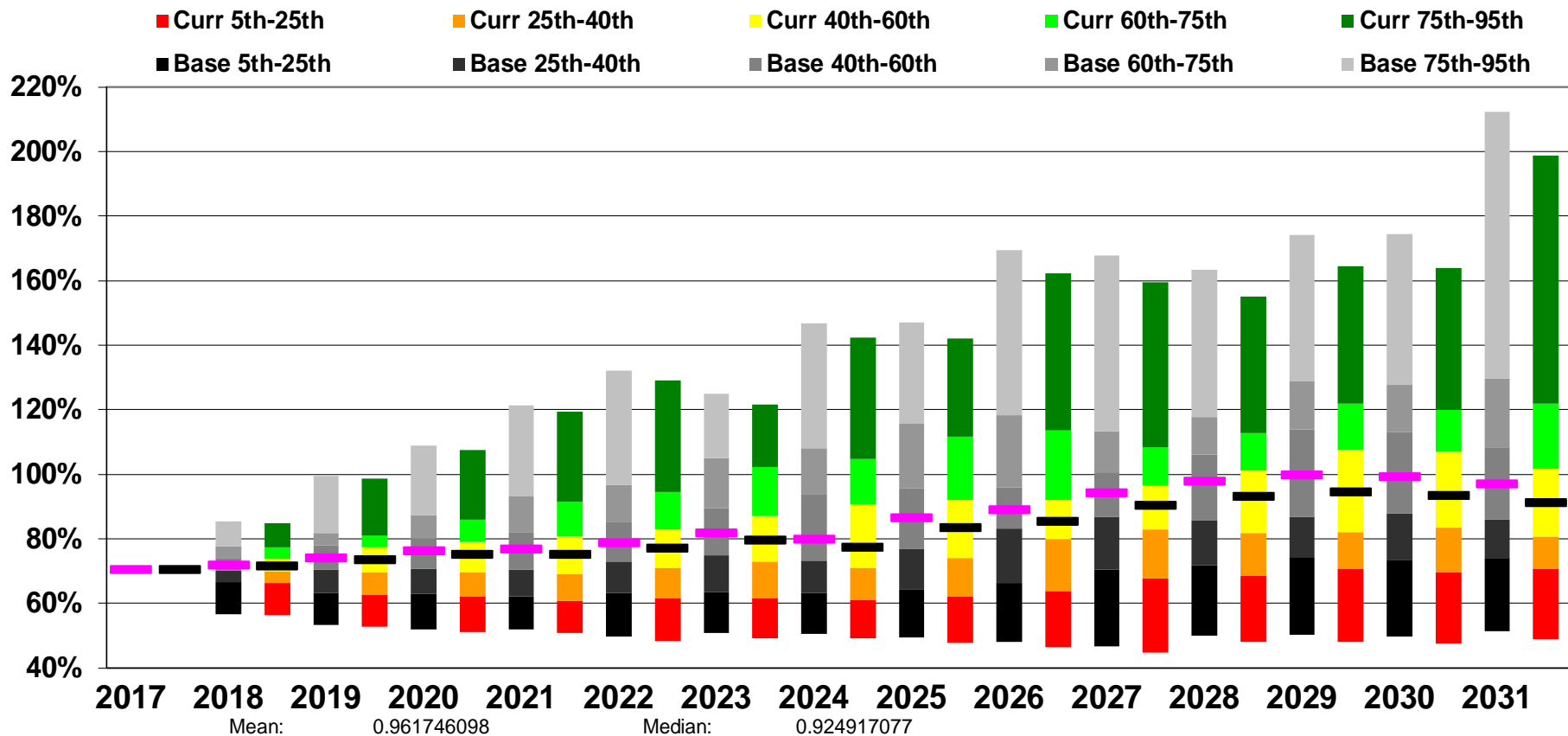
	Geometric Return	Standard Deviation									
Current	7.25%	14.00%									Complete
Baseline	7.25%	14.00%									Complete



# Why is Stress Testing Important



## MVA Funding Ratio



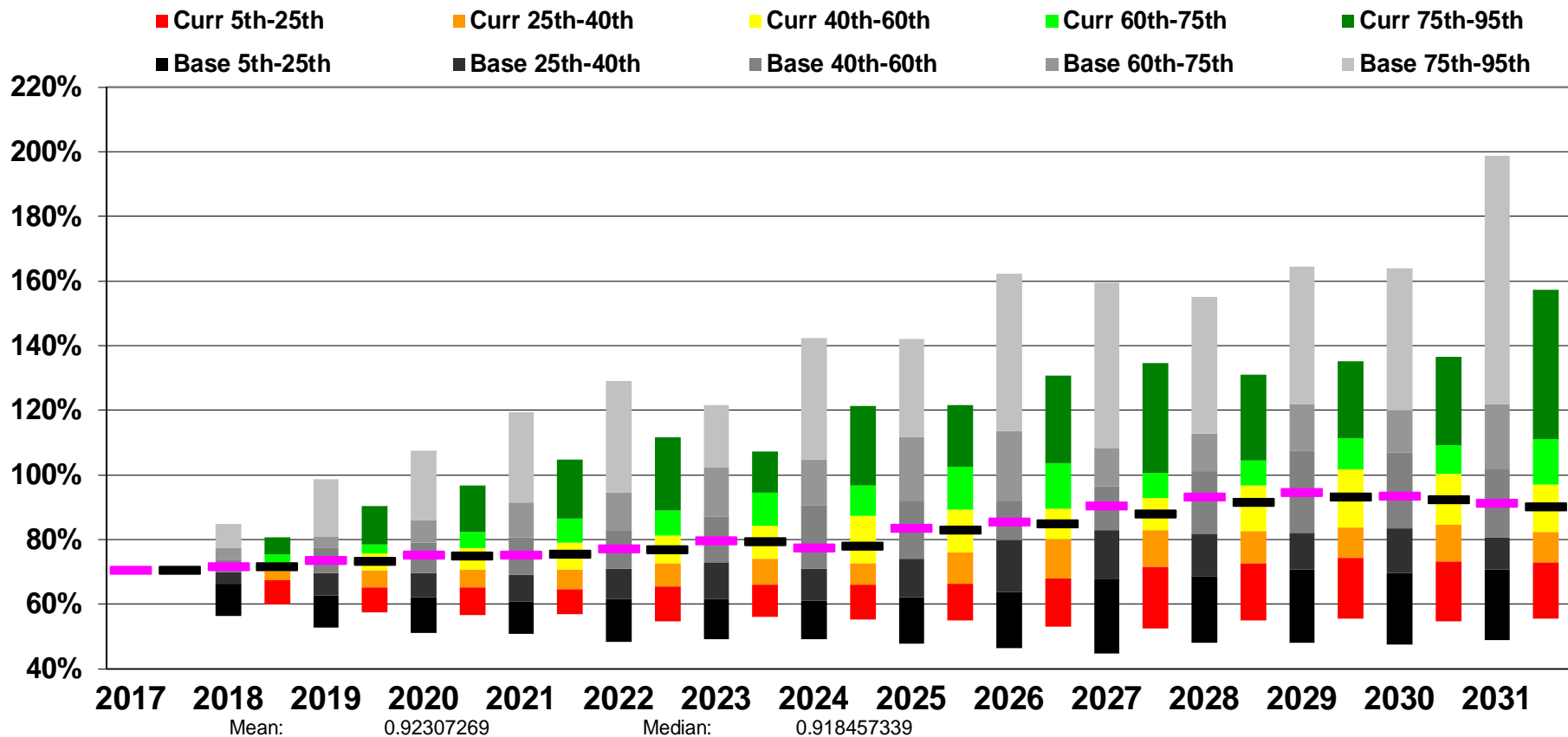
	Geometric Return	Standard Deviation								
Current	6.75%	14.00%								Complete
Baseline	7.25%	14.00%								Complete

July 30, 2018

# Why is Stress Testing Important



## MVA Funding Ratio



	Geometric Return	Standard Deviation									
Current	6.75%	10.00%									Complete
Baseline	6.75%	14.00%									Complete

July 30, 2018

# Why Is It Important?



- Without projections you have no idea if funding works
- Baseline projections are never right
  - Uncertainty increases over time
- Most pension plans today are mature
- Mature plans have negative cash flows
- Negative cash flow plans are most vulnerable
- Forward looking potential outcomes are important decision making factors

# Required Disclosures



The purpose of this presentation is to provide background and illustrations of the value of stress testing for retirement systems in testimony to the Pennsylvania Public Pension Management and Asset Investment Review Commission.

The presentation expresses opinions that pertain in general to retirement systems and have no specific bearing on the Pennsylvania State Retirement Systems. It represents general opinions and positions held by the Cheiron consultants, with the intent of demonstrating the importance of this measurement in monitoring and decision making regarding the management of risk typically experienced by all self-funded defined benefit retirement systems. To the best of our knowledge, this presentation and its contents have been prepared in accordance with generally recognized and accepted actuarial principles and practices which are consistent with the Code of Professional Conduct and applicable Actuarial Standards of Practice set out by the Actuarial Standards Board. Furthermore, as a credentialed actuary, I meet the Qualification Standards of the American Academy of Actuaries to render the opinion contained in this presentation. This presentation does not address any contractual or legal issues. We are not attorneys, and our firm does not provide any legal services or advice.

Cheiron's presentation was prepared solely for the Pennsylvania Public Pension Management and Asset Investment Review Commission for the purposes described therein. Other users are not intended users as defined in the Actuarial Standards of Practice, and Cheiron assumes no duty or liability to any other user.

A handwritten signature in blue ink, appearing to read 'K.A. Kent', is positioned above the printed name.

Kenneth A. Kent, FSA, FCA, MAAA, EA  
Principal Consulting Actuary