Guide to Investment Performance Analysis

Ohio Retirement Study Council

April 23, 2015

RVK

Total Fund Performance Summary

	Market Value ($000)	Performance (%)									
		2 Quarters	1 Year	3 Years	5 Years	7 Years	10 Years	2013	2012	2011	2010
PERS (DB)	**77,119,386**	**0.33**	**7.25**	**12.17**	**10.11**	**4.97**	**6.76**	**14.65**	**14.78**	**0.58**	**14.01**
PERS (DB) Total Fund Benchmark		-0.51	5.83	11.72	9.34	4.58	6.37	14.24	15.35	-0.88	13.06
Difference		0.84	1.42	0.45	0.77	0.39	0.39	0.41	-0.57	1.46	0.95
Rank		56	29	39	41	65	52	62	8	57	34
PERS (HC)	**12,489,751**	**-1.30**	**5.46**	**10.22**	**8.65**	**4.95**	**6.21**	**11.54**	**13.85**	**-0.38**	**13.51**
PERS (HC) Total Fund Benchmark		-1.27	5.03	9.70	8.15	4.84	6.10	10.70	13.54	-0.71	12.88
Difference		-0.03	0.43	0.52	0.50	0.11	0.11	0.84	0.31	0.33	0.63
Rank		97	74	78	85	68	78	83	31	80	46
STRS	**73,654,603**	**1.81**	**7.95**	**12.91**	**10.61**	**4.91**	**7.25**	**17.39**	**13.60**	**1.49**	**13.32**
STRS Total Fund Benchmark		1.79	8.26	13.35	10.78	5.21	7.15	18.09	13.93	0.83	13.59
Difference		0.02	-0.31	-0.44	-0.17	-0.30	0.10	-0.70	-0.33	0.66	-0.27
Rank		14	18	21	18	70	19	26	44	33	48
OP&F	**14,261,134**	**-0.13**	**6.74**	**12.94**	**11.35**	**5.83**	**7.60**	**16.93**	**15.41**	**2.57**	**15.85**
OP&F Total Fund Benchmark		-0.22	6.87	12.08	10.18	5.22	7.00	14.61	14.94	2.43	12.61
Difference		0.09	-0.13	0.86	1.17	0.61	0.60	2.32	0.47	0.14	3.24
Rank		74	46	19	6	28	7	31	3	25	7
SERS	**12,547,655**	**0.52**	**6.92**	**12.65**	**9.92**	**4.38**	**6.57**	**16.86**	**14.42**	**-0.07**	**12.35**
SERS Total Fund Benchmark		0.92	6.59	11.76	9.02	4.43	6.39	15.32	13.56	-0.07	10.40
Difference		-0.40	0.33	0.89	0.90	-0.05	0.18	1.54	0.86	0.00	1.95
Rank		51	35	30	49	85	63	34	17	74	72
HPRS	**848,790**	**0.78**	**6.73**	**12.46**	**9.48**	**4.72**	**6.26**	**19.59**	**11.45**	**-2.85**	**13.81**
HPRS Total Fund Benchmark		1.20	7.03	12.23	10.16	5.69	7.07	16.79	13.07	1.20	13.40
Difference		-0.42	-0.30	0.23	-0.68	-0.97	-0.81	2.80	-1.62	-4.05	0.41
Rank		37	47	35	69	76	78	8	90	99	40
All Public Plans > $1B-TF Median		*0.52*	*6.57*	*11.75*	*9.88*	*5.15*	*6.76*	*15.85*	*13.34*	*0.77*	*13.09*

❶ **Total Fund Gross of Fees Returns**
❷ **Total Fund Benchmark Returns**
❸ **Difference Lines**
❹ **Peer Ranking**

Performance shown is gross of fees.

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Total Fund Performance Summary

Key Concepts

❶ **Total Fund Gross of Fees Returns —** The "gross" return is the return produced before investment management fees are deducted. Gross performance is typically used to benchmark plan performance against other institutional investors as plan sponsor peer group returns are only reported to the data provider on a gross of fees basis.
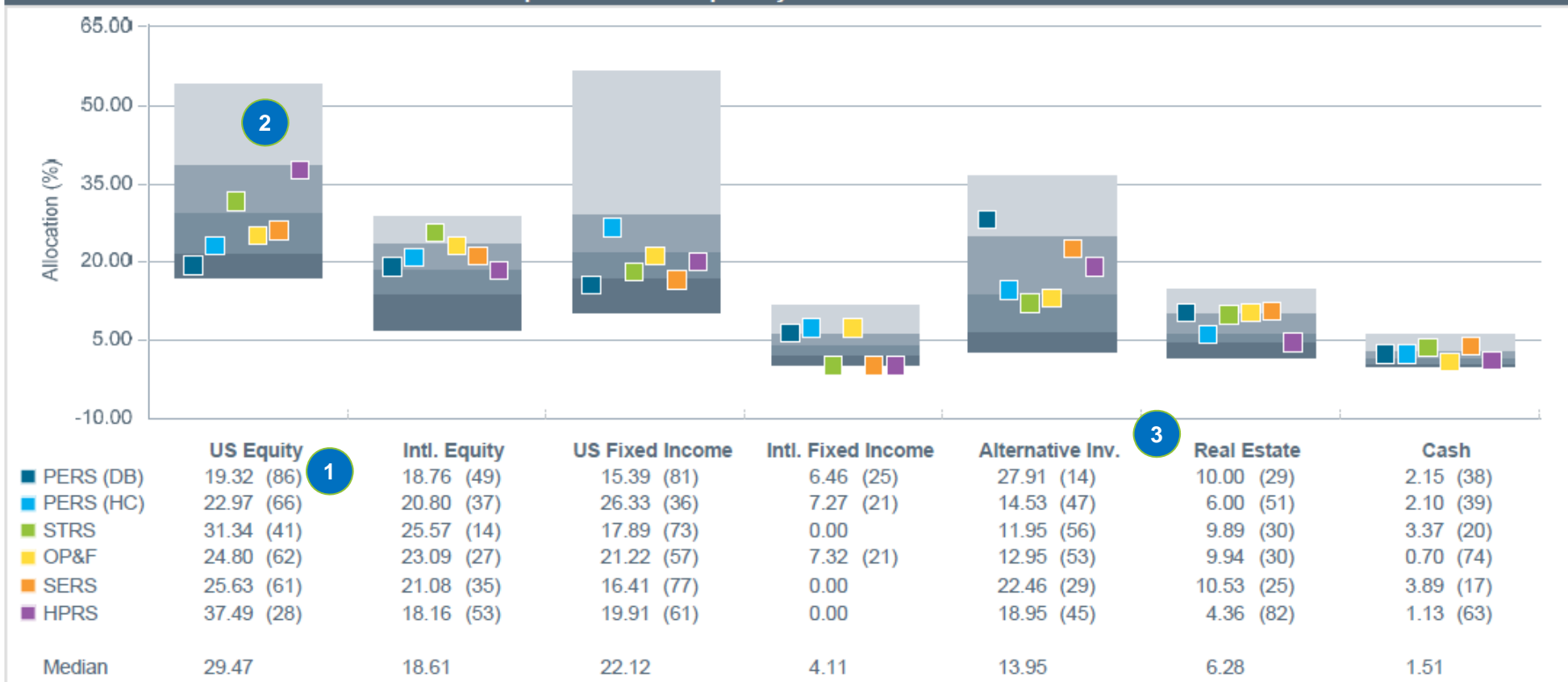
Key Metrics

❷ **Total Fund Benchmark Returns —** This benchmark represents the target-weighted aggregate performance of all of the underlying asset class benchmarks against which each System's asset class composites are measured. If Total Fund trails the benchmark, this means that the combined performance of System's managers failed to outperform the underlying asset class composite benchmarks at the target weights and/or the asset allocation differed from the target allocation.

❸ **Difference Lines —** The difference lines are color coded based on over/underperformance relative to the benchmark shown. If the value is black, the manager or composite outperformed its benchmark over the specified time period. If it is red, the manager/composite underperformed its respective benchmark for the period.

❹ **Peer Ranking —** Peer rankings show how the plan performed relative to other public plans in the peer universe. The lower the rank, the better the individual System is performing relative to this group. Generally, lower rankings are driven by both asset allocation decisions and manager selection.

Notes on Performance Analysis

❑ **Strategy Dissimilarities with Plan Sponsor Peer Groups —** While peer groups provide a rough gauge of performance relative to other public plans, these metrics should be viewed with caution. The plans in the peer group may have markedly different return objectives, risk tolerances, and investment constraints. There may be periods in which an individual System underperforms peers simply due to differences in the underlying investment objectives of the plan.

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Current Asset Allocation vs. Peers

Plan Sponsor Peer Group Analysis - Total Fund Asset Allocation

	US Equity	Intl. Equity	US Fixed Income	Intl. Fixed Income	Alternative Inv.	Real Estate	Cash
■ PERS (DB)	19.32 (86)	18.76 (49)	15.39 (81)	6.46 (25)	27.91 (14)	10.00 (29)	2.15 (38)
■ PERS (HC)	22.97 (66)	20.80 (37)	26.33 (36)	7.27 (21)	14.53 (47)	6.00 (51)	2.10 (39)
■ STRS	31.34 (41)	25.57 (14)	17.89 (73)	0.00	11.95 (56)	9.89 (30)	3.37 (20)
■ OP&F	24.80 (62)	23.09 (27)	21.22 (57)	7.32 (21)	12.95 (53)	9.94 (30)	0.70 (74)
■ SERS	25.63 (61)	21.08 (35)	16.41 (77)	0.00	22.46 (29)	10.53 (25)	3.89 (17)
■ HPRS	37.49 (28)	18.16 (53)	19.91 (61)	0.00	18.95 (45)	4.36 (82)	1.13 (63)
Median	29.47	18.61	22.12	4.11	13.95	6.28	1.51

❶ **Plan Sponsor Peer Group Allocation Rank**
❷ **Peer Group Allocation Quartiles**
❸ **Alternative Investments**

Parentheses contain percentile ranks. Allocations shown may not sum up to 100% exactly due to rounding.

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Current Asset Allocation vs. Peers

Key Metrics

❶ **Plan Sponsor Peer Group Rank —** This chart shows how each System's current allocation compares to other public funds in the plan sponsor peer group. The numbers in parentheses represent where the current allocation ranks in the peer group. A value less than 50 indicates a higher than median allocation while a value greater than 50 represent a lower than median allocation to the given asset class.

❷ **Peer Group Allocation Quartiles —** The grey shaded areas shown the range of peer group asset class allocation quartiles. The lightest grey shading indicates a higher allocation to the individual asset class.

❸ **Alternative Investments —** Alternative investments may include, but are not limited to, hedge funds, private equity, commodities, and real assets excluding real estate.

Notes on Current Asset Allocations

❑ Comparing asset allocation differences to peers can help explain differences in returns, especially over shorter time periods.

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Current Asset Allocation by Thematic Category
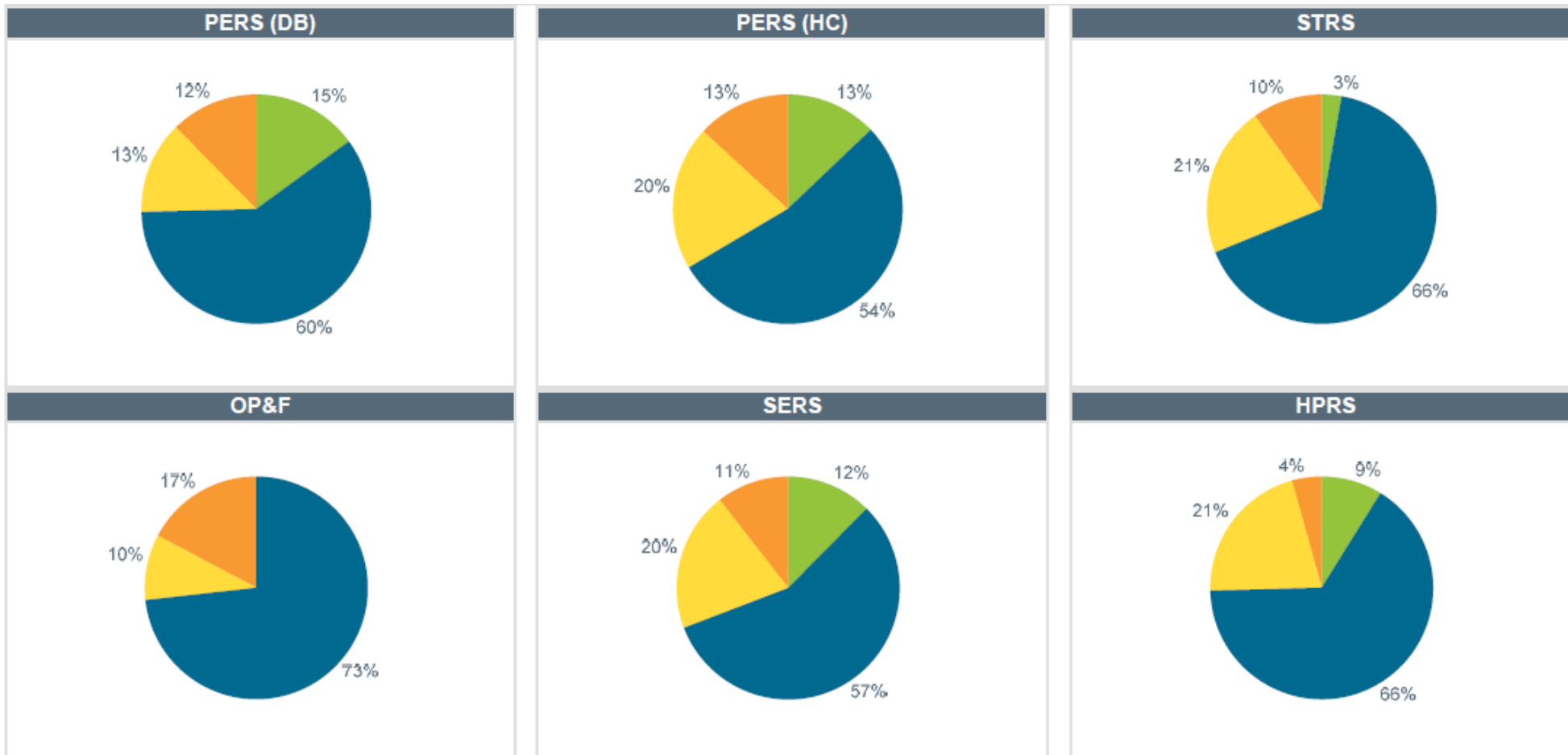
❶	**Alpha**
❷	**Capital Appreciation**
❸	**Capital Preservation**
❹	**Inflation**

OP&F does not have any dedicated exposure to Alpha strategies, but does have alpha exposure embedded with other asset class buckets. Asset allocation by Theme is based on dedicated composite allocations and not underlying investment manager exposures; as such, thematic allocations are approximations.

Current Asset Allocation by Thematic Category

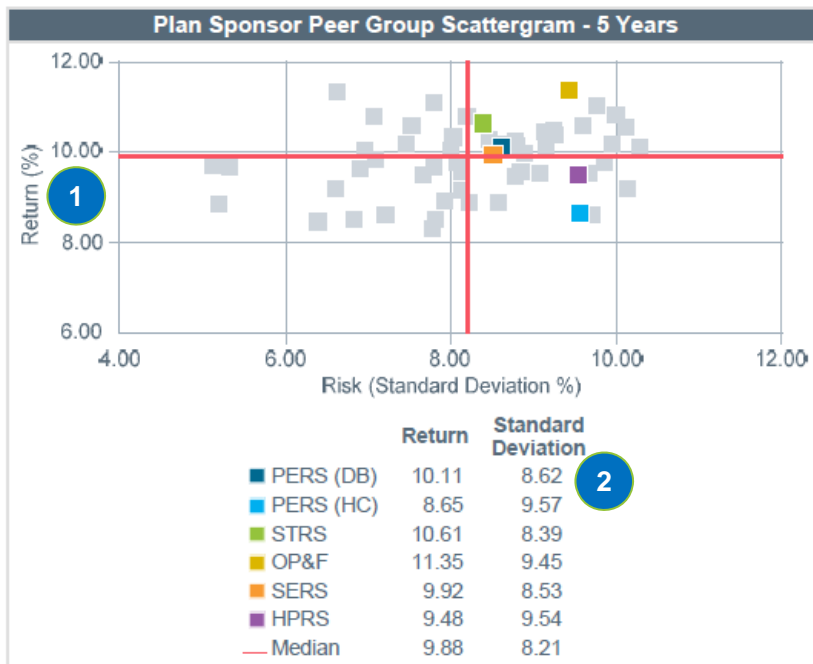## Notes on Thematic Categories

❑ Most strategic portfolio discussions focus on asset classes; however, some asset classes share common objectives or "themes"

❑ Broadening the discussion to thematic categorizations can provide valuable perspective

❑ RVK generally breaks down portfolios into four core themes

❑ Asset allocation by Theme is based on dedicated composite allocations and not underlying investment manager exposures; as such, thematic allocations are approximations
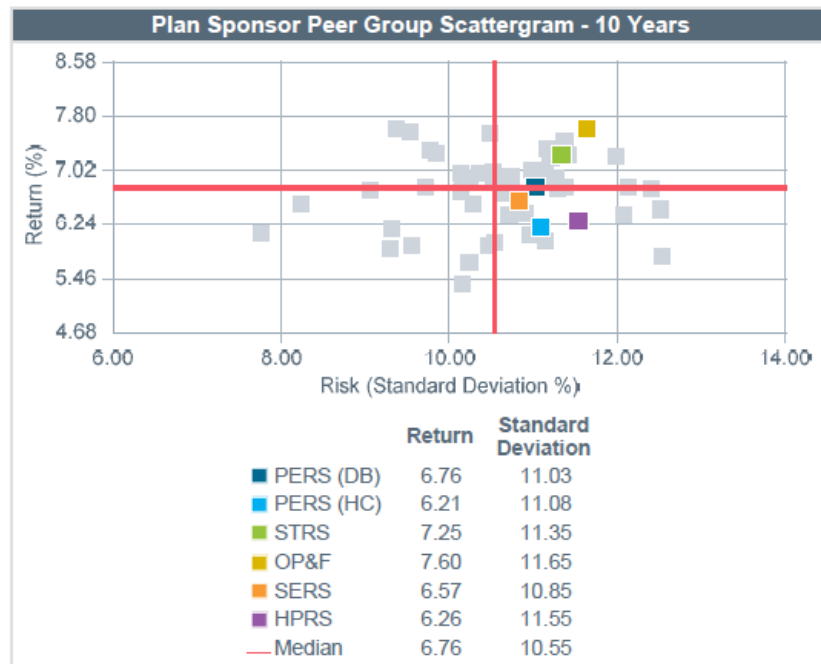
Key Metrics

❶ **Alpha —** Aims to continually provide a return in excess of the portfolio benchmark return for a given level of risk and are intended to provide diversification (primarily with the Capital Appreciation and Capital Preservation)

- Includes: Hedge Funds and Global Tactical Asset Allocation (GTAA)

❷ **Capital Appreciation —** Seeks high level of capital gains through increased risk-return trade-off.

- Includes: Public & Private Equities, High Yield, Emerging Markets Debt, MLPs, Timber, Non-Core Real Estate, and Opportunistic Investments

❸ **Capital Preservation —** Conservative strategy designed to avoid risk of loss of principal.

- Includes: Core Fixed Income and Cash Equivalents

❹ **Inflation —** Provide returns that will keep pace with normal inflationary movements in the long-term market. Designed not to lose value in an inflationary environment.

- Includes: TIPS, Commodities, Real Return, Floating Rate Debt, REITs, and Core Real Estate

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Performance Analysis: Risk and Return Peer Comparisons

Plan Sponsor Peer Group Scattergram - 5 Years

	Return	Standard Deviation
■ PERS (DB)	10.11	8.62
■ PERS (HC)	8.65	9.57
■ STRS	10.61	8.39
■ OP&F	11.35	9.45
■ SERS	9.92	8.53
■ HPRS	9.48	9.54
— Median	9.88	8.21

Sharpe Ratio - 5 Year

PERS (DB)	1.16
PERS (HC)	0.92
STRS	1.25
OP&F	1.19
SERS	1.16
HPRS	1.00
All Public Plans > $1B-Total Fund Median	*1.16*

Plan Sponsor Peer Group Scattergram - 10 Years

	Return	Standard Deviation
■ PERS (DB)	6.76	11.03
■ PERS (HC)	6.21	11.08
■ STRS	7.25	11.35
■ OP&F	7.60	11.65
■ SERS	6.57	10.85
■ HPRS	6.26	11.55
— Median	6.76	10.55

Sharpe Ratio - 10 Year

PERS (DB)	0.51
PERS (HC)	0.46
STRS	0.54
OP&F	0.56
SERS	0.50
HPRS	0.45
All Public Plans > $1B-Total Fund Median	*0.53*

Key Metrics

❶ **Plan Sponsor Scattergram —** This figure provides a visual representation of historical risk (as measured by standard deviation) and returns relative to other public plans. The red cross hairs represents the median public plan in terms of risk and return. The colored square represent each individual System's historical risk and return and each grey square represents a plan included in the peer group.

❷ **Standard Deviation —** This measures the volatility of the portfolio returns. The higher the standard deviation, the greater the volatility of returns.

❸ **Sharpe Ratio –** This is a metric that approximates the risk-adjusted return of the portfolio. Higher Sharpe ratios indicate greater absolute returns generated for each unit of risk.

Notes on Performance Analysis

❑ **Strategy Dissimilarities with Peer Groups —** Peer comparisons must be viewed cautiously, as differences in risk and return objectives may produce "underperformance" for reasons that are acceptable to the plan.

Performance shown is gross of fees. Calculations are based on quarterly periodicity.

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Performance Analysis: Equity Beta

Equity Beta

	2 Quarters	1 Year	3 Years	5 Years	7 Years	10 Years
PERS (DB)	0.39	0.57	0.48	0.57	0.66	0.66
PERS (HC)	0.78	0.85	0.57	0.63	0.66	0.66
STRS	0.58	0.63	0.53	0.58	0.68	0.68
OP&F	0.40	0.65	0.54	0.63	0.70	0.70
SERS	0.50	0.62	0.54	0.57	0.64	0.64
HPRS	0.48	0.59	0.63	0.66	0.70	0.70
S&P 500 Index (Cap Wtd)	1.00	1.00	1.00	1.00	1.00	1.00

5 Year Rolling Equity Beta
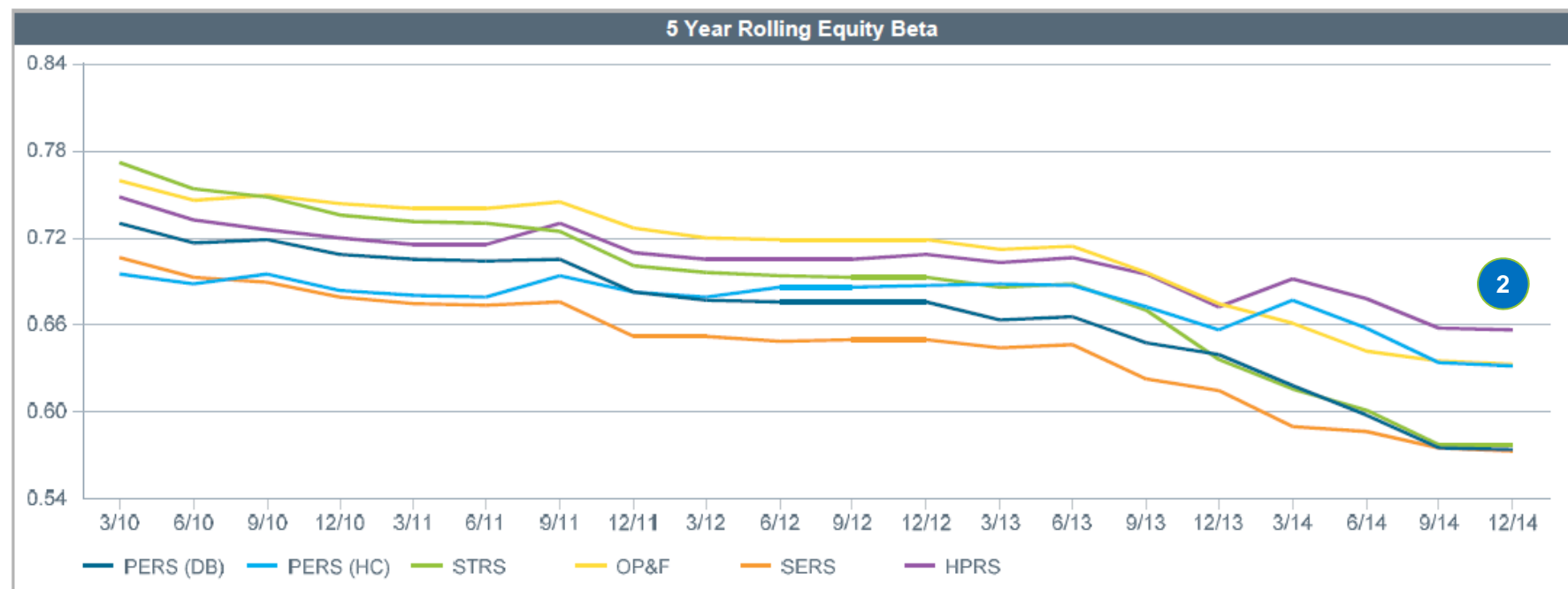
Key Metrics

❶ **Beta** — This is a measure of sensitivity of a portfolio to movements of the U.S. equity market as represented by the S&P 500 Index. Beta measures a portfolio's non-diversifiable or systematic risk. As an example, a Beta of 0.70 indicates that a portfolio captures roughly 70% of the S&P 500 Index return. If the S&P 500 Index returns 10% the portfolio would be expected to return 7%.

❷ **5 Year Rolling Beta** — This displays the trailing 5-year portfolio beta, over the past 20 quarters. Displaying data on a rolling-period basis helps analyze any historical trends experienced by a portfolio.

Performance shown is gross of fees. Calculations are based on quarterly periodicity.

Asset Class Composite Performance Summary

	Performance									
	2 Quarters	1 Year	3 Years	5 Years	7 Years	10 Years	2013	2012	2011	2010
Domestic Equity										
PERS (DB)	**4.63**	**11.29**	**20.20**	**15.44**	**7.32**	**7.78**	**33.86**	**16.58**	**1.15**	**16.68**
R 3000 Index	5.25	12.55	20.51	15.63	7.54	7.94	33.55	16.42	1.03	16.93
Difference	-0.62	-1.26	-0.31	-0.19	-0.22	-0.16	0.31	0.16	0.12	-0.25
Rank	48	53	49	63	55	56	59	47	34	78
PERS (HC)	**4.63**	**11.29**	**20.20**	**15.44**	**7.32**	**7.78**	**33.86**	**16.58**	**1.15**	**16.68**
R 3000 Index	5.25	12.55	20.51	15.63	7.54	7.94	33.55	16.42	1.03	16.93
Difference	-0.62	-1.26	-0.31	-0.19	-0.22	-0.16	0.31	0.16	0.12	-0.25
Rank	48	53	49	63	55	56	59	47	34	78
STRS	**4.71**	**11.70**	**19.48**	**15.09**	**7.04**	**7.62**	**32.14**	**15.56**	**1.51**	**16.64**
R 3000 Index	5.25	12.55	20.51	15.63	7.54	7.94	33.55	16.42	1.03	16.93
Difference	-0.54	-0.85	-1.03	-0.54	-0.50	-0.32	-1.41	-0.86	0.48	-0.29
Rank	43	44	73	73	62	67	84	71	27	81
OP&F	**3.95**	**11.27**	**19.89**	**16.35**	**8.37**	**8.63**	**35.53**	**14.28**	**0.94**	**22.57**
Wilshire 5000 Index	5.34	12.71	20.29	15.54	7.49	7.99	33.07	16.06	0.98	17.16
Difference	-1.39	-1.44	-0.40	0.81	0.88	0.64	2.46	-1.78	-0.04	5.41
Rank	72	53	58	18	19	12	24	93	41	5
SERS	**3.49**	**10.99**	**20.83**	**15.96**	**7.63**	**7.84**	**35.76**	**17.09**	**0.13**	**18.69**
R 3000 Index	5.25	12.55	20.51	15.63	7.54	7.94	33.55	16.42	1.03	16.93
Difference	-1.76	-1.56	0.32	0.33	0.09	-0.10	2.21	0.67	-0.90	1.76
Rank	77	60	21	35	43	54	19	25	50	45
HPRS	**5.39**	**11.97**	**20.75**	**16.07**	**8.14**	**8.34**	**35.56**	**16.01**	**-1.01**	**20.87**
R 3000 Index	5.25	12.55	20.51	15.63	7.54	7.94	33.55	16.42	1.03	16.93
Difference	0.14	-0.58	0.24	0.44	0.60	0.40	2.01	-0.41	-2.04	3.94
Rank	27	36	24	32	24	31	24	62	76	7
All Public Plans > $1B-US Equity Segment Median	*4.58*	*11.42*	*20.16*	*15.66*	*7.42*	*7.88*	*34.70*	*16.51*	*0.10*	*17.98*

## Notes on Performance Analysis

Asset Class Composite reports summarize the performance of key asset classes. When a System uses active managers, the goal is to outperform relevant indices for each asset class. However, benchmarks are not perfect, particularly for illiquid asset classes, such as real estate, hedge funds, and private equity.

Performance shown is gross of fees.

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Individual System Characteristics Summary

Summary

- PERS (DB) has outperformed its benchmark over the trailing 10-year period.
- Relative to a US 60 Equity/40 Bonds, the plan has exhibited similar up-market capture and larger down-market capture characteristics over the past ten years.
- PERS (DB) has earned a return of 1.2% for each unit of risk over the trailing 5-year period and 0.5% for each unit of risk over the trailing 10-year period.
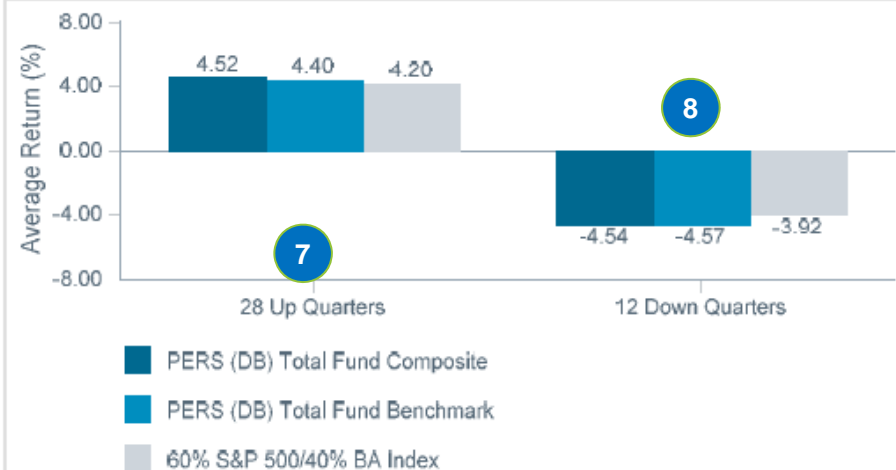
Growth of $1 - 10 Years

Legend:
— PERS (DB) Total Fund Composite
--- PERS (DB) Total Fund Benchmark
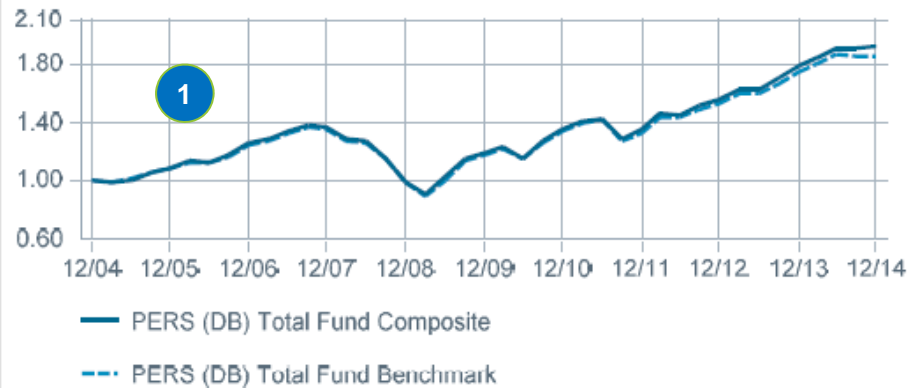
MPT Stats

	5 Years	10 Years
Maximum Return	9.71	12.34
Minimum Return	-9.24	-13.81
Standard Deviation	8.62	11.03
vs. PERS (DB) Total Fund Benchmark		
Info Ratio	0.78	0.39
Tracking Error	0.92	0.92
Alpha	0.76	0.43
vs. S&P 500 Index (Cap Wtd)		
Beta	0.57	0.66
vs. BofA ML 3 Mo US T-Bill Index		
Sharpe Ratio	1.16	0.51

Asset Allocation vs. Targets

	Market Value ($)	Allocation (%)	Target (%)
Domestic Equity	14,901,328,151	19.32	21.40
International Equity	14,467,441,375	18.76	19.50
Core Fixed Income	7,627,247,698	9.89	10.30
EMD	4,258,974,565	5.52	6.00
High Yield	2,226,937,382	2.89	3.00
Floating Rate Debt	487,595,758	0.63	0.70
Securitized Debt	777,987,324	1.01	1.00
Global High Yield	726,670,158	0.94	1.00
TIPS	748,730,013	0.97	1.00
Real Estate	7,709,834,104	10.00	10.00
Hedge Funds	6,291,769,972	8.16	8.00
Private Equity	9,348,282,448	12.12	10.00
Opportunistic	78,668,995	0.10	0.10
Commodities	578,863,245	0.75	1.00
Risk Parity	3,692,898,356	4.79	5.00
GTAA	1,536,868,852	1.99	2.00
Cash Equivalents	438,450,852	0.57	0.00
Rebalancing	1,220,836,644	1.58	0.00
Total Fund	77,119,385,891	100.00	100.00

Up/Down Markets - 10 Years

Values shown: 28 Up Quarters — 4.52, 4.40, 4.20; 12 Down Quarters — -4.54, -4.57, -3.92

Legend:
- PERS (DB) Total Fund Composite
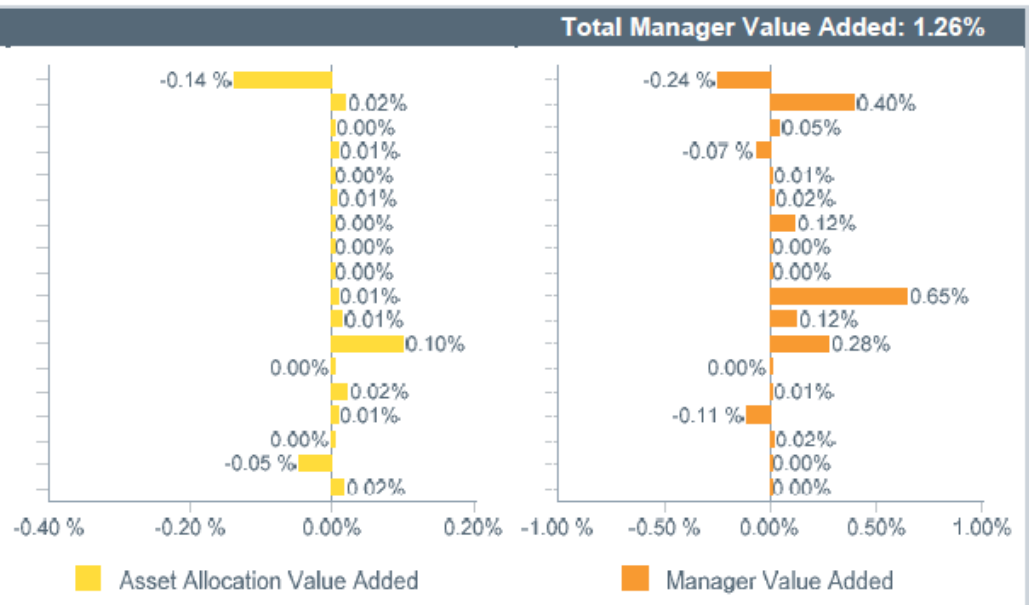- PERS (DB) Total Fund Benchmark
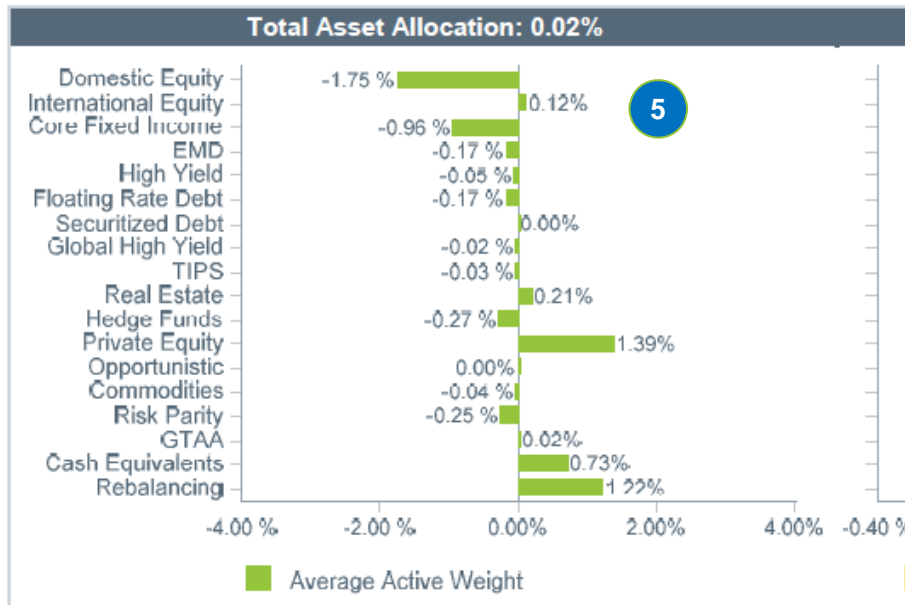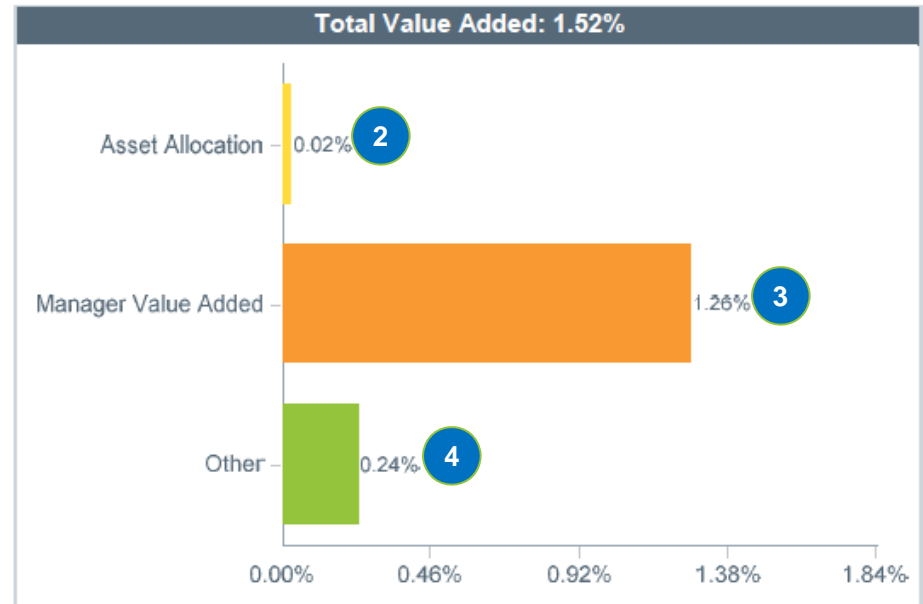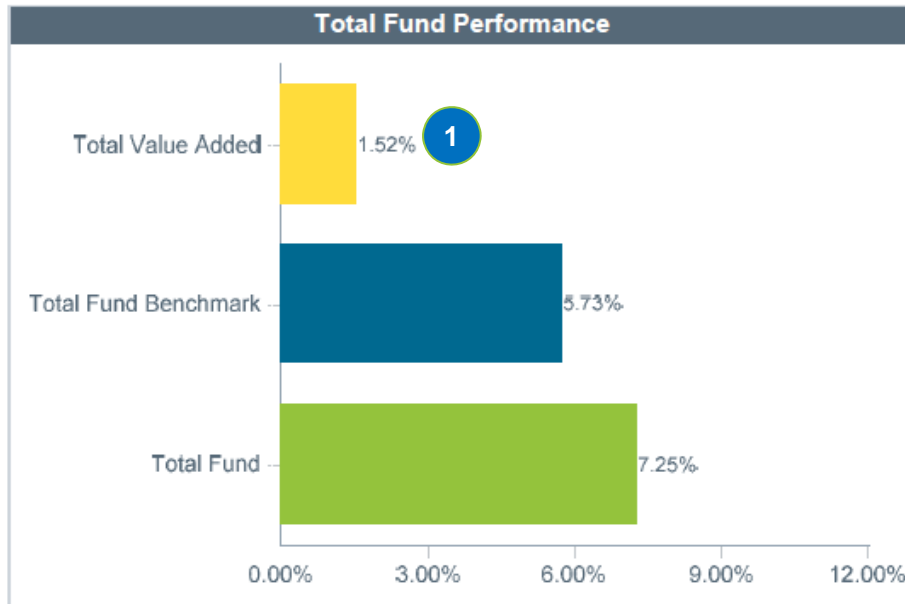- 60% S&P 500/40% BA Index

Performance shown is gross of fees. Calculations are based on quarterly periodicity.

Performance Analysis: Statistical Measures

Key Metrics

❶ **Growth of $1 —** Measures the amount generated by investing $1.00 in the portfolio at the beginning of the specified time period.

❷ **Asset Allocation —** This shows the current allocation of assets in the portfolio as of the given date.

❸ **Target Allocation —** The targets shown are representative of those approved by the Board and governed by the Investment Policy.

❹ **Return and Risk:**

- **Maximum Return —** The maximum quarterly return earned over the specified time period.

- **Minimum Return —** The minimum quarterly return earned over the specified time period.

- **Standard Deviation —** This measures the volatility of the portfolio returns. The higher the standard deviation, the greater the volatility of returns.

❺ **Relative Statistics:**

- **Info Ratio —** Measured by dividing the active rate of return by the tracking error (see below). The higher the information ratio, the more value-added contribution by the portfolio relative to the market benchmark.

- **Tracking Error —** This reflects the standard deviation of a portfolio's performance relative to the performance of a market benchmark, the Total Fund Benchmark in this instance.

- **Alpha —** Measures the difference between a portfolio's actual returns and its expected performance, given its level of risk as measured by beta. Alpha is a measure of the portfolio's historical performance unexplained by movements of the market.

- **Beta —** Measures the degree to which the value of a portfolio moves relative to the S&P 500 Index (Cap Wtd).

❻ **Risk-Adjusted Return:**

- **Sharpe Ratio —** This is a metric that approximates the risk-adjusted return of the portfolio. Higher Sharpe ratios indicate greater absolute returns generated for each unit of risk.

❼ **Up Market Capture —** The average portfolio return earned during periods of positive market benchmark performance. Higher values indicate more favorable portfolio performance,

❽ **Down Market Capture —** The average portfolio return earned during periods of negative market benchmark performance. Lower values indicate less favorable portfolio performance.

Total Fund Attribution

Total Fund Performance

Total Value Added	1.52% (1)
Total Fund Benchmark	5.73%
Total Fund	7.25%

Total Value Added: 1.52%

Asset Allocation	0.02% (2)
Manager Value Added	1.26% (3)
Other	0.24% (4)

Total Asset Allocation: 0.02%   (5)   **Total Manager Value Added: 1.26%**

	Average Active Weight	Asset Allocation Value Added	Manager Value Added
Domestic Equity	-1.75%	-0.14%	-0.24%
International Equity	0.12%	0.02%	0.40%
Core Fixed Income	-0.96%	0.00%	0.05%
EMD	-0.17%	0.01%	-0.07%
High Yield	-0.05%	0.00%	0.01%
Floating Rate Debt	-0.17%	0.01%	0.02%
Securitized Debt	0.00%	0.00%	0.12%
Global High Yield	-0.02%	0.00%	0.00%
TIPS	-0.03%	0.00%	0.00%
Real Estate	0.21%	0.01%	0.65%
Hedge Funds	-0.27%	0.01%	0.12%
Private Equity	1.39%	0.10%	0.28%
Opportunistic	0.00%	0.00%	0.00%
Commodities	-0.04%	0.02%	0.01%
Risk Parity	-0.25%	0.01%	-0.11%
GTAA	0.02%	0.00%	0.02%
Cash Equivalents	0.73%	-0.05%	0.00%
Rebalancing	1.22%	0.02%	0.00%

- 🟩 Average Active Weight
- 🟨 Asset Allocation Value Added
- 🟧 Manager Value Added

Performance shown is gross of fees. Calculations are based on monthly periodicity. Total Fund Benchmark return is calculated by RVK and may differ from the Plan provided return due to rounding.

RVK

Total Fund Attribution

Key Metrics

❶ **Total Value Added –** The percentage over- or underperformance of the Total Fund as compared to the benchmark for the specified time period.

❷ **Asset Allocation Value Added —** Measures the portfolio value-added attributable to the portfolio's allocation deviations from the policy targets.

❸ **Manager Value Added —** Measures the portfolio value-added attributable to the performance of the fund's investments, relative to the asset class composite benchmarks within the Total Fund Benchmark.

❹ **Other —** The contribution of other residual factors, including estimation error and transaction timing.

❹ **Average Active Weight –** The average percentage over- or underweight to each investment relative to the policy targets over the period.

PORTLAND   CHICAGO   NEW YORK