



# 2018

Ohio Public Employees Retirement System

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**ANNUAL INVESTMENT PLAN**

Defined Benefit Fund  
Health Care 115 Trust Fund

Ohio Public Employees Retirement System  
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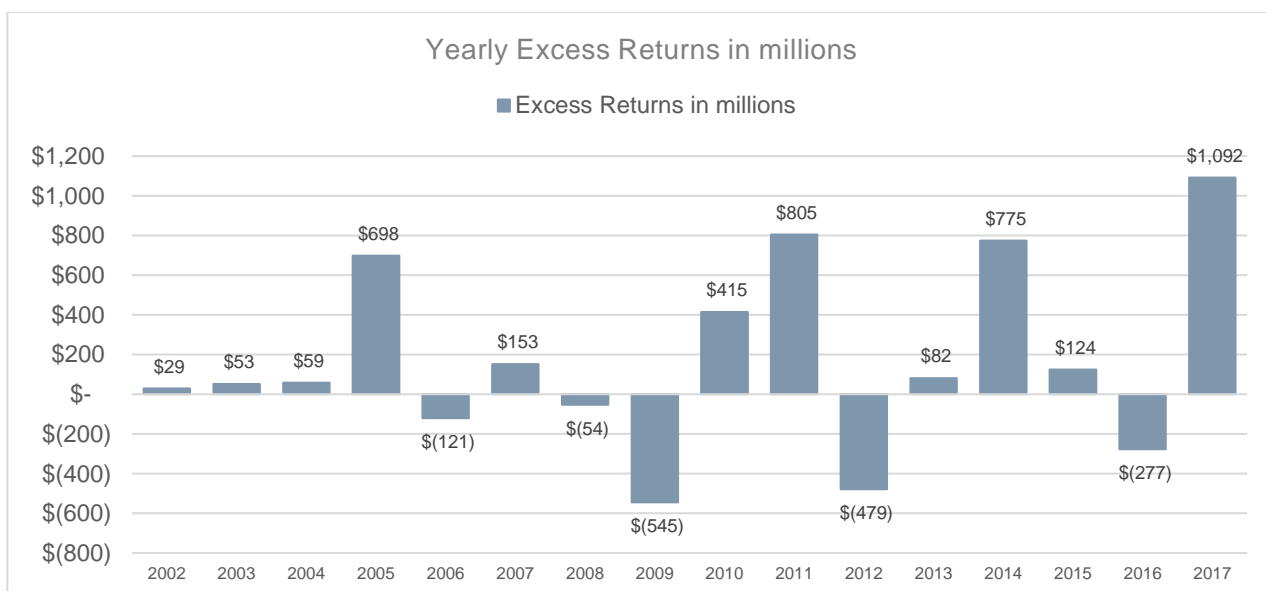
## CHIEF INVESTMENT OFFICER'S LETTER

On behalf of the Investments Division, I am pleased to report a very successful investment year for OPERS Funds in 2017. Most would define our success as achieving returns that were twice our 7.5% actuarial target return, at over 16%. This letter takes a closer look at the definition of success in pension plan investing.

I begin by examining and celebrating accomplishments, while highlighting why they are important. The second part of my letter puts the year's results in broader perspective.

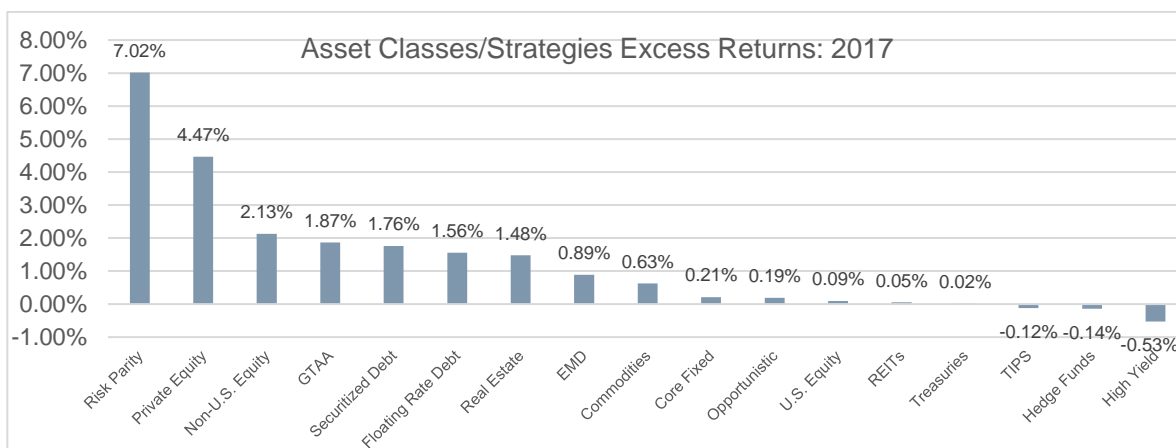
### Major Highlights from 2017

- Market returns in 2017 were 16.8% and 15.2% for OPERS Defined Benefit and Health Care Plans, respectively. For the 10-years ended in 2017, returns are 5.8% and 5.4% for Defined Benefit and Health Care Funds, respectively, indicating that both Funds are still recovering from the Global Financial Crisis a decade ago.
- Staff produced returns in 2017 that were above benchmarks after subtracting all manager costs. These returns above the benchmark are referred to as “excess” or “active” returns and they were 1.6% and 0.9% in the Defined Benefit and Health Care Funds, respectively. These equate to \$1.1 billion in excess returns for Defined Benefit Fund and \$0.1 billion for Health Care Fund in 2017.
- Active returns in 2017 were the best since OPERS began keeping these records in 2002.
- Active return results in 2017 validate Staff's ability to continue to produce returns above a simple passive implementation of the allocation over time on a cost-effective basis.
- Active returns have contributed \$2.8 billion toward member benefits since 2002. This means that 3.2% of existing Plan assets have come from the value added by Staff in implementing the Board's investment allocation.



## Additional Highlights

- Both total returns and the active returns in the Defined Benefit Plan would have been far less without the contribution from our investments in illiquid (private) assets, principally private equity and private real estate. As an example, the 10-year returns for private equity and real estate are 9.9% and 7%, respectively, versus the 10-year total return for the Plan at just 5.8%.
- Good markets “raised all boats” In 2017. However, comparing ourselves to peers as of 12/31/2017 shows OPERS Defined Benefit Fund was ranked in the top quarter of the comparison universe (23<sup>rd</sup> percentile) for the year, as well as for the last three years (21<sup>st</sup> percentile). Staff’s excess returns achievement is reflected in these results versus our peers.
- The total value of investments under management for all OPERS Funds (Defined Benefit, Health Care and Defined Contribution) reached \$100 billion for the first time.
- Hedge funds returned 7.2%, twice the return of the Bloomberg Barclays U.S. Aggregate Index which is the performance benchmark for the other major stabilization asset in the allocation (core bonds for the 5-year period ended in 2017).
- Excess returns were produced very broadly across all investment teams and in all but three asset classes or strategies, as seen in the chart below:



## Perspective on Returns

While the Investments Staff did an outstanding job last year measured by excess returns, and the markets themselves rewarded investors very well, OPERS reminds audiences that it must remain a long-term investor focused on multi-decade results. We use a 7.5% actuarial return target in Defined Benefit planning. Good years like 2017 help to balance out the bad years like 2016 that had very low returns or years like 2008 that had very negative returns.

OPERS began the year with a \$34 billion shortfall from its long-term investment return expectations.

<b>Defined Benefit Expected Return Shortfall (2007-2016)</b>	
Beginning asset balance on 12/31/2007	\$70 Billion
Expected ending value if 8% earned each year	\$112 Billion
Ending value using actual 4.7% annual return	\$78 Billion
Investment return shortfall	\$34 Billion

So what is the significance of superior market returns for a single year? The well-above average market returns in 2017 amortize a portion of the existing shortfall in the defined benefit plan. Yet more than \$25 billion of shortfall remains.

A robust and secure pension requires many inputs over time: your own contributions, your employer's contributions, an investments team that keeps expenses as low as possible, very capable executive management and oversight, and many, many individual years of market returns on contributions – just to name a few. Contributions rates do not change frequently. But market returns are different every year. When we earn 16% in a particular year, it balances lower returns in other years. Therefore, many years of “good” market returns are needed if we expect to average 8% (or 7.5% currently).

OPERS is a mature pension plan with over eighty years of existence. All mature pension plans pay out more in benefits than they receive in contributions, and this means that the timing of market returns on its existing portfolio impacts OPERS. Paying out more in benefits than it receives in contributions in years when markets fall, means there is less money at work when markets are recovering. In the extreme, this condition could even require plan design changes.

To make sure OPERS has the most money at work in the markets in years of market recovery like 2017, it is important to build the allocation with an eye focused on stability of returns as well as size of returns. The Trustees have done this.

In summary, success in pension plan investing requires meeting actuarial investment return assumptions while mitigating the large swings in returns. Staff must implement the allocation successfully, and OPERS returns must be competitive with pension peers who pursued different allocation approaches to pursue the same goals. Finally, success requires that we beat indexed portfolios over time, in order to add to assets and to demonstrate the high quality of the investment implementation, as the Investments Staff did in 2017 and has done successfully since at least 2002.

Respectfully,

Richard D. Shafer, CFA  
 Chief Investment Officer  
 January 17, 2018



EXECUTIVE SUMMARY

The following Summary outlines the strategies, asset allocation, and asset class strategies for OPERS Defined Benefit and Health Care 115 (“HC 115”) Trust Funds. This Summary also discusses initiatives and resources as well as performance and risk expectations.

**FUND STRATEGIES**

The Defined Benefit and Health Care Funds will initiate transitioning toward their dynamic asset allocations approved by the OPERS Retirement Board in January 2018. Staff plans to complete these transitions by the first quarter of 2018, depending on the market environment. Within asset classes, adjustments will be made where portfolio liquidity can be improved for little give-up in return expectation and where internal management of assets provides a better expected net return.

The following table outlines the projected base case returns with ranges for the Defined Benefit and Health Care 115 Trust Funds. The base case return expectations are lower than in 2017 for both the Defined Benefit and Health Care 115 Trust Funds largely due to lower expected returns for all asset classes. The active return for both Funds are unchanged from 2017.

	<b>Base Case Return*</b>	<b>Return Range</b>	<b>Active Return</b>	<b>Tracking Error</b>	<b>Information Ratio</b>
<b><u>Defined Benefit Fund</u></b>	- - - - - % - - - - -		- - - - - % - - - - -		
<b>2018</b>	6.91	-6.69 to 20.51	0.42	1.05	0.40
<b>2017</b>	7.18	-6.72 to 21.08	0.42	1.05	0.40
<b><u>HC 115 Trust Fund</u></b>					
<b>2018</b>	6.26	-6.14 to 18.66	0.31	0.78	0.40
<b>2017</b>	6.41	-6.09 to 18.91	0.31	0.78	0.40

\*Base Case Return includes the active return

The active returns shown above incorporate an information ratio of 0.40. This ratio measures the active return per unit of tracking error (active risk).

Additional details regarding the Defined Benefit and Health Care 115 Trust Funds strategies are included later in this Annual Investment Plan.

**ASSET ALLOCATION AND ASSET CLASS STRATEGIES**

The Public Equity benchmark allocation in the Defined Benefit and Health Care 115 Trust Funds is changed from the global weighting of U.S. Equity and Non-U.S. Equity based on the MSCI All Country World Index-Investable Market Index (“MSCI ACWI-IMI”) to fixed target weights for both Funds. Below is the summary of the Public Equity benchmark asset allocation recommendation, which reflects the positive bias on the Non-U.S. Asset Class.

<b>Defined Benefit Fund</b>	<b>Current Asset Allocation</b>	<b>New Asset Allocation</b>	<b>Net Change</b>
U.S. Equity	20.3%	19.0%	-1.3%
Non-U.S. Equity	18.7%	20.0%	1.3%
Total Equity	39.0%	39.0%	0.0%
<b>Health Care 115 Trust Fund</b>	<b>Current Asset Allocation</b>	<b>New Asset Allocation</b>	<b>Net Change</b>
U.S. Equity	22.4%	21.0%	-1.4%
Non-U.S. Equity	20.6%	22.0%	1.4%
Total Equity	43.0%	43.0%	0.0%

Within the Fixed Income asset class, several changes in the sub asset allocation will be implemented for both Funds. After building out an internal high yield team and strategy during 2017, the internal Fixed Income team plans to integrate the current internal high yield portfolio of assets into a newly created Core Plus portfolio with a target allocation of 1%. Below is the summary of dynamic asset allocation recommendation.

<b>Defined Benefit Fund</b>	<b>Current Asset Allocation</b>	<b>New Asset Allocation</b>	<b>Net Change</b>
Core Fixed	8.3%	10.3%	2.0%
High Yield	2.7%	1.7%	-1.0%
Emerging Markets Debt	7.0%	6.0%	-1.0%
<b>Health Care 115 Trust Fund</b>	<b>Current Asset Allocation</b>	<b>New Asset Allocation</b>	<b>Net Change</b>
Core Fixed	15.3%	17.3%	2.0%
High Yield	2.7%	1.7%	-1.0%
Emerging Markets Debt	7.0%	6.0%	-1.0%

Other initiatives within the traditional asset classes are being considered in order to manage a greater proportion of assets internally. These will be discussed as they are developed and will be part of a multi-year effort to continue to control risks and remain cost-effective. But they are implementation initiatives, not changes in allocation.

Within the Alternatives, Risk Parity, and GTAA Asset Classes, no strategic allocation changes are expected.

The Fund Management Committee will continue to monitor overall fund asset allocation and exposures, rebalancing as appropriate in observance of Board Policies.

### **Resources**

The Investments Division Staff is comprised of 67 budgeted positions as of January 2018. Staff biographies are provided in the Appendix.

The Investments Division submitted an estimated compensation and operating budget of \$27.5 million for 2018. The budget includes the Finance Division's estimate of the 2018 incentive compensation payout, based on the prior year's budget. The budget includes the Investments Division's internal investment management expenses.

Staff estimates the total cost to manage the OPERS asset base at 66.8 basis points or \$664.5 million. The cost assumes a long-term growth trend in the fund's asset base, whereas an unanticipated bear market would reduce the cost. While asset allocation (e.g. alternatives vs. traditional investments) and investment structure (internal management of portfolio vs. external management) are main drivers of investment expenses, success also raises fees (e.g. some managers get a slice of profits, and appreciation of asset values raises the total amount of assets on which fees are charged). The cost estimate also includes tens of millions of dollars in fees to private equity and private real estate managers that are repaid to OPERS along with its other capital contributions when investments are sold. To this extent, fee estimates can be overstated by material amounts. All returns reported in this AIP are net of all fees. Fees are discussed in greater details in later pages.



FUND STRATEGIES

**DEFINED BENEFIT FUND**

**Expected Asset Growth – Defined Benefit Fund**

The table below summarizes Staff’s estimate (base case) of market values and ranges for the Defined Benefit Fund at December 31, 2018. Pessimistic and optimistic cases are also provided for reference.

	Defined Benefit Fund 2018 Expected Asset Growth Estimated Market Values, Returns and Cash Flows		
	Pessimistic Case	Base Case	Optimistic Case
<b>12/31/17 Market Value (\$ billions)</b>	\$86.00	\$86.00	\$86.00
<b>Expected Total Return</b>	-6.69%	6.91%	20.51%
<b>Expected Investment Gain (\$ billions)</b>	-\$5.76	\$5.94	\$17.64
<b>Expected Cash Flow (\$ billions)</b>	-\$3.60	-\$3.60	-\$3.60
<b>12/31/18 Market Value (\$ billions)</b>	\$76.64	\$88.34	\$100.04

The anticipated beginning market value of \$86 billion for December 31, 2017 is derived by a smoothing projection from the actual market value as of November 30, 2017.

**Asset Allocation – Defined Benefit Fund**

The 2018 target asset allocation and ranges for the Defined Benefit Fund reflect an estimate by Staff of the expected progress to be made toward dynamic asset allocation targets recommended by NEPC at the January 2018 Board meeting. Also included are Board approved policy asset allocation target, which was initially approved by the Board in June 2016 as part of the asset-liability study, and dynamic asset allocation targets approved by the Board in January 2017. The asset allocations for a peer group of large pension plans as of June 2017 is listed in the last column for reference.

Asset Class	12/31/2017 Estimated	12/31/2018 Target	Board Policy Target	Range	Peer Group*
<b>Public Equity</b>	<b>40.90%</b>	<b>40.90%</b>	<b>39.00%</b>	<b>31% to 47%</b>	<b>49.96%</b>
U.S. Equity	22.00%	20.90%	20.10%	Mkt. Wgt. ±5%	28.16%
Non-U.S. Equity	18.90%	20.00%	18.90%	Mkt. Wgt. ±5%	21.80%
<b>Fixed Income</b>	<b>23.00%</b>	<b>23.00%</b>	<b>23.00%</b>	<b>16% to 30%</b>	<b>22.85%</b>
Core Fixed	8.90%	10.30%	8.30%	7% to 13%	17.25%
Core Plus	0.00%	1.00%	1.00%	0% to 2%	0.00%
Emerging Markets Debt	7.00%	6.00%	7.00%	3% to 9%	1.59%
Floating Rate Debt	0.10%	0.00%	0.00%	0% to 2%	0.01%
Securitized Debt	1.00%	1.00%	1.00%	0% to 2%	0.09%
High Yield	3.00%	1.70%	2.70%	0% to 5%	2.33%
TIPS	2.00%	2.00%	2.00%	1% to 3%	1.50%
U.S. Treasury	1.00%	1.00%	1.00%	0% to 2%	0.08%
<b>Alternatives</b>	<b>29.10%</b>	<b>29.10%</b>	<b>31.00%</b>	<b>22% to 40%</b>	<b>23.88%</b>
Private Equity	10.00%	10.00%	10.00%	5% to 15%	9.54%
Real Estate	10.00%	10.00%	10.00%	5% to 15%	9.42%
Hedge Funds	8.00%	8.00%	8.00%	4% to 12%	3.37%
Opportunistic	0.10%	0.10%	2.00%	0% to 4%	0.01%
Commodities	1.00%	1.00%	1.00%	0% to 2%	1.54%
<b>Risk Parity</b>	<b>5.00%</b>	<b>5.00%</b>	<b>5.00%</b>	<b>2% to 8%</b>	<b>0.45%</b>
<b>GTAA</b>	<b>2.00%</b>	<b>2.00%</b>	<b>2.00%</b>	<b>0% to 4%</b>	<b>0.50%</b>
<b>Other</b>					<b>2.36%</b>
<b>Total Defined Benefit Fund</b>	<b>100.00%</b>	<b>100.00%</b>	<b>100.00%</b>		<b>100.00%</b>

\*The asset allocations are derived from the organizations in the Peer Group Comparison section on page 41.

	Schedule of Expected Performance and Volatility					
	Average Allocation (%)	Active Return Performance Objectives (bps)	Active Return Performance Contribution (bps)	Target Tracking Error (bps)	Tracking Error Range (bps)	Target Information Ratio
<b>U.S. Equity</b>	<b>20.9%</b>	20	4	50	0-100	0.40
<b>Non-U.S. Equity</b>	<b>20.0%</b>	60	12	150	0-300	0.40
<b>Fixed Income</b>	<b>23.0%</b>	20	5	50	0-200	0.40
<b>Alternatives</b>	<b>29.1%</b>	63	18	500	250-750	0.13
<b>Risk Parity</b>	<b>5.0%</b>	0	0	100	0-200	NA
<b>GTAA</b>	<b>2.0%</b>	160	3	400	0-800	0.40
<b>Defined Benefit Fund</b>	<b>100.0%</b>	<b>NA</b>	<b>42</b>	<b>105</b>	<b>0-300</b>	<b>0.40</b>

The above table shows a projected active management contribution of 42 basis points to the Defined Benefit Fund's return. The estimated tracking error of 105 basis points indicates a 68% probability that the active return will be in a range of -63 basis points to +147 basis points. This interval is calculated by subtracting the tracking error from, and adding the tracking error to, the expected active return. The projected active management contribution to the Defined Benefit Fund performance is unchanged from 2017.



### **Return and Risk – Defined Benefit Fund**

The performance objectives for the Defined Benefit Fund are to: (1) exceed the return of the Policy benchmark within an appropriately risk-constrained framework, net of investment fees and expenses; and (2) exceed the actuarial interest rate over a reasonably longer time horizon. The Policy benchmark combines designated market indices for asset classes, weighted by asset allocation targets. Asset class targets and benchmarks are set by the OPERS Retirement Board.

The return estimates in the following table were derived from the asset class return expectations developed by the OPERS Retirement Board's retained Investment Advisor, NEPC. The single-point estimate return of 6.91% is comprised of an expected return of 6.49% from the policy mix and an additional contribution of 0.42% from active management, net of fees.

In the following table, Staff divides return and risk into two components.

**Policy:** The return and risk derived from the policy asset allocation and the intermediate term return and risk forecast of the underlying asset classes

**Active:** The return and risk associated with deviations from benchmark allocations at either the asset class level or portfolio level. It reflects the potential impact to relative performance from deviating from the asset class policy allocation targets, and from individual portfolio active risk

The Policy Return and Active Return are calculated as weighted averages of expected returns and expected alphas of each sub-asset class.

2018 Policy Return Assumptions			
Asset Classes	Pessimistic	Base	Optimistic
<b>Public Equity</b>	<b>-11.54%</b>	<b>7.15%</b>	<b>25.84%</b>
U.S. Equity	-12.80%	5.50%	23.80%
Non-U.S. Equity	-13.36%	8.34%	30.04%
<b>Fixed Income</b>	<b>-3.19%</b>	<b>3.71%</b>	<b>10.61%</b>
Core Fixed	-3.24%	2.75%	8.74%
Core Plus	-3.73%	3.23%	10.19%
Emerging Markets Debt	-7.88%	5.22%	18.32%
Securitized Debt	-9.25%	3.75%	16.75%
High Yield	-9.25%	3.75%	16.75%
TIPS	-3.25%	3.25%	9.75%
U.S. Treasury	-3.25%	2.25%	7.75%
<b>Alternatives</b>	<b>-6.71%</b>	<b>6.99%</b>	<b>20.69%</b>
Private Equity	-15.00%	8.00%	31.00%
Real Estate	-7.51%	6.49%	20.49%
Hedge Funds	-2.99%	5.71%	14.41%
Opportunistic	-12.25%	5.25%	22.75%
Commodities	-14.25%	4.75%	23.75%
<b>Risk Parity</b>	<b>-11.35%</b>	<b>6.75%</b>	<b>24.85%</b>
<b>GTAA</b>	<b>-8.39%</b>	<b>6.51%</b>	<b>21.41%</b>
<b>Policy Return</b>	<b>-6.41%</b>	<b>6.49%</b>	<b>19.39%</b>

2018 Total Return Assumptions			
Sources of Return	Pessimistic	Base	Optimistic
<b>Policy</b>	-6.41%	6.49%	19.39%
<b>Active</b>	-0.63%	0.42%	1.47%
<b>Total Return</b>	<b>-6.69%</b>	<b>6.91%</b>	<b>20.51%</b>

2018 Total Risk and Active Risk Assumptions			
Sources of Risk	Variability Risk	Information Ratio	Sharpe Ratio*
<b>Policy</b>	12.90%		0.35
<b>Active</b>	1.05%	0.40	
<b>Total Risk</b>	<b>13.60%</b>		<b>0.36</b>

\*In Sharpe Ratio, 2% (5-7 year Cash Return) is used as risk free rate.

**HEALTH CARE 115 TRUST FUND**

**Expected Asset Growth – Health Care 115 Trust Fund**

The table below summarizes Staff’s estimate (base case) of market values and ranges for the Health Care 115 Trust Fund at December 31, 2018. Pessimistic and optimistic cases are also provided for reference.

	Health Care 115 Trust Fund 2018 Expected Asset Growth Estimated Market Values, Returns and Cash Flows		
	Pessimistic Case	Base Case	Optimistic Case
<b>12/31/17 Market Value (\$ millions)</b>	\$12.80	\$12.80	\$12.80
<b>Expected Total Return</b>	-6.14%	6.26%	18.66%
<b>Expected Investment Gain (\$ millions)</b>	-\$0.79	\$0.80	\$2.39
<b>Expected Cash Flow (\$ millions)</b>	-\$1.32	-\$1.32	-\$1.32
<b>12/31/18 Market Value (\$ millions)</b>	\$10.69	\$12.28	\$13.87

The anticipated beginning market value of \$12.80 billion for December 31, 2017 is derived by a smoothing projection from the actual market value as of November 30, 2017.

**Asset Allocation – Health Care 115 Trust Fund**

The 2018 target asset allocation and ranges for the Health Care 115 Trust Fund reflect an estimate by Staff of the expected progress to be made toward dynamic asset allocation targets recommended by NEPC at January 2018 Board meeting. Also included are Board approved policy asset allocation target, which was initially approved by the Board in December 2016 as part of the asset-liability study, and dynamic asset allocation targets approved by the Board in January 2017. There is no peer universe of public pension plans with separate health care funds to compare to.

Asset Class	12/31/2017 Estimated	12/31/2018 Target	Board Policy Target	Range
<b>Public Equity</b>	<b>44.90%</b>	<b>44.90%</b>	<b>43.00%</b>	<b>34% to 52%</b>
U.S. Equity	24.10%	22.90%	22.20%	Mkt. Wgt. ±5%
Non-U.S. Equity	20.80%	22.00%	20.80%	Mkt. Wgt. ±5%
<b>Fixed Income</b>	<b>34.00%</b>	<b>34.00%</b>	<b>34.00%</b>	<b>24% to 44%</b>
Core Fixed	15.90%	17.30%	15.30%	12% to 23%
Core Plus	0.00%	1.00%	1.00%	0% to 2%
Emerging Markets Debt	7.00%	6.00%	7.00%	3% to 11%
Floating Rate Debt	0.10%	0.00%	0.00%	0% to 2%
Securitized Debt	1.00%	1.00%	1.00%	0% to 2%
High Yield	3.00%	1.70%	2.70%	0% to 4%
TIPS	6.00%	6.00%	6.00%	3% to 9%
U.S. Treasury	1.00%	1.00%	1.00%	0% to 2%
<b>Alternatives</b>	<b>14.10%</b>	<b>14.10%</b>	<b>16.00%</b>	<b>11% to 21%</b>
REITs	6.00%	6.00%	6.00%	3% to 9%
Hedge Funds	6.00%	6.00%	6.00%	3% to 9%
Opportunistic	0.10%	0.10%	2.00%	0% to 4%
Commodities	2.00%	2.00%	2.00%	0% to 4%
<b>Risk Parity</b>	<b>5.00%</b>	<b>5.00%</b>	<b>5.00%</b>	<b>2% to 8%</b>
<b>GTAA</b>	<b>2.00%</b>	<b>2.00%</b>	<b>2.00%</b>	<b>0% to 4%</b>
<b>HC 115 Trust Fund</b>	<b>100.00%</b>	<b>100.00%</b>	<b>100.00%</b>	

## FUND STRATEGIES

	Average Allocation (%)	Performance Objectives (bps)	Performance Contribution (bps)	Tracking Error (bps)	Error Range (bps)	Target Information Ratio
<b>U.S. Equity</b>	<b>22.9%</b>	20	5	50	0-100	0.40
<b>Non-U.S. Equity</b>	<b>22.0%</b>	60	13	150	0-300	0.40
<b>Fixed Income</b>	<b>34.0%</b>	20	7	50	0-200	0.40
<b>Alternatives</b>	<b>14.1%</b>	24	3	300	200-400	0.08
<b>Risk Parity</b>	<b>5.0%</b>	0	0	100	0-200	NA
<b>GTAA</b>	<b>2.0%</b>	160	3	400	0-800	0.40
<b>HC 115 Trust Fund</b>	<b>100.0%</b>	<b>NA</b>	<b>31</b>	<b>78</b>	<b>0-300</b>	<b>0.40</b>

The above table shows an anticipated active management contribution of 31 basis points to the Health Care 115 Trust Fund's return. The estimated tracking error of 78 basis points indicates a 68% probability that the active return will be in a range of -47 basis points to +109 basis points. This interval is calculated by subtracting the tracking error from, and adding the tracking error to, the expected active return. The expected active management contribution to the Health Care 115 Trust Fund performance for 2017 was 31 basis points.

### **Return and Risk – Health Care 115 Trust Fund**

The performance objective for the Health Care 115 Trust Fund is to exceed the return of the Policy benchmark within an appropriately risk-constrained framework, net of investment fees and expenses. The Policy benchmark combines designated market indices for asset classes, weighted by asset allocation targets. Asset class targets and benchmarks are set by the OPERS Retirement Board.

The return estimates in the table below were derived from the asset class return expectations developed by the OPERS Retirement Board's retained Investment Advisor, NEPC. The single-point estimate return of 6.26% is comprised of an expected return of 5.95% from the policy mix and an additional contribution of 0.31% from active management, net of fees.

In the following table, Staff divides return and risk into two components.

**Policy:** The return and risk derived from the policy asset allocation and the intermediate term return and risk forecast of the underlying asset classes

**Active:** The return and risk associated with deviations from benchmark allocations at either the asset class level or portfolio level. It reflects the potential impact to relative performance from deviating from the asset class policy allocation targets, and from individual portfolio active risk

The Policy Return and Active Return are calculated as weighted averages of expected returns or expected alphas of each sub-asset class.



2018 Policy Return Assumptions			
Asset Classes	Pessimistic	Base	Optimistic
<b>Public Equity</b>	<b>-11.54%</b>	<b>7.15%</b>	<b>25.84%</b>
U.S. Equity	-12.80%	5.50%	23.80%
Non-U.S. Equity	-13.36%	8.34%	30.04%
<b>Fixed Income</b>	<b>-2.63%</b>	<b>3.46%</b>	<b>9.55%</b>
Core Fixed	-3.24%	2.75%	8.74%
Core Plus	-3.73%	3.23%	10.19%
Emerging Markets Debt	-7.88%	5.22%	18.32%
Securitized Debt	-9.25%	3.75%	16.75%
High Yield	-9.25%	3.75%	16.75%
TIPS	-3.25%	3.25%	9.75%
U.S. Treasury	-3.25%	2.25%	7.75%
<b>Alternatives</b>	<b>-6.66%</b>	<b>6.24%</b>	<b>19.14%</b>
REITs	-14.50%	6.50%	27.50%
Hedge Funds	-2.99%	5.71%	14.41%
Opportunistic	-12.25%	5.25%	22.75%
Commodities	-14.25%	4.75%	23.75%
<b>Risk Parity</b>	<b>-11.35%</b>	<b>6.75%</b>	<b>24.85%</b>
<b>GTAA</b>	<b>-8.39%</b>	<b>6.51%</b>	<b>21.41%</b>
<b>Policy Return</b>	<b>-6.13%</b>	<b>5.95%</b>	<b>18.03%</b>

2018 Total Return Assumptions			
Sources of Return	Pessimistic	Base	Optimistic
<b>Policy</b>	<b>-6.13%</b>	<b>5.95%</b>	<b>18.03%</b>
<b>Active</b>	<b>-0.47%</b>	<b>0.31%</b>	<b>1.09%</b>
<b>Total Return</b>	<b>-6.14%</b>	<b>6.26%</b>	<b>18.66%</b>

2018 Total Risk and Risk Attribution Assumptions			
Sources of Risk	Variability Risk	Information Ratio	Sharpe Ratio*
<b>Policy</b>	<b>12.08%</b>		<b>0.33</b>
<b>Active</b>	<b>0.78%</b>	<b>0.40</b>	
<b>Total Risk</b>	<b>12.40%</b>		<b>0.34</b>

\*In Sharpe Ratio, 2% (5-7 year Cash Return) is used as risk free rate.

### TACTICAL OUTLOOK

The following tactical outlooks provide a background and context for the asset class strategies for the Defined Benefit and Health Care 115 Trust Funds. There are two components of the tactical outlook: the capital markets observations and the asset class outlook. The Investment Advisors (NEPC and Aon Hewitt Investment Consulting), retained by OPERS Retirement Board, provided these outlooks for 2018.

#### **Capital Markets Observations**

- Key Market Themes are relatively constant going into 2018.
  - Extended U.S. Economic Cycle
  - Federal Reserve Gradualism
  - China Transitions
  - Globalization Backlash
- Market stability has been persistent; A strong positive for risk assets.
  - Stability is seen both in the volatility of asset classes but also the minimal variation in growth and inflation rates.
- Economic conditions remain supportive of equities but likely provide less of a tailwind.
  - We continue to encourage an overweight tilt to non-US equities.
  - However, potential catalyst of US tax reform and repatriation of foreign cash can spur further US equity gains with benefits also flowing to non-US equities.
  - While we view equities positively in a pro-risk environment, we will look for opportunities to manage portfolio volatility should market stability breakdown.
- Prioritize additional actions that aid in reducing total portfolio volatility or provide exposures that mitigate market drawdowns.
  - Look to rebalance “safe haven” fixed income exposure back to targets.
  - Other actions include adding systematic global macro or long volatility exposures.

#### **U.S. Equity Outlook**

- Valuations remain elevated; however pockets of opportunities exist as bond proxies have been bid up to risky levels while more economically sensitive segments look more attractive.
- U.S. corporate profitability is near an all-time high which does pose some risk.
- Other risks remain high market valuations (for all financial assets) and extreme low volatility; anything causing these to revert to mean would be a detriment to portfolios.

#### **Non-U.S. Equity Outlook**

- Relative valuations for developed market stocks are attractive.
- Maintain overweight exposure to non-U.S. developed market equities as multi-year earnings recovery offers the potential for elevated return.

- Improving economic conditions within Europe and shareholder friendly actions in Japan
- Non-US small cap strategies offer the best opportunity to exploit inefficiencies in the market and complement global implementation.
- Continue to favor emerging markets equity given a positive China controlled deleveraging story and broad-based improving fundamentals for EM economies and businesses.
  - Possibility of a sustained multi-year earnings growth offer great return potential for emerging markets equity; valuations still look attractive.
  - Within emerging markets equity, we continue to like small cap for more idiosyncratic opportunities and more diversified, pure local market drivers.

### Fixed Income Outlook

- Both Investment Grade and High Yield credit spreads remain tight.
  - While spreads may remain range bound for the near term, we do not feel investors are being compensated for the credit risk they are taking in corporate credit (HY and IG).
  - High Yield Corporate returns have been strong year-to-date, however a majority of this has been from coupon income. Should spreads widen in the future, much of this return year-to-date return will be washed away.
  - We continue to favor Senior Floating Rate Bank Loans believing investors can benefit from the floating rate coupon in a rising rate environment, seniority in the capital structure, and higher recoveries should we encounter another default cycle. We remain cautious on the increased issuance of covenant-lite loans.
- Credit Cycle
  - We believe that we are in the later stages of the current cycle, however there is no definitive end in sight.
  - Domestic market investor sentiment is positive. Many believe the current cycle will progress into 2018 with positive fundamental data supporting current sentiment.
  - Global markets have continued to overlook events which were previous thought to be catalysts of volatility, as seen in the recent European votes, however we anticipate continued global monitoring of the geopolitical environment in Europe (ex: Catalonia).
  - Looking ahead, we see signs that defaults in high yield may have peaked in the previous year, and may continue to trend down gradually, though defaults in bank loans are still low versus historical averages.
- Relative to last year, we continue to expect a dampening return outlook, heightened volatility, and an increase in treasury yields.
  - In the U.S. – a potential shift toward fiscal spending could result in upward pressure on inflation – TIPS could be a defensive portfolio hedge.
  - Spreads are priced close to perfection; markets not leaving much ability to absorb shocks.
  - Abroad – key upcoming European events might introduce further political tail risks similar to Brexit and the U.S. election.
  - New issuance in 2018 is expected to come in line with, or higher than total 2017 issuance.

- Globally, not much has changed in developed sovereign credits where a large part remains in negative yield territories. The Rates hike cycle completely diverged in a lot of places between emerging markets and developed markets, emerging market inflation in check.
- Emerging markets debt continue its rally, spreads on the sovereign hard currency and corporates are getting tight, opportunities remain in local where real rates differentials are high and emerging market currencies remain cheap.
- Positive emerging markets equity outlook also provide flows support for emerging markets currencies.

### Real Assets Outlook

- Commodity markets continue to make progress towards equilibrium.
  - Most commodities have been trading below the marginal cost of production for an extended period, resulting in capex cuts and reduced output.
  - The coordinated OPEC cuts should bode well for the price of oil.
  - Improvements in the Chinese economy may generate an increase in broad commodity consumption.
  - Long-only commodities remain unattractive given negative roll yield.
    - Some commodity curves have begun to shift, with backwardation in the outer years, but contango persists in near-term.
- Within U.S. REITs favorable supply demand imbalances should continue to lead to strong cash flow and dividend growth.
  - REIT returns are normalizing; valuations are high and volatility is expected in the near term.
- Midstream/MLPs have underperformed despite company balance sheets generally improving.
  - This may make for an attractive entry- or rebalancing-point.
- Natural Resource Equities have continued to perform well.
  - Valuations remain attractive; outperformance may continue if commodity prices stabilize.
- Listed infrastructure offers low yields while adding volatility.
  - Significant exposure from broader equity benchmarks limits diversification benefits.
  - Select areas (such as midstream/MLPs) are better accessed directly.
  -

### Private Equity Update & Outlook

- 2018's private equity (PE) exit activity is expected to fall from the peak levels experienced in 2016 and 2017. New investment activity is expected to be difficult due to signs of overheating in several areas of the industry:
  - Purchase price multiples for new investments are at all-time highs and are expected to continue fueled by easy credit and an abundance of dry powder (capital committed but not yet drawn down).

- Older deals completed before the Global Financial Crisis have largely been exited and the remaining deals are not yet mature; new investments are now held longer as high purchase price multiples require greater operational changes to drive value.
  - Total fundraising in 2018 is expected to fall from the peak levels of 2016 and 2017; dry powder has reached a new peak of \$1.3 trillion, 78% of which is less than three years old.
  - While allocations to PE have generally been increasing amongst institutional investors, the combination of a slowdown in exit activity and new investments is causing many investors to reach their target allocation to PE in the coming year
  - The number of new deals has been declining since 2015, and the aggregate value of those deals began to fall in 2017. “Add on” deals are likely to continue increasing as a proportion of total deals, as managers work to reduce overall purchase price multiples and seek ways to drive value.
  - Managers with strong track records will continue to raise larger funds, often with only one close. Appetite for the best-performing funds is high, potentially pushing those managers to raise too much capital.
- Capital markets are robust with high valuations and high availability of debt.
    - Purchase prices continue to run at peak levels of 10.3x and 10.1x EBITDA, for Large-cap and Mid-cap deals, respectively.
    - Debt continues to be broadly available at very borrower friendly terms hovering near peak leverage levels. There are no indications this trend will slow. If rates increase we could see a slowdown, but do not expect an increase in defaults as many financing packages were done with little to no covenants.
  - Growth in the U.S. has been slow but steady with two recent stronger quarters and projected to grow at a moderate 2.83% in 2018. Europe overall is at a slower rate with little to point to as a catalyst for near-term increased growth. Asia is mixed depending on the region but overall expected to show stronger growth of ~5.5%.
  - Venture capital is seeing increasing interest as evidenced by funds raised, deals done and dry powder. We expect 2018 to experience similar interest.
    - Strong recent venture returns have lured investors back to this riskier sub-asset class as they seek higher returns.
    - Investment activity remains at high levels, although below the 2015 – 2016 peaks. Non- traditional investors like hedge funds and mutual funds are now also competing for investments in this space - especially in late stage financing rounds.
    - Recent vintage funds have seen strong returns, and valuations are high for almost all deal stages.
    - Consistent with last year, technology and healthcare companies are flush with cash and continue to seek growth through acquisition.
  - 2018 is not a year to “double down” on private equity but rather stay the course and selectively invest in promising managers / strategies. Even in downturns, top-performing managers generate solid returns. There are pockets of attractive investment strategies within all sectors of private equity.

- We favor investment in all sectors over multiple vintage years in order to avoid overexposure to any one strategy or economic cycle as one cannot time the market and good funds to be raised in any vintage year. It may be prudent to temper allocations to secondary investments, mezzanine strategies, mega cap buyout funds and venture, especially late stage venture investing.
- As always, manager selection will be the key to generating the best returns with a current focus on choosing managers with strong operational capabilities and high levels of valuation discipline on new deals.

### Real Estate Update & Outlook

- The U.S. economy is expected to maintain measured growth over the near term, continuing to support the commercial U.S. real estate sector in 2018. That said, the current real estate cycle is mature, and thus more susceptible to downside volatility. Returns for the asset class are past their peak for this cycle, and have since moderated back in line with the sector's long-run average. Continued moderation is to be expected for the asset class, with returns likely to dip below the sector's long-run average (approximately 7%) over the next year.
- Fundamentals for the U.S. commercial real estate sector are generally healthy, albeit moderating, and can be expected to remain on solid footing moving into 2018:
  - Vacancy rates across the four main property types have reached, or even fallen below, their pre-global financial crisis lows driven by new supply largely failing to meet demand, which has helped to support NOI growth. However, this trend has started to turn. The expectation is that over the next two years, new supply will outstrip the pace of demand, driving vacancy rates up slightly and slowing rent growth.
  - Transaction volume, while still elevated historically, has been declining for most property types for some time now. This is being driven by a growing disconnect between buyers' and sellers' return expectations. Liquidating high-quality stabilized assets into the marketplace is holding up best.
  - On a relative basis across multiple asset classes, real estate remains attractive. Persistently low interest rates have made for a healthy spread between real estate cap rates and the 10-year U.S. Treasury, offering a buffer as interest rates rise
- Several broader market risk factors remain active:
  - Heightened economic and political uncertainty
    - Elevated uncertainty creates the potential for higher volatility and increases risks to real estate investors due to potential changes in interest rates, trade agreements, demand patterns, and the like.
    - New capital deployed in 2018 will likely need to ride out a cyclical downturn in the asset class, especially if deployed in closed-end fund structures.



- We are recommending that institutional investors consider the following actions given that the current market environment represents more downside risk than upside potential:
  - Consider portfolio structure and other long-term, risk-mitigating measures to manage liquidity and interest rate sensitivities over the medium-term period
  - Incorporate risk-mitigating tools into portfolios given the current mature point in the real estate cycle
    - Prepare portfolio for downward pressure on rent growth, and eventually on pricing
    - Real estate debt, secondary market offerings, and preferred equity can help to mitigate cyclical risks over the medium-term period

### Hedge Fund Update & Outlook

- Our expectations for 2017 were that shifts in the capital markets and world economies would lead to improved hedge fund returns on both a relative and absolute basis. During the past year, hedge fund performance has improved with the trailing one-year return for the HFR Fund Weighted Composite at 7.2% through September versus 5.0% for the previous twelve months. An increase in cross-sectional security return dispersion was likely the biggest driver of increased opportunity for hedge funds.
- Hedge fund flows for the year have been a net positive \$2.9 billion whereas in 2016 they were a net negative of -\$70 billion. While these net flow numbers are both small relative to the more than \$3 trillion in total allocated to the space, it is encouraging to see positive net investment in this space again.
- At the strategy level, returns were generally strong in 2017, with the notable exception of macro strategies. Discretionary macro strategies generally suffered in 2017 with a variety of widely unanticipated events such as the impact of the Trump election. Systematic macro strategies have also suffered as persistent trends have been scarce and reversals common. Through September, CTAs are down around -5.0% and the HRF Discretionary Macro Index is up only about 2.8%, trailing most other hedge fund categories.
- Event-driven strategies were one of the better-performing areas for the past twelve months with returns reaching into the low double digits for some sub-strategies, such as distressed and special situations. Distressed strategy returns, in particular, have been quite idiosyncratic and dependent on where the manager was invested. Equity long-short funds also performed well although they continue to lag the long-only stock market.
- We have seen an increasing number of opportunistic drawdown funds launched by hedge fund managers in 2017, particularly to take advantage of developments in Europe. European banks are being required to divest of non-core assets at prices that hedge funds find attractive. The banks have also taken a step back from many lending markets they used to serve, creating a void that hedge funds have begun to fill. We find these opportunistic funds attractive because: 1) we find the investment thesis compelling and 2) we believe that the fund structure is well matched to the liquidity of the underlying assets.

- In addition to opportunistic drawdown funds, Alternative Risk Premia (ARP) strategies have started to gain traction among investors. We believe these funds can serve an attractive role as either an initial allocation to alternatives or as a complement to other hedge fund strategies. ARP strategies attempt to exploit well-documented investor behaviors such as a preference for dividend paying securities or common measures of relative value. These behaviors, or alternative risk premia, are accessed through a quantitative implementation, both long and short, across a range of asset classes. They are just now becoming available in well sorted out, low fee and liquid vehicles.
- We also believe that event-driven strategies should continue to enjoy a fertile environment in 2018, although the opportunity set will likely evolve from mergers to more distressed-oriented opportunities. The timing of this transition will depend on the stock market taking a pause and the bond market becoming less willing to finance any issuer with a pulse.
- The thought of stock markets taking a pause at the same time that credit spreads widen would represent more of a material change than many investors may realize. Conventional wisdom has bonds providing the “anchor” in a portfolio -- the risk offset to more growth-oriented assets, such as stocks. Recently that pairing has worked exceptionally well. Not only has a 60/40 stock/bond portfolio produced exceptional returns but since January, 2000 bonds have had on average a slightly negative correlation to stocks. Stocks and bonds have not, however, always behaved in this manner. From January, 1976 through December 1999 the rolling correlation averaged a positive 0.4. If we return to that sort of environment it will be much more difficult to diversify risks across portfolios using only conventional asset classes. Investments in hedge funds and other alternative strategies may prove much more valuable when we are not enjoying such strong diversification benefits from bonds in addition to a strong run in stocks.
- Financial markets are notoriously difficult to predict and many aspects of the current market have little historic precedence, making the task even harder. That said, the current economic expansion has been going for quite some time and there are signs that we may be further along in the cycle than markets are discounting. We are starting to see labor market tightness, industrial commodities have ticked up in price and Europe and Japan are starting to respond to their vigorous Quantitative Easing programs. Recent market performance has obfuscated the benefits of diversification – simple US stock and bond portfolios have handily outperformed more complex portfolios. The benefits of hedge funds and other alternative strategies may become more apparent as the cycle progresses and longer term market dynamics return. History doesn’t repeat itself but it often rhymes.

## ASSET CLASS STRATEGIES

## PUBLIC EQUITY

The Defined Benefit and Health Care 115 Trust Fund's Public Equity allocation is unchanged from 2017. However, the Public Equity benchmark allocation in the Defined Benefit and Health Care 115 Trust Funds is changed from the global weighting of U.S. Equity and Non-U.S. Equity based on the MSCI All Country World Index-Investable Market Index ("MSCI ACWI-IMI") to fixed target weights for both Funds. Below is the summary of the Public Equity benchmark asset allocation recommendation, which reflects the positive bias on the Non-U.S. Asset Class.

<b>Defined Benefit Fund</b>	<b>Current Asset Allocation</b>	<b>New Asset Allocation</b>	<b>Net Change</b>
U.S. Equity	20.3%	19.0%	-1.3%
Non-U.S. Equity	18.7%	20.0%	1.3%
Total Equity	39.0%	39.0%	0.0%
<b>Health Care 115 Trust Fund</b>	<b>Current Asset Allocation</b>	<b>New Asset Allocation</b>	<b>Net Change</b>
U.S. Equity	22.4%	21.0%	-1.4%
Non-U.S. Equity	20.6%	22.0%	1.4%
Total Equity	43.0%	43.0%	0.0%

Sub-asset class allocations within the Non-U.S. Equity asset class are currently in alignment with the custom strategic benchmark ("custom benchmark") approved by the Board in July 2011. The custom benchmark includes an allocation to the Emerging Markets small cap segment (4%) and an explicit allocation to Developed Markets small cap securities (10%). The custom benchmark is composed of 55% MSCI World Index (ex U.S.) Standard Index; 10% MSCI World Index (ex U.S.) Small Cap Index; 31% MSCI Emerging Markets Standard Index; and 4% MSCI Emerging Markets Small Cap Index. This structure reflects a strategic overweight to Emerging Markets compared to the Emerging Markets allocation of MSCI All Country World Index ex U.S. Investable Markets Index ("MSCI ACWI ex U.S. IMI"). The Investments Division has established a significant base of internally managed Non-U.S. Equity portfolios.

The following table shows the benchmarks and performance objectives for the Public Equity asset class.

Public Equity Asset Calss				
Alpha Target and Target Tracking Error				
	Benchmark	Alpha Target (net of fees) (bps)*	Target Tracking Error (bps)	Target Information Ratio
U.S. Equity	Russell 3000	20	50	0.40
Non-U.S. Equity	Custom Benchmark	60	150	0.40

\*bps = basis points

In addition to traditional actively managed and index-oriented portfolios, OPERS internally manages four smart beta portfolios in the Public Equity asset class. Smart beta strategies employ weighting schemes that differ from traditional capitalization-weighted indices and seek to position the portfolio with exposure to attractive styles or factors which are expected to outperform. These strategies are systematic, rules-based approaches constructed using quantitative modeling techniques. The internal quantitative management group manages these strategies. Staff is performing additional research and dedicating resources to further develop the capabilities to internally develop models for creating additional smart beta strategies. The objective is to implement a new smart beta strategy in the Public Equity asset class in 2018. Staff also Investigates return enhancement opportunities in the funding swap or beta areas for possible inclusion in equity portfolios, cash portfolios or in the Opportunistic allocation.

**FIXED INCOME**

After building out an internal high yield team and strategy during 2017, the internal Fixed Income team plans to integrate the current internal high yield portfolio of assets into a newly created Core Plus portfolio. The internal high yield allocation will remain of a higher credit quality bias, with the remaining Core Plus portfolio assets reallocated from a portion of the existing internal Core Fixed portfolio.

Within the Fixed Income asset class, several changes in the sub asset allocation will be implemented for both Funds. Below is the summary of dynamic asset allocation recommendation.

Defined Benefit Fund	Current Asset Allocation	New Asset Allocation	Net Change
Core Fixed	8.3%	10.3%	2.0%
High Yield	2.7%	1.7%	-1.0%
Emerging Markets Debt	7.0%	6.0%	-1.0%
<b>Health Care 115 Trust Fund</b>			
Current Asset Allocation	New Asset Allocation	Net Change	
Core Fixed	15.3%	17.3%	2.0%
High Yield	2.7%	1.7%	-1.0%
Emerging Markets Debt	7.0%	6.0%	-1.0%

## ASSET CLASS STRATEGIES

The Floating Rate Debt portfolio will continue to be phased out in an orderly fashion. U.S. Treasury sub-asset class was created as a part of 2016 NEPC dynamic asset allocation recommendation, which was approved by the OPERS Retirement Board in its January 2016 meeting. The move from Floating Rate Debt to U.S. Treasury allocation would result in the improvement in liquidity of the Funds. Additional liquidity from U.S. Treasury portfolio will be valuable if the corporate credit markets continue to be strained in 2018, as is observed by the Investment advisor, NEPC. Treasury account should be the “last resort source” to be tapped for benefit payments during extremely distressed and correlated market events.

The following table shows the benchmarks and performance objectives for the Fixed Income asset class.

<b>Fixed Income Asset Class</b>				
<b>Alpha Target and Target Tracking Error</b>				
	<b>Benchmark</b>	<b>Alpha Target (net of fees) (bps)*</b>	<b>Target Tracking Error (bps)</b>	<b>Target Information Ratio</b>
<b>Core Fixed</b>	<i>Bloomberg Barclays Aggregate</i>	30	75	0.40
<b>Core Plus</b>	<i>Custom Benchmark**</i>	30	75	0.40
<b>Emerging Markets Debt</b>	<i>EMD Custom Benchmark***</i>	92	230	0.40
<b>Securitized Debt</b>	<i>Securitized Debt Custom Benchmark****</i>	80	200	0.40
<b>High Yield</b>	<i>Bloomberg Barclays U.S. High Yield</i>	34	170	0.20
<b>TIPS</b>	<i>Bloomberg Barclays TIPS</i>	0	15	NA
<b>U.S Treasury</b>	<i>Bloomberg Barclays U.S. Treasury</i>	0	30	NA

\*bps = basis points

\*\* 65/35 mix of the Bloomberg Barclays U.S. Aggregate Index & Bloomberg Barclays VLI BB Index

\*\*\* 50/50 mix of the JP Morgan EM Bond Index Global & the JP Morgan Government Bond Index- Emerging Markets Global Diversified

\*\*\*\* 50/50 mix of the Bloomberg Barclays Non-Agency Investment Grade CMBS: Bbb Total Return Index Unhedged USD & Bloomberg Barclays Non-Agency CMBS Agg Eligible Total Return Index Value Unhedged USD

### **Securities Lending**

In the securities lending program, Staff utilizes multiple lending agents to maximize lending revenue. Staff strives to hire agents who provide competitive fee splits, while providing risk controls and expertise in the asset class being loaned. We are biased toward lending assets in an auction environment so borrowers are providing maximum revenue in a competitive environment on a regular basis. In 2018, Staff will continue lending the Treasury and Agency assets in-house. This effort has increased revenues from Treasury lending. The collateral from the securities lending program is managed internally. The combination of lending revenue and investment income comprise the total securities lending performance. We continue to explore lending of other asset classes, as well as other opportunities that may increase revenue generated from securities lending and cash management.

### **Cash Management**

The cash portfolios are managed with a low-to-moderate risk profile that results in principal preservation while exceeding the performance of the respective benchmarks. The benchmark for the OPERS Short Term Investment Funds ("STIF") is the Merrill Lynch 3-month Treasury Bill Index. The benchmark for the Securities Lending STIF and the Key/MBS STIF is the Overnight Bank Funding Rate published on a daily basis by the Federal Reserve Bank of NY.



## ALTERNATIVES

The Alternatives Asset Class is composed of Private Equity, Real Estate, Hedge Funds, Opportunistic, REITs, and Commodities investment strategies. The Defined Benefit and Health Care 115 Trust Funds invest in different sub-asset classes and weightings in the Alternatives Asset Class to meet their unique investment objectives.

The following table summarizes the benchmark, performance objectives and tracking error for the various alternative investment strategies utilized within the Fund.

Alternatives Asset Class				
Alpha Target and Target Tracking Error				
	Benchmark	Alpha Target (net of fees) (bps)	Target Tracking Error (bps)	Target Information Ratio
Private Equity	<i>State Street Private Equity Index</i>	100	700	0.14
Real Estate	<i>Net NFI-ODCE + 0.85%</i>	40	700	0.06
Hedge Funds	<i>Custom Benchmark*</i>	50	400	0.13
Opportunistic	<i>Custom Benchmark**</i>	16	40	0.40
REITs	<i>DJ U.S. Select RESI</i>	0	10	NA
Commodities	<i>S&amp;P GSCITR Index</i>	36	90	0.40

\* Weighted average of underlying strategies in page 30

\*\* Market cap weighted average of underlying investments benchmark returns

### Private Equity

The Private Equity Program (“Program”) is approximately 1.1% above its 10% target allocation in the Defined Benefit Fund (“Fund”). The allocation percentage was fairly steady at 11% +/-10 basis points throughout 2017, even though the Program’s market value increased. Staff expects the Private Equity allocation to be 50 to 100 basis points above its target allocation for several years, assuming the value of the overall Defined Benefit Fund stays flat. If the value of the overall Defined Benefit Fund increases, as it did last year, then the allocation will likely approach its 10% target by early 2020.

Staff expects Private Equity to near its target allocation through a combination of factors: the cash flow profile of secondary funds, the harvesting of primary funds committed to in 2010-2013, the ongoing robust environment for selling companies, and the reduced amount of commitments made and expected to be made during 2014-2019 compared to 2010 and 2011.

Staff anticipates committing \$1 billion to a number of existing managers who are expected to raise new funds during 2018. Over the next several years Staff will focus on re-ups with existing managers. However, if Staff decides to allocate capital to new managers in the near-term, it will likely be in the following strategies: U.S. small to middle market buyout, energy, and emerging

markets. Co-investment is an important component of the Program with a 12.4% allocation, near the 15% target. Staff will continue to focus on growing the co-investment program to reach its target allocation of 15%. Improved terms for OPERS will continue to be a priority for Staff with the expectation of continuing our successful results of reducing the costs of the Program.

### **Real Estate**

Private market real estate has a target allocation to the Defined Benefit (“DB”) Fund of 10.0%. The portfolio began 2017 with an estimated market value of \$8.02 billion or 10.4% of the DB Fund and at the end of November had a market value of \$7.57 billion or 8.8% of the DB Fund. The Health Care 115 Trust (“HC 115”) has a target real estate allocation of 6.0%, and this exposure is obtained through investments in publicly traded real estate securities known as Real Estate Investment Trusts or REITs. The value of the REIT portfolio was \$717.32 million or 6.1% of the HC 115 at the beginning of 2017 and had a market value of \$773.25 million or 6.0% of the HC Fund at the end of November.

Total returns for domestic private market commercial real estate continued to moderate in 2017. The NFI-ODCE produced a trailing one-year gross return of 7.66% as of 3Q 2017, after producing double digit gross returns in six of the prior seven calendar years.

Staff expects current income will drive domestic commercial real estate returns in 2018. Staff believes cap rates have plateaued and future appreciation will come from increases in net operating income. Staff expects property fundamentals will remain healthy due to growth in GDP, the low unemployment rate and modest levels of new construction.

Staff’s goal for 2018 is to discover and exploit niches that have strong demand drivers but currently attract less institutional capital, which should lead to portfolio outperformance. Staff intends to investigate investment themes that are driven by (1) demographic trends, (2) consumer behavior and (3) capital markets conditions.

Changes in housing preferences by ageing Baby Boomers and maturing Millennials are two demographic trends Staff intends to investigate. Staff believes there will be opportunities to develop apartments that cater to seniors who no longer want the responsibilities of home ownership. Staff also sees a niche to develop or redevelop apartments located in good public school districts that target young families who are in search of more space. Staff also believes the increased demand for health care services from an aging population will create an opportunity to develop health care facilities.

The growth of on-line retail and the changes in supply chain management is driving the demand for state-of-the-art warehouse buildings. Staff intends to continue the current strategy of the selective

development of modern industrial buildings. Staff sees consumer demand for properties that provide a “walkable live-work-play” environment. Staff will continue to seek development and redevelopment opportunities of mixed-use assets that contain residential, office and retail assets.

Staff realizes the domestic commercial real estate market is late in the recovery cycle. Staff intends to sell assets where capital is plentiful and invest where capital is scarce. Staff anticipates it will continue to sell Core assets when buyers are aggressively pricing these properties and the future return expectations are modest. Staff plans to continue to reduce the exposure to first-loss positions and deploy capital into first mortgage debt, subordinate debt and preferred equity positions. The focus will continue to be on assets that do not have stabilized cash flows and the supply of debt is limited, as is the case for development or redevelopment projects. Staff will also focus on real estate secondaries where OPERS can earn a return premium by providing liquidity. Staff anticipates the Non-Core percentage of the portfolio will increase in 2018 as OPERS sells stabilized properties and invests in properties that do not yet have stabilized cash flows. Finally, Staff intends to use leverage in moderation on the portfolio.

### Hedge Funds

The Hedge Funds sub-asset class is near its target allocations of 8% in the Defined Benefit Fund, and 6% in the Health Care Fund. In 2018, Staff will focus on: 1) increasing exposure to funds with low correlation to equity and bond markets, and 2) continuing to improve the fee structure through negotiations with existing managers and adding lower cost strategies.

Hedge Funds Strategy Allocation Target and Range for 2018

Strategy	Target	Range
Equity Hedge	20%	0-35%
Event Driven	30%	0-40%
Relative Value	25%	0-35%
Macro/Tactical	25%	0-35%

### Opportunistic

The Opportunistic sub-asset class is intended to permit investments in assets or strategies not presently contemplated in the respective Defined Benefit or Health Care 115 Trust Funds. The maximum size for any single benchmarked strategy is 0.5% of the total fund. The Opportunistic allocation currently contains an Interest Rate and Volatility portfolio which provides exposure to the U.S. interest rate and volatility markets using a combination of Treasuries, futures and options. The benchmark is the Barclays U.S. Treasury Index with a duration of approximately five years.

Uncommitted portions of the Opportunistic asset class will be allocated into the U.S. and non-U.S. equity exposure within the Public Equity asset class.

### **Commodities**

The Commodity sub-asset class provides exposure to both the Defined Benefit and Health Care 115 Trust Funds as shown in the Fund Strategies sections. The allocation includes a risk-controlled mix of index and enhanced index commodity strategies.

### **RISK PARITY**

Risk parity is an alternative approach to asset allocation which focuses on allocation of risk rather than allocation of capital. When asset allocations are adjusted to the same risk level, the portfolio can achieve a higher risk adjusted return and can be more resistant to equity market downturns than a traditionally equity-centric portfolio.

OPERS has applied 5% of both Defined Benefit and Health Care assets to the Risk Parity concept. For operational reasons it is treated as an asset class. The performance benchmark for the Risk Parity asset class is the HFR Risk Parity Vol 15 Institutional Index, effective January 1, 2018. Knowing that risk parity managers are trying to construct diversified balanced portfolios and not trying to outperform a benchmark, the Risk Parity asset class has an expected alpha target of zero.

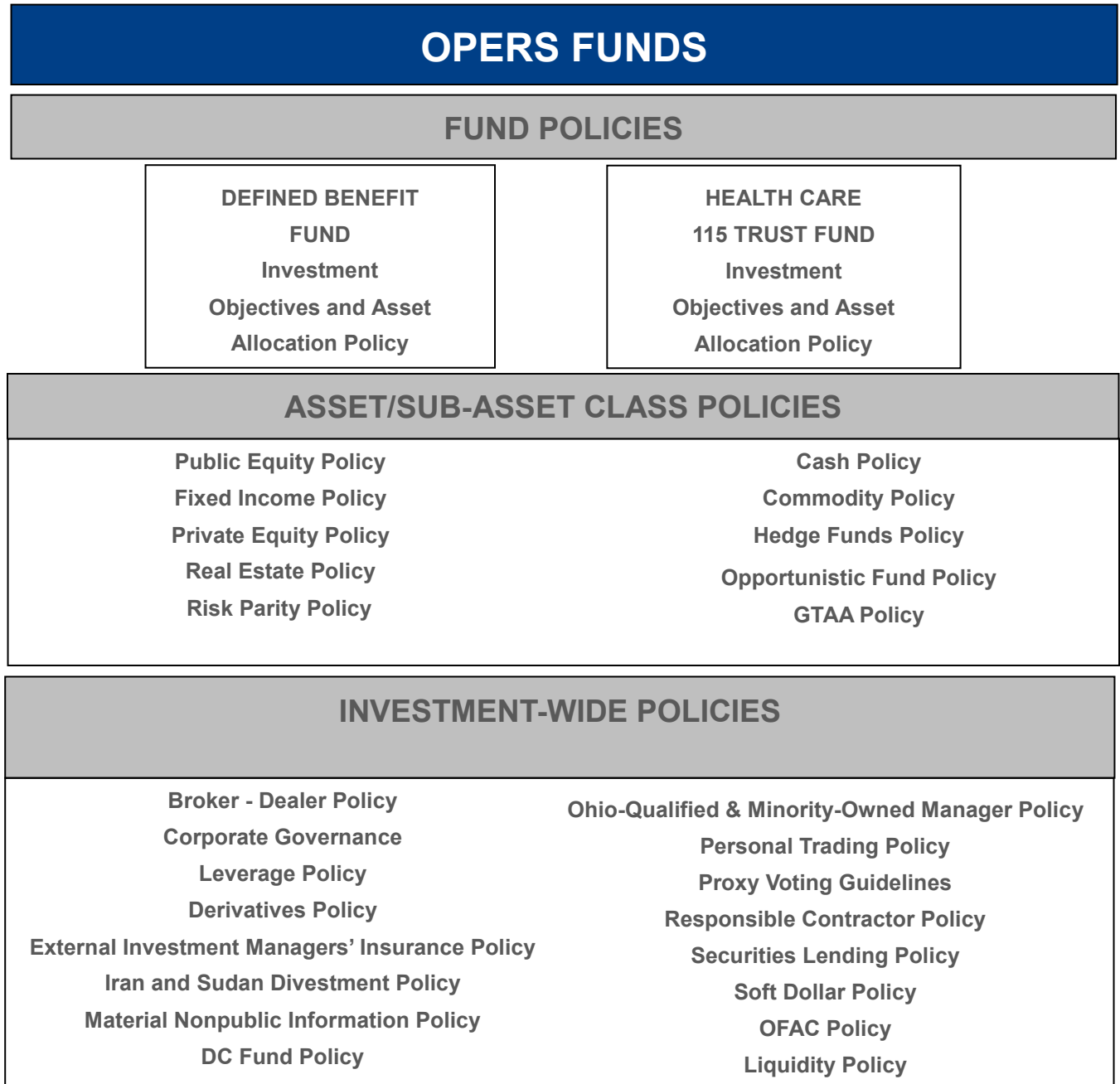
### **GLOBAL TACTICAL ASSET ALLOCATION**

Global Tactical Asset Allocation, or GTAA, is a “top-down” investment strategy that attempts to exploit short-term mis-pricings among a global set of asset classes. This strategy focuses on general movements in markets rather than on performance of “bottom-up” security selection. Target allocations of 2% for the Defined Benefit and Health Care 115 Trust Funds were completed in the first quarter of 2013. The performance benchmark for the GTAA asset class is the weighted average of underlying managers’ performance benchmarks. GTAA has an alpha target of 160 basis points with a target tracking error of 400 basis points.

**POLICIES, COMMITTEES, AND RESOURCES**

**OPERS RETIREMENT BOARD POLICIES GOVERNING INVESTMENT ACTIVITIES**

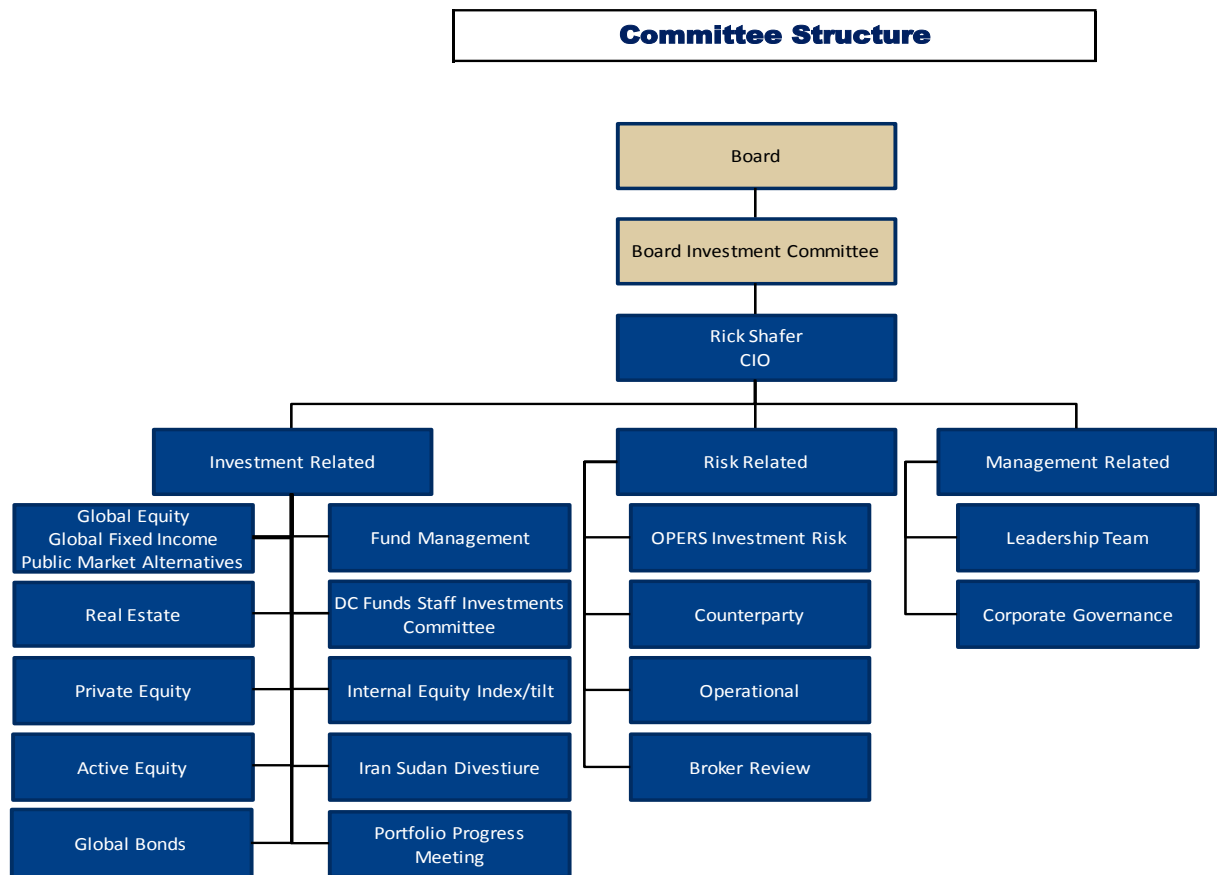
The following exhibit illustrates the structure and relationship of the Policies within the total System and its three investment Funds. All Policies are available at [www.opers.org](http://www.opers.org).





## POLICIES, COMMITTEES, AND RESOURCES

The Chief Investment Officer (“CIO”) utilizes a variety of committees, working groups and meeting structures to govern the Investments Division’s activities. Committees enhance collective inputs, retain institutional knowledge, document due diligence and other processes, promote transparency and accountability, and formalize decision-making. Committees are designed to combine structure and flexibility to efficiently share information and bring appropriate decision makers together on a timely basis, while minimizing operational risk. The committees and working groups vary in both the frequency of meetings and the degree of structure and formality. Here is an outline of the Investment related committees and meetings.



## POLICIES, COMMITTEES, AND RESOURCES

<b><u>Committee/Meeting</u></b>	<b><u>Purpose and Description</u></b>
<b>Investment Committees</b>	<b>Approvals and Decisions</b>
Broker Review*	Monitor/Approve and Evaluate Brokers, Complete ORSC Reports
Counterparty*	Set Counterparty Limits and Monitor Counterparty Exposures
DC Funds Staff Investments Committee*	Review/Monitor Defined Contribution Fund's Allocation and Rebalancing Activities
Fund Management*	Implement Asset Allocation and Investment Strategies, Cash Forecasting, Fund and Portfolio Exposure Metrics, and Set Quarterly Fund Target Benchmark Allocations Transitions, Liquidity Management
Operational Risk*	Identify and Monitor Operational Risks
Investment Risk*	Assess and Prioritize Risk Matters
<b>Investment Meetings</b>	<b>External Portfolio Management</b>
Private Equity*	Review PE Opportunities for CIO Approval
Real Estate*	Review RE Opportunities for CIO Approval
Public Markets Alternatives*	Review Hedge Funds, Risk Parity, GTAA, Commodities, and Opportunistic strategies
<b>Investment Meetings</b>	<b>Internal Portfolio Management</b>
Active Equity	Review Sector Outlooks, Portfolio Composition, and Risk Management
Global Bonds	Review Sector Outlooks, Portfolio Composition, and Risk Management
Quantitative Equity Index/Tilt/Derivatives	Review Strategies, Derivatives, Index, and Tilt Portfolios
Portfolio Progress Meeting	Plan and Implement New Portfolio
Transition Management	Transition Assets between Managers and Conduct Rebalancing
<b>Investment Meetings</b>	<b>Internal and External Portfolio Management</b>
Global Equity*	Review All Internal and External Global Equity Investment
Global Fixed Income*	Review All Internal and External Global Fixed Income Investment
<b>Non-Investment Division Committees</b>	<b>Committees with Investment Staff Involvement</b>
Iran/Sudan Divestiture*	Leadership Team*
Corporate Governance*	
* Committee has charter	

**STAFFING**

Recruiting and retaining the best and most talented Staff is a critical priority for the Investments Division. The following table shows the anticipated staffing for 2018.

Target Staffing for Year End 2018								
	Office of the CIO	Fixed Income Internal Mgmt.	Active Equity Internal Mgmt.	Index Quant Trading	Fund Management	Cash/Sec Lending	External Funds	Total Invest. Division
2018 Investment Plan Projected Staffing	8	14	9	10	6	3	17	67

**Staffing Costs**

Assuming full staffing levels for 2018, the chart below details the estimated \$17.81 million of compensation for the Investments Division. This represents approximately 2 basis points of cost, an increase of only 0.18 basis points from the 2017 projection despite two Staff additions.

Estimated 2018 Total Compensation Costs (\$ millions)					
	Office of the CIO	Internal Mgmt.	External Mgmt.	2018 Projected Total	2017 Projected Total
Salaries	\$ 1.49	\$ 6.16	\$ 2.03	\$ 9.68	\$ 9.65
Benefits	\$ 0.73	\$ 3.11	\$ 1.02	\$ 4.86	\$ 4.83
Incentive Compensation	\$ 0.37	\$ 2.21	\$ 0.69	\$ 3.27	\$ 3.20
Total Compensation	\$ 2.58	\$ 11.48	\$ 3.74	\$ 17.81	\$ 17.68
Average Assets (\$ billions)	\$ 99.40	\$ 37.77	\$ 61.63	\$ 99.40	\$ 89.50
Compensation (Basis Points)	0.26	3.04	0.61	1.79	1.98

## Operating Budget

The Investments Division's 2018 operating budget (excluding compensation) is \$10.89 million. This operating budget reflects an increase of \$0.82 million from the 2017 budget due to transfer expenses from soft dollar to hard dollar budget in 2018.

	Operating Budget less Total Compensation (\$ millions)		
	Internal Mgmt.	External Mgmt.	Total Invest. Division
<b>2017 Operating Budget</b>	\$ 7.15	\$ 2.93	\$ 10.07
<b>2018 Operating Budget</b>	\$ 8.41	\$ 2.48	\$ 10.89
<b>Percent Change</b>	17.7%	-15.3%	8.1%
<b>Percent of Total</b>	77.2%	22.8%	100.0%
<b>Average Assets (\$ billions)</b>	\$ 37.77	\$ 61.63	\$ 99.40
<b>Operating Budget (Basis Points)</b>	2.23	0.40	1.10

## Management Cost

The expected annual external management fees by asset class and sub-asset class for the Investments Division are in the table below. The estimate of fees is based on the projected average market value for the Defined Benefit and Health Care 115 Trust Funds, as shown by sub-asset class in the average assets column below. For three sub-asset classes within the Alternatives Asset Class, Staff estimates the performance fees based on the average performance assumption over the market cycle of each sub-asset class. Since the performance fee is based on yearly performance, its hurdle rate and other fee payment conditions, this portion is the most difficult to estimate.

POLICIES, COMMITTEES, AND RESOURCES

Estimate of External and Internal Management Costs Total for 2018						
	Internal Management			External Management		
	Average Assets (\$ millions)	Annual Cost (\$ millions)	Annual Cost (bps)	Average Assets (\$ millions)	Annual Cost (\$ millions)	Annual Cost (bps)
<b>Public Equity</b>	<b>21,790</b>	<b>2.7</b>	<b>1.2</b>	<b>19,366</b>	<b>74.8</b>	<b>38.6</b>
U.S. Equity	17,271	2.0	1.1	3,755	15.4	41.1
Non-U.S. Equity	4,520	0.7	1.5	15,611	59.3	38.0
<b>Public Fixed Income</b>	<b>16,425</b>	<b>1.5</b>	<b>0.9</b>	<b>7,817</b>	<b>27.4</b>	<b>35.0</b>
Core Fixed	10,953	1.0	0.9	143	0.6	42.0
Emerging Markets Debt	0	0.0	0.0	5,964	20.9	35.0
Floating Rate Debt	0	0.0	0.0	20	0.1	45.0
U.S. Treasury	994	0.1	0.5	0	0.0	0.0
Securitized Debt	994	0.2	2.0	0	0.0	0.0
High Yield	0	0.0	0.0	1,690	5.8	34.4
Core Plus	994	0.2	0.0	0	0.0	34.0
TIPS	2,490	0.1	1.4	0	0.0	0.0
<b>Alternatives</b>	<b>852</b>	<b>0.1</b>	<b>0.9</b>	<b>26,191</b>	<b>255.6</b>	<b>97.6</b>
Private Equity	0	0.0	0.0	8,685	117.3	135.1
Real Estate	0	0.0	0.0	8,685	50.6	58.3
REITs	753	0.0	0.4	0	0.0	0.0
Hedge Funds	0	0.0	0.0	7,701	87.7	113.9
Opportunistic	99	0.1	5.0	0	0.0	0.0
Commodities	0	0.0	0.0	1,120	1.5	13.0
<b>Risk Parity</b>	<b>0</b>	<b>0.0</b>	<b>0.0</b>	<b>4,970</b>	<b>23.4</b>	<b>47.0</b>
<b>GTAA</b>	<b>0</b>	<b>0.0</b>	<b>0.0</b>	<b>1,988</b>	<b>17.5</b>	<b>88.0</b>
<b>Total</b>	<b>39,068</b>	<b>4.3</b>	<b>1.1</b>	<b>60,332</b>	<b>398.6</b>	<b>66.1</b>
Custody		<b>5.0</b>			<b>2.5</b>	
<b>Total Fund</b>	<b>39,068</b>	<b>9.3</b>	<b>2.4</b>	<b>60,332</b>	<b>401.1</b>	<b>66.5</b>
<b>Performance Fee</b>						
Private Equity	0	0.0	0.0	8,685	77.0	88.7
Real Estate	0	0.0	0.0	8,685	63.6	73.2
Hedge Funds	0	0.0	0.0	7,701	89.1	115.7
<b>Total Performance Fee</b>	<b>0</b>	<b>0.0</b>	<b>0.0</b>	<b>25,071</b>	<b>229.7</b>	<b>91.6</b>
<b>Total Fund with Perf. Fee</b>	<b>39,068</b>	<b>9.3</b>	<b>2.4</b>	<b>60,332</b>	<b>630.9</b>	<b>104.6</b>

There is a significant cost advantage for passive and systematic forms of asset management and further savings are achieved for internally-managed assets. Sources of internal cost savings arise from lower rent, less travel, no marketing costs, no stand-alone business expenses and no profit margin. But there are also many appropriate business and risk management reasons why OPERS uses external management for some asset classes and portfolios.

**Total Costs**

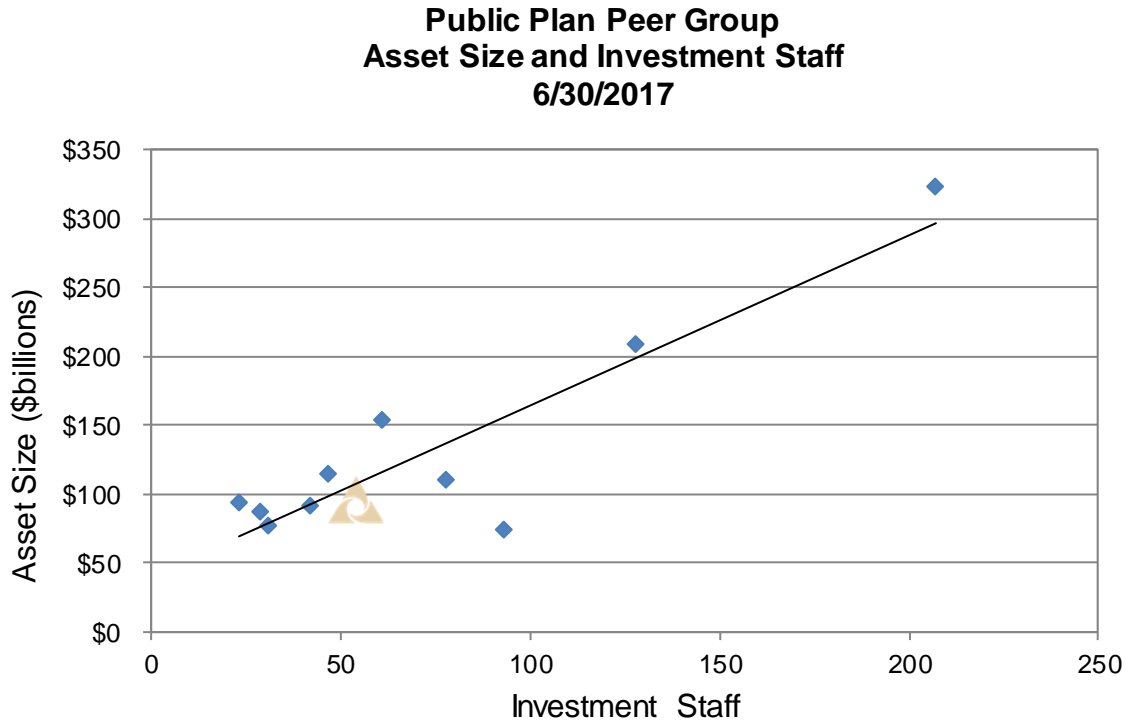
All investment performance returns are reported after fees. Using the same “CEM – compatible\*” fee calculation used in prior years, the total costs of the investment program in 2018 are projected to be \$587.5 million, or 59.1 basis points of assets under management. However, the CEM method excludes the estimated “carry costs” from Private Equity, including these latter costs raises the total fees, estimated for 2018 to 66.8 basis points, or \$664.5 million.

	Estimated 2018 Total Costs (\$ millions)			
	Internal Mgmt.	External Mgmt.	Total Invest. Division	% of Total
Total Compensation	14.1	3.7	17.8	2.7%
Operating Budget less Compensation	8.4	2.5	10.9	1.6%
Manager Fees		628.3	628.3	94.6%
Custody	5.0	2.5	7.5	1.1%
<b>Total Costs</b>	<b>27.5</b>	<b>637.0</b>	<b>664.5</b>	<b>100.0%</b>
Percent of Total	0.0	1.0		
Average 2017 Asset Size (\$ billions)	37.8	61.6	99.4	
<b>Costs in Basis Points</b>	<b>7.3</b>	<b>103.4</b>	<b>NA</b>	
<b>Costs in Basis Points to Total Fund</b>	<b>NA</b>	<b>NA</b>	<b>66.8</b>	

\*CEM Benchmarking, Inc. is an independent firm that provides an assessment of pension plans and it evaluates OPERS investment program relative to a peer group of comparably sized public plans.

**Peer Group Comparison**

The following chart compares OPERS asset size and Investment Staff to its peer group as of June 30, 2017. While differences in the percentage and types of assets managed internally exist, OPERS compares very favorably. Data are from Pension Fund Data Exchange.



The following table lists the public pension peer group referenced in the chart.

Public Plan Peer Group (as of 6/30/2017)			
Peers	Asset Size (\$ millions)	Investment Staff	Asset Size per Investment Staff
California Public Employees' Retirement System	\$323,500	207	\$1,563
California State Teachers' Retirement System	\$208,700	128	\$1,630
State Board of Administration of Florida	\$153,600	61	\$2,518
New York State Teachers' Retirement System	\$114,700	47	\$2,440
State of Wisconsin Investment Board	\$110,100	78	\$1,412
North Carolina Retirement System	\$94,100	23	\$4,091
<b>Ohio Public Employees Retirement System</b>	<b>\$93,400</b>	<b>52</b>	<b>\$1,796</b>
Washington State Investment Board	\$91,600	42	\$2,181
Employees Retirement System of Georgia	\$87,100	29	\$3,003
New Jersey Division of Investment	\$76,000	31	\$2,452
Ohio State Teachers Retirement System	\$73,600	93	\$791
<b>Average</b>	<b>\$129,673</b>	<b>72</b>	<b>\$2,171</b>



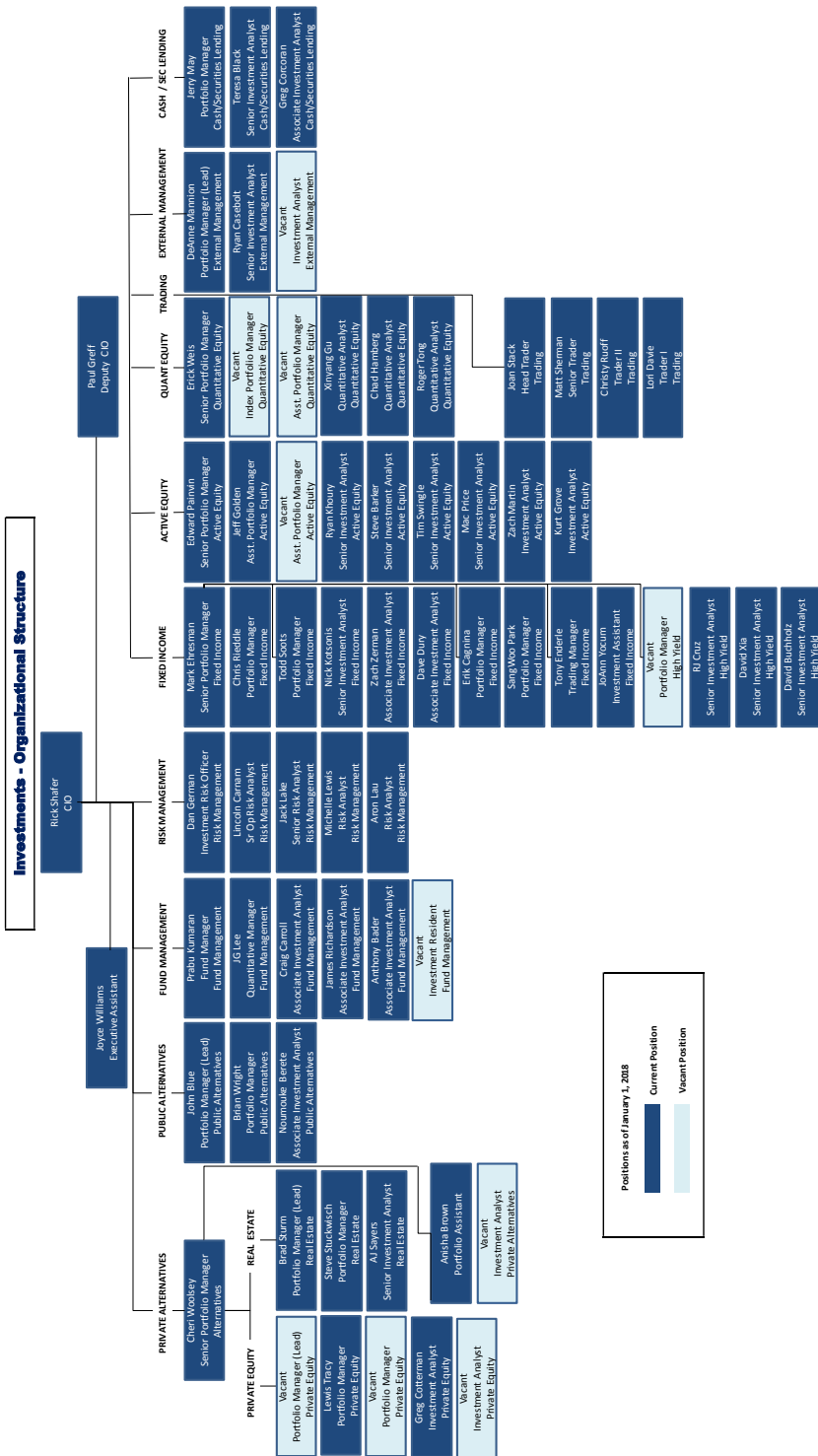


# APPENDIX













# INVESTMENT ORGANIZATION STRUCTURE

## INVESTMENT ORGANIZATION STRUCTURE









# STAFF DIRECTORY

## STAFF DIRECTORY






Name	Department/Title Education/Designation/ License	Investment Experience		Name	Department/Title Education/Designation/ License	Investment Experience	
		OPERS	Total			OPERS	Total
 Anthony Bader	Fund Management Associate Investment Analyst BS, The Ohio State University CFA Charterholder	1	5	 Steven Barker	Active Equity Senior Investment Analyst MBA, The Ohio State University BS, The Ohio State University	18	18
 Teresa Black	Cash/Securities Lending Senior Investment Analyst BS, The Ohio State University Passed Level I of the CFA Program	18	22	 John Blue	Public Alternatives Lead Portfolio Manager MBA, The Ohio State University BS, The Ohio State University CFA Charterholder CAIA Charterholder	24	26
 Noumouke Berete	Public Alternatives Associate Investment Analyst MFE, Ohio University BS, Franklin University CIPM,FRM CAIA Charterholder 2018 Level III Candidate in the CFA Program	2	4	 Anisha Brown	Private Equity Portfolio Assistant BA, The Ohio State University	2	2
 David Buchholz	Fixed Income Senior Investment Analyst BS, Wright State University CFA Charterholder	9	12	 Erik Cagnina	Fixed Income Portfolio Manager MBA, Case Western Reserve BS, Miami (OH) University CFA Charterholder	12	23
 Lincoln Carnam	Risk Management Senior Operational Risk Analyst MBA, William & Mary Mason School of Business BA, Muhlenberg College CFA Charterholder Investment Adviser Certified Compliance Professional Designation	5	18	 Craig Carroll	Fund Management Associate Investment Analyst BA, Eastern Michigan University BA, Michigan State University 2018 Level III Candidate in the CFA Program	2	11



# STAFF DIRECTORY

Name	Department/Title	Investment Experience		Name	Department/Title	Investment Experience	
	Education/Designation/ License	OPERS	Total		Education/Designation/ License	OPERS	Total
 Ryan Casebolt	External Public Markets Senior Investment Analyst  BS, The Ohio State University  CFA Charterholder CAIA Charterholder	4	15	 Greg Corcoran	Cash/Securities Lending Associate Investment Analyst  BS, St. Michaels College	4	9
 Greg Cotterman	Private Alternatives Investment Analyst  BS, Franklin University BMus, Capital University  Series 63	8	16	 R.J. Cruz	Fixed Income Senior Investment Analyst  MBA, Golden Gate University MSBA, University of Southern California  CFA Charterholder	1	32
 Lorie Davie	Trading Trader I  BA, Ashford University MAOM, Ashford University  CP (Certified Paralegal) Series 63	20	20	 David Dury	Fixed Income Associate Investment Analyst  BS, Xavier University  CFA Charterholder	6	9
 Mark Ehresman	Fixed Income Senior Portfolio Manager  MBA, Case Western Reserve BS, Miami (OH) University  CFA Charterholder	16	16	 Tony Enderle	Fixed Income Trading Manager  BS, Bowling Green State University  CFA Charterholder	16	16
 Dan German	Risk Management Investment Risk Officer  MBA, University of Pittsburgh BS, Allegheny College  CFA Charterholder	10	19	 Jeff Golden	Active Equity Assistant Portfolio Manager  BS, Princeton University  CFA Charterholder	3	18







# STAFF DIRECTORY

Name	Department/Title	Investment Experience		Name	Department/Title	Investment Experience	
	Education/Designation/ License	OPERS	Total		Education/Designation/ License	OPERS	Total
 Paul Greff	Public Markets Deputy CIO  MBA, University of Detroit BA, Kalamazoo College  CFA Charterholder	9	28	 Kurt Grove	Active Equity Associate Investment Analyst  BS, The Ohio State University  CFA Charterholder	3	4
 Xinyang Gu	Quantitative Management Quantitative Analyst  MS, The Ohio State University BS, Southeast University, China	17	17	 Chad Hamberg	Quantitative Management Investment Analyst  MBA, Wright State University BS, Wright State University  2018 Level II Candidate in the CFA Program	6	15
 Ryan Khoury	Active Equity Senior Investment Analyst  BS, University of Minnesota, Twin Cities  CFA Charterholder	8	19	 Nick Kotsonis	Fixed Income Senior Investment Analyst/Economist  BS, Miami (OH) University  CFA Charterholder	10	13
 Prabu Kumaran	Fund Management Fund Manager  MBA, Asian Institute of Management B Eng (Mech), Anna University  CFA Charterholder	9	20	 Jack Lake	Risk Management Senior Risk Analyst  MBA, Case Western Reserve BS, Marist College  CFA Charterholder	10	24
 Aron Lau	Risk Management Risk Analyst  BS, The Ohio State University  CFA Charterholder	3	7	 J.G. Lee	Fund Management Quant Manager  PhD, The Ohio State University  CFA Charterholder FRM Charterholder PRM Charterholder	16	21

# STAFF DIRECTORY

Name	Department/Title	Investment Experience		Name	Department/Title	Investment Experience	
	Education/Designation/ License	OPERS	Total		Education/Designation/ License	OPERS	Total
 Michelle Lewis	Risk Management Risk Analyst  MBA, University of Phoenix BA, Wright State University  2018 Level II Candidate in the CFA Program	7	7	 DeAnne Mannion	External Public Markets Lead Portfolio Manager  MBA, The Ohio State University BA, The Ohio State University BA, Mt. Holyoke College  Passed Level I of the CFA Program	17	24
 Zachary Martin	Active Equity Investment Analyst  BBA, University of Kentucky  CFA Charterholder	6	8	 Jerry May	Fixed Income Portfolio Manager  MBA, Ashland University BA, Abilene Christian University  CTP	14	26
 Edward Painvin	Active Equity Senior Portfolio Manager  MBA, Wake Forest University BA, Flagler College  CFA Charterholder CMT Charterholder	4	20	 SangWoo Park	Fixed Income Portfolio Manager  MBA, University of Chicago BA, Northwestern University  CFA Charterholder FRM Charterholder	1	11
 Mac Price	Active Equity Senior Investment Analyst  MBA, Boston University JD, University of Chicago BA, James Madison University  CFA Charterholder	6	11	 James Richardson	Fund Management Associate Investment Analyst  BBA, Eastern Kentucky University  2018 Level III Candidate in the CFA Program	2	6
 Chris Rieddle	Fixed Income Portfolio Manager  MBA, Indiana University BS, Indiana University  CFA Charterholder	11	28	 Christy Ruoff	Trading Trader II  BS, Franklin University  Series 63	35	35

# STAFF DIRECTORY

Name	Department/Title Education/Designation/ License	Investment Experience		Name	Department/Title Education/Designation/ License	Investment Experience	
		OPERS	Total			OPERS	Total
 A.J. Sayers	Real Estate Investment Analyst  BA, The Ohio State University  CFA Charterholder CAIA Charterholder	5	5	 Rick Shafer	CIO  BA, Dartmouth College  CFA Charterholder	9	44
 Matthew Sherman	Trading Senior Equity Trader  MBA, Otterbein University BA, The Ohio State University  Series 63	12	23	 Todd Soots	Fixed Income Portfolio Manager  MBA, The Ohio State University BS, The Ohio State University  CFA Charterholder	16	18
 Joan Stack	Trading Head Trader Equities  MBA, Fordham University BA, Mt. Holyoke College	15	42	 Stephen Stuckwisch	Real Estate Portfolio Manager  MBA, The Ohio State University BA, Hanover College  CFA Charterholder CAIA Charterholder	22	32
 Bradley Sturm	Real Estate Lead Portfolio Manager  MBA, The Ohio State University MA, University of Cincinnati MAIR, University of Cincinnati BA, University of Cincinnati  CAIA Charterholder	24	24	 Timothy J. Swingle	Active Equity Senior Investment Analyst  BSBA, The Ohio State University  CFA Charterholder CMT Charterholder CPA (Inactive) CMA	19	19
 Roger Tong	Quantitative Management Quantitative Analyst  MBA, The College of Insurance MS, New Jersey Institute of Technology  Passed Level I of the CFA Program	14	23	 Lewis Tracy	Private Alternatives Portfolio Manager  PhD, The Ohio State University MBA, The Ohio State University BA, University of California at Berkeley  CAIA Charterholder	17	17



# STAFF DIRECTORY

Name	Department/Title	Investment Experience		Name	Department/Title	Investment Experience	
	Education/Designation/ License	OPERS	Total		Education/Designation/ License	OPERS	Total
 Erick Weis	Quantitative Management Senior Portfolio Manager  MBA, The Ohio State University BBA, University of Toledo  CFA Charterholder	23	24	 Joyce Williams	Executive Assistant  BS, Franklin University  Awarded the Claritas® Investment Certificate (2014)	8	10
 Cheri Woolsey	Private Alternatives Senior Portfolio Manager  MBA, Baylor University BA, Baylor University  CFA Charterholder	7	26	 Brian Wright	Public Alternatives Portfolio Manager  MS, Indiana University BSBA, Auburn University  CFA Charterholder CPA (Inactive)	8	11
 David Xia	Fixed Income Senior Investment Analyst  MBA, University of Chicago MS, John Hopkins University BS, University of Maryland	1	5	 JoAnn Yocum	Fixed Income Investment Assistant  AS, Bliss Business College	18	32
 Zachary Zerman	Fixed Income Associate Investment Analyst  BS, Miami (OH) University  CFA Charterholder	3	11				