April 4, 2019



Wyoming State Loan and Investment Board

Asset Allocation Recommendations

## **Individual Investment Pool Characteristics**



#### 2018: \$20.2 Billion

## **WSTO Investment History**



Pie charts and market values reflect the Total Fund as of December 31. Pie chart key: Green = Public Equity, Blue = Fixed Income & Cash, Yellow = Alternatives, Grey = Mixed Assets. Market values include Public Purpose Investments. PMTF Target Risk Assets include public equity, mixed assets, and alternatives. Convertibles were reclassified as mixed assets in 2017 and are included in the 2018 total allocation. Current targets to Risk Assets are Total Return Focus Perm. Funds: 56%, Income Focus Perm. Funds: 44%, Workers' Comp: 27%, Pool A: 23%, SAP: 5% (convertibles only).



# **Summary of 2017 Asset Allocation Enhancements**

**Permanent Funds** (*PMTF, PLF, UPLF, CSPLF, Hathaway, and Higher Ed*)

Improved the likelihood of achieving each pool's long-term return objectives, focusing on long-term total return or income generation based on respective spending policy goals and needs.
 Increased allocations to public equity and alternatives for pools with a long-term total return focus, increased allocations to higher yielding assets for pools with an income focus.

### **State Agency Pool**

 Focused on aligning the risk profile appropriately with the needs of the constituent investors. Emphasized risk reduction and capital preservation to help mitigate significant short-term draw downs.

Introduced low duration fixed income to reduce portfolio interest rate risk.

### Workers' Compensation Fund

• Examined risk in terms of surplus volatility to help preserve the fund's fiscal health with a healthy funded status.

Introduced a modest allocation to long duration fixed income to help reduce funded status volatility.

**Pool A Investment Account** (formerly Tobacco Settlement Fund)

• Introduced public equity and alternative investments in a thoughtful manner such that the overall risk profile remains appropriate.

### Gradually introduce allocations to risk assets when better entry points are available.



# **Completed & Upcoming Initiatives**

### **Completed:**

- ☑ November 2018 External low duration credit funded (State Street) (State Agency Pool)
- October 2018 Long Duration Fixed Income mandates funded (Internal Gov't & Logan Circle Credit) (Workers Comp)
- August 2018 Small Cap US Equity allocation transitioned to passive mandate (Total Return, Income Focus, Workers Comp, Pool A)
- ☑ July 2018 MLPs funded (Harvest) (Total Return, Income Focus, Workers Comp, Pool A)
- ☑ June 2018 Hedge Funds portfolio initiated (discretionary and internal) (Total Return Focus)
- June 2018 Preferred Stock funded (Cohen & Steers) (Income Focus & Pool A)
- February 2018 Arrowstreet mandate converted from global to international equity (Total Return, Income Focus, Workers Comp)
- **February 2018** Internal low duration gov't fixed income portfolio funded (State Agency Pool)

### **Upcoming:**

- □ Manager searches for Emerging Markets Debt and Bank Loans (All Funds)
- □ Private Equity additional commitments (Total Return Focus)
- Core and Non-Core Real Estate additional commitments (Total Return, Income Focus, Workers Comp)
- □ Removal of asset classes with no long-term target (All Funds)
- Establish public equity allocations (Pool A)



# **Grouping of Permanent Funds**

The Permanent Funds are grouped into two buckets for purposes of asset allocation, based on each fund's unique objectives and constraints.

### 1. Total Return Focus

- Emphasis on maximizing total return over the long-term with an appropriate level of risk, while meeting annual spending needs.
- Higher long-term total return and corpus growth.
- Permanent Funds:
  - Permanent Mineral Trust Fund
  - Permanent Land Fund
  - University Permanent Land Fund
  - Hathaway Scholarship Fund

### 2. Income Focus

- Emphasis on generating sufficient levels of income to meet guaranteed annual spending levels. Secondary focus on maximizing total return over the long-term with an appropriate level of risk.
- Lower long-term total return and corpus growth.
- Permanent Funds:
  - Common School Permanent Land Fund
  - Higher Education Endowment Fund



## **Permanent Funds – Total Return Focus**

Permanent Mineral Trust Fund, Permanent Land Fund, University Permanent Land Fund, and Hathaway Scholarship Fund

Combined Assets (12/31/18):	\$8,234 million								
Fund Horizon:	Permanent Fund (Perpetual)								
Primary Investment Goal:	Preserve long-term purchasing power after spending and inflation, while providing stable income for distributions								
Investment Constraints:	<ul> <li>The corpus must be held inviolate and cannot be spent</li> <li>Only income and net capital gains can be spent (realized losses can become problematic in this regard)</li> <li>Maximum of 70% of the total book value of permanent funds may be invested in equities and alternative investments (has been increased several times beginning with the initial allowance to invest in equities in 1996)</li> </ul>								
Spending Policy:	<ul> <li>Permanent Mineral Trust Fund: 5% of the trailing 5-year average market value, with 2.5% guaranteed to the General Fund.</li> <li>FY 2021: 4.75% of the trailing 5-year average market value</li> <li>FY 2022 and thereafter: 4.5% of the trailing 5-year average market value</li> <li>Amounts must be sourced from investment income (interest and dividends) and realized capital gains.</li> <li>Earnings in excess of the spending policy are appropriated to the reserve account. Reserve account balance must exceed 150% of the current fiscal year's spending policy before transferring any excess funds to the corpus.</li> <li>Hathaway Scholarship Fund: The amount necessary to fully fund scholarships awarded under W.S. 21-16-1301 <i>et seq</i>.</li> <li>Amounts must be sourced from investment income (interest and dividends) and realized capital gains.</li> <li>Earnings in excess of the spending policy are appropriated from the Hathaway expenditure account to the Hathaway Fund reserve account. Reserve account balance must exceed \$12 million or an amount equal to 4.5% of the previous 5-year average market value before transferring any excess funds to the corpus.</li> </ul>								
Other Considerations:	Avoid a high correlation with mineral prices								



## **Permanent Funds – Income Focus**

Common School Permanent Land Fund and Higher Education Endowment Fund

Combined Assets (12/31/18):	\$3,868 million						
Fund Horizon:	Permanent Fund (Perpetual)						
Primary Investment Goal:	Provide sufficient income to meet guaranteed spending levels, while preserving long-term purchasing power after spending and inflation						
Investment Constraints:	<ul> <li>The corpus must be held inviolate and cannot be spent</li> <li>Only income and net capital gains can be spent (realized losses can become problematic in this regard)</li> <li>Maximum of 70% of the total book value of permanent funds may be invested in equities and alternative investments (has been increased several times beginning with the initial allowance to invest in equities in 1996)</li> </ul>						
Spending Policy:	<ul> <li>Common School Permanent Land Fund: 5% of trailing 5-year average market value, with the full spending policy amount guaranteed to the General Fund.</li> <li>FY 2021: 4.75% of the trailing 5-year average market value</li> <li>FY 2022 and thereafter: 4.5% of the trailing 5-year average market value</li> <li>Amounts must be sourced from investment income (interest and dividends) and realized capital gains.</li> <li>Earnings in excess of the spending policy are appropriated to the reserve account. Reserve account balance must exceed 150% of the current fiscal year's spending policy before transferring any excess funds to the corpus.</li> <li>Higher Education Endowment Fund: 4.75% of trailing 5-year average market value of the fund, calculated on the first day of the fiscal year.</li> <li>Amounts must be sourced from investment income (interest and dividends) and realized capital gains.</li> <li>Earnings in excess of the spending policy are appropriated to the reserve account. Reserve account be sourced from investment income (interest and dividends) and realized capital gains.</li> <li>Earnings in excess of the spending policy are appropriated to the reserve account. Reserve account balance must exceed 150% of the current fiscal year's spending policy before transferring any excess funds to the corpus.</li> </ul>						
Other Considerations:	Avoid a high correlation with mineral prices.						





## **Total Return & Income Focus Comparison**

Investment Objectives, Constraints, and Spending Policies

	Total Return Focus	Income Focus				
Fund Horizon:	Permanent Fu	nds (Perpetual)				
Investment Constraints:	<ul> <li>Corpus must be held inviolate and cannot be</li> <li>Only capital gains and income can be spent</li> <li>Maximum of 70% may be invested in equities</li> </ul>	spent and alternative investments				
Primary Investment Goal:	<ol> <li>Long-Term Total Return</li> <li>Stable Income</li> </ol>	<ol> <li>Sufficient Income</li> <li>Long-Term Total Return</li> </ol>				
Spending Policy:	<ul> <li>PMTF: 2.5% guaranteed to General Fund</li> <li>Hathaway: Full amount necessary to fully fund scholarships</li> </ul>	<ul> <li>CSPLF: Full spending policy amount guaranteed to General Fund</li> <li>Higher Education: 4.75%</li> </ul>				
Implementation:	Increased allocations to equities and alternative investments (Hedge Funds, Private Equity, Non-Core Real Estate)	Increased allocations to higher yielding assets (Preferred Stock, MLPs, Bank Loans)				



# State Agency Pool & LSRA

Total Assets (12/31/18):	\$5,311 million
Fund Horizon:	Non-Permanent Fund
Primary Investment Goal:	<ul> <li>Stability assuring that appropriated funds remain to the greatest extend possible intact for their intended purposes. SAP is intended to be moderately liquid.</li> <li>SAP is one of two pools holding a diverse array of individual funds ranging from agency budgets to reserve accounts.</li> </ul>
Investment Constraints:	<ul> <li>This fund dispenses income and capital gains.</li> <li>Cannot invest in equities or alternative investments</li> </ul>
Spending Policy:	Investment income (interest, dividends, and capital gains) is deposited as prescribed by statute.

### **RVK Comments:**

The recent legislative session brought about changes to the long-term structure of the State Agency Pool, including the removal of LSRA.

• A new pool will be created specifically for LSRA with its own unique investment objectives and asset allocation.



# **Workers' Compensation Fund**

Total Assets (12/31/18):	\$2,042 million
Fund Horizon:	Permanent Fund (Perpetual)
Primary Investment Goal:	To provide for a return that assures the Fund will be self-funding or nearly self-funding in order to substantially reduce or eliminate the need for employer contributions.
Funded Status	163%
Duration of Liabilities	11.4 years
Investment Constraints:	<ul> <li>Maximum of 70% of the total book value of permanent funds may be invested in equities and alternative investments (has been increased several times beginning with the initial allowance to invest in equities in 1996).</li> <li>This fund retains income and capital gains.</li> </ul>
Spending Policy:	The exact cash level shall be determined by the Staff of the Wyoming Department of Workforce Services and dependent on the liquidity needs of the Fund. Those cash estimates shall be presented to the State Treasurer's Office on an annual basis.





## **Pool A Investment Account**

(Formerly Tobacco Settlement Fund)

Total Assets (12/31/18):	\$244 million
Fund Horizon:	Non-Permanent Fund
Primary Investment Goal:	<ul> <li>Stability and return on investment. Pool A is intended to be moderately liquid and safely invested, but also be invested for return and growth.</li> <li>Pool A is one of two pools holding a diverse array of individual funds from agency budgets to reserve accounts.</li> </ul>
Investment Constraints:	<ul> <li>This fund dispenses income and capital gains.</li> <li>Maximum of 60% of the total book value of Pool A may be invested in equities and alternative investments.</li> </ul>
Spending Policy:	Investment income (interest, dividends, and capital gains) is deposited as prescribed by statute.



# **Summary Matrix**

	Permanent Mineral Trust Fund	Permanent Land Fund	University Permanent Land Fund	Hathaway Scholarship Fund	Common School Permanent Land Fund	Higher Education Endowment Fund	Workers' Compensation Fund	Pool A Investment Account	State Agency Pool & LSRA	
Fund Type										
Fund Horizon	Permanent Fund	Permanent Fund	Permanent Fund	Permanent Fund	Permanent Fund	Permanent Fund	Permanent Fund	Non-Permanent	Non-Permanent	
	(Perpetual)	(Perpetual)	(Perpetual)	(Perpetual)	(Perpetual)	(Perpetual)	(Perpetual)	Fund	Fund	
Market Value as of 12/31/18	\$7,460,761,290	\$186,115,275	\$22,120,087	\$564,866,146	\$3,752,502,577	\$115,125,909	\$2,041,824,850	\$243,661,351	\$5,310,951,031	
Percentage of the Total Fund MV	Total Return	0.9% Total Return	U. 1% Total Return	Z.9% Total Return	19.170	0.0%	10.4%	1.270	21.0%	
Permanent Fund Asset Allocation Grouping	Focus	Focus	Focus	Focus	Income Focus	Income Focus	N/A	N/A	N/A	
Investment Objectives and Constraints										
Primary Investment Goal	Preserve long-te	erm purchasing powe providing stable inco	To provide for a return that assures the Fund will be self-funding or nearly self- funding.	Stability and return on investment. Pool A is intended to be moderately liquid and safely invested, but also be invested for return and growth.	Stability assuring that appropriated funds remain to the greatest extend possible intact for their intended purposes. SAP is intended to be moderately liquid.					
Treatment of Income and Capital Gains	The corpus must	pe held inviolate and	cannot be spent bu dispense income	ut only invested for i and capital gains.	ncome and capital (	gains. These funds	This fund retains income and capital gains.	These funds disp capita	ense income and I gains.	
Maximum Equity and Alternatives Allocation	70%	70%	70%	70%	70%	70%	70%	60%	0%	
Spending Policy		1						Decling of mon	av frame different	
Funding Source	Constitutional and statutory mineral severance tax revenues.	Mineral royalties, permits, and other from sta	leases, fees and revenue generated te lands.	Mineral royalties	Mineral royalties, leases, fees and permits, and other revenue generated from state lands.	Mineral royalties	Employer premiums	Pooling of money from different agencies which are not specifically invested for that agency, ranging from agency budgets to reserve and savings accounts, and special		
Spending Policy	5% of the trailing 5-year average market value (FY 2021: 4.75%; FY 2022 and thereafter: 4.5%)	Income (capital gains, interest and dividends) is deposited as prescribed by the Act of Admission and statute.	Income (capital gains, interest and dividends) is deposited to UW as prescribed by the Act of Admission and statute.	The amount necessary to fully fund scholarships awarded under W.S. 21-16-1301 <i>et seq.</i>	nt 5% of the trailing 5-year average 4.75% of the staff of the Dept. of Workforce Services and dependent on the thereafter: 4.5%)		1.75% of the annually by the staff of the Dept. of Workforce arage market value dependent on the liquidity needs of WC.		gains, interest and sited as prescribed atute.	
Annual Spending Guaranteed to General Fund	2.50%	N/A	N/A	N/A	Full Spending Policy Amount	N/A	N/A	N/A	N/A	
Long-Term Policy Target			·	-	· · ·	-				
Long-Term Return Expectation	CPI + 3%	CPI + 3%	CPI + 3%	CPI + 3%	CPI + 3%	CPI + 3%	CPI + 3%	CPI + 2%	CPI + 2%	
Current Equity and Alternatives Long-Term Target	56%	56%	56%	56%	44%	44%	27%	23%	0%	

Long-Term Return Expectations are from the WSTO Investment Policy Statement.



## **Capital Market Assumptions**



## **Themes for 2019 Capital Market Assumptions**

- Past and future inflation levels are studied and considered given market conditions, break-even indications, sovereign intervention, and inflation component pricing behavior. 2019 assumption is for a 2.5% long-term expected increase (no change from 2018 assumption).
- Mean reversion is considered for asset classes demonstrating weaker recent returns and pricing environments. *Non-US equity return assumptions were increased.*
- Return decomposition models are run and examined in light of current and possible future market conditions.
- Yield history, current environment, and prospective environments are considered. US fixed income return assumptions were increased given the rise in yields.
- Alternative asset classes are examined for impact from underlying asset classes. *Hedge fund assumptions reflect underlying exposure to asset class trends including equity and fixed income, along with structural characteristics.*

Asset Class	Return Expectation	Rationale
US Equity	=	Valuations Remain Expensive
Non-US Equity		Valuations Improving
Fixed Income		Yields Improving



# **RVK 2019 Capital Market Assumptions**

### **Year-over-Year Changes**

		20	)19			2018				One Year Adjustment (2019-2018)					
Asset Class	Nominal Return (Geo.)	Risk (StDev)	Nominal Return (Arith.)	Return / Risk Ratio	Nominal Return (Geo.)	Risk (StDev)	Nominal Return (Arith.)	Return / Risk Ratio	Nominal Return (Geo.)	Risk (StDev)	Nominal Return (Arith.)	Return / Risk Ratio			
Large/Mid Cap US Equity	5.30%	17.75%	6.75%	0.38	5.30%	17.75%	6.75%	0.38							
Small Cap US Equity	5.20%	21.25%	7.25%	0.34	5.20%	21.25%	7.25%	0.34							
Broad US Equity	5.35%	17.80%	6.80%	0.38	5.35%	17.80%	6.80%	0.38							
Broad International Equity	6.94%	20.95%	8.90%	0.42	6.66%	20.80%	8.60%	0.41	+0.28%	+0.15%	+0.30%	+0.01			
Global Equity	6.26%	18.40%	7.80%	0.42	6.12%	18.35%	7.65%	0.42	+0.14%	+0.05%	+0.15%	+0.01			
Convertibles	4.72%	13.70%	5.60%	0.41	4.72%	13.70%	5.60%	0.41							
Preferred Stock	4.93%	13.25%	5.75%	0.43	4.93%	13.25%	5.75%	0.43							
MLPs	6.65%	23.00%	9.00%	0.39	6.34%	22.00%	8.50%	0.39	+0.32%	+1.00%	+0.50%	+0.00			
Low Duration Fixed Income	3.44%	3.50%	3.50%	1.00	2.94%	3.50%	3.00%	0.86	+0.50%		+0.50%	+0.14			
US Aggregate Fixed Income	3.58%	6.00%	3.75%	0.63	3.33%	6.00%	3.50%	0.58	+0.25%		+0.25%	+0.04			
Int. Duration Govt Fixed Income	3.13%	5.00%	3.25%	0.65	3.15%	4.63%	3.25%	0.70	-0.02%	+0.37%		-0.05			
Long Duration Fixed Income	3.12%	11.50%	3.75%	0.33	2.87%	11.50%	3.50%	0.30	+0.25%		+0.25%	+0.02			
TIPS	3.81%	6.25%	4.00%	0.64	3.56%	6.25%	3.75%	0.60	+0.25%		+0.25%	+0.04			
High Yield	4.95%	15.00%	6.00%	0.40	4.45%	15.00%	5.50%	0.37	+0.50%		+0.50%	+0.03			
Bank Loans	4.78%	10.00%	5.25%	0.53	4.78%	10.00%	5.25%	0.53							
EMD (Local)	5.02%	12.50%	5.75%	0.46	5.02%	12.50%	5.75%	0.46							
Core Real Estate	5.27%	12.50%	6.00%	0.48	5.52%	12.50%	6.25%	0.50	-0.25%		-0.25%	-0.02			
Non-Core Real Estate	5.73%	22.50%	8.00%	0.36	6.75%	22.50%	9.00%	0.40	-1.02%		-1.00%	-0.04			
Custom Hedge Funds	5.46%	9.50%	5.88%	0.62	5.33%	9.50%	5.75%	0.61	+0.13%		+0.13%	+0.01			
Private Equity	6.65%	25.50%	9.50%	0.37	6.90%	25.50%	9.75%	0.38	-0.26%		-0.25%	-0.01			
Commodities	3.70%	19.75%	5.50%	0.28	3.95%	19.75%	5.75%	0.29	-0.25%		-0.25%	-0.01			
Cash Equivalents	2.96%	3.00%	3.00%	1.00	2.46%	3.00%	2.50%	0.83	+0.50%		+0.50%	+0.17			
US Inflation	2.46%	3.00%	2.50%	0.83	2.46%	3.00%	2.50%	0.83							

Blue highlighted cells indicate values are being calculated base on a roll up of underlying asset classes.

Broad US Equity is a combination of 92.9% Large/Mid Cap US Equity and 7.1% Small Cap US Equity.

Broad International equity is a combination of 64.0% Dev'd Large/Mid Cap Int'l Equity, 10.7% Dev'd Small Cap Int'l Equity, and 25.3% Emerging Markets Equity.

Global Equity is combination of 54.0% Broad US Equity and 46.0% International Equity.

Convertibles is a combination of 65.0% Broad US Equity and 35.0% US Aggregate Fixed Income.

Custom Hedge Funds is a combination of 50.0% Diversified Hedge Fund of Funds and 50.0% Multi-Strategy Hedge Funds.

# **RVK 2019 Correlation Matrix**

### Interrelationship of Various Asset Class Pairings

	Lg/Md Cap US Equity	Small Cap US Equity	Broad US Equity	Broad Int'l Equity	Global Equity	Convrts.	Pref. Stock	MLPs	Low Duration Fl	US Agg Fl	Int. Duration Gov't FI	Long Duration FI	TIPS	High Yield	Bank Loans	EMD (Local)	Core Real Estate	Non- Core Real Estate	Custom HFs	Private Equity	Comm.	Cash Equiv.	US Inflation
Large/Mid Cap US Equity	1.00																						
Small Cap US Equity	0.83	1.00																					
Broad US Equity	0.99	0.88	1.00																				
Broad Int'l Equity	0.82	0.73	0.83	1.00																			
Global Equity	0.93	0.83	0.94	0.97	1.00																		
Convertibles	0.79	0.86	0.83	0.76	0.83	1.00																	
Preferred Stock	0.51	0.44	0.51	0.55	0.55	0.45	1.00																
MLPs	0.44	0.41	0.45	0.45	0.48	0.44	0.43	1.00															
Low Duration FI	0.10	0.02	0.08	-0.07	-0.10	0.02	0.25	0.07	1.00														
US Agg FI	0.18	0.07	0.16	0.00	-0.02	0.10	0.27	0.03	0.89	1.00													
Int. Duration Gov't FI	0.05	-0.05	0.03	-0.22	-0.25	-0.10	0.05	-0.13	0.94	0.96	1.00												
Long Duration FI	0.19	0.08	0.15	0.03	0.01	0.09	0.26	0.00	0.72	0.93	0.84	1.00											
TIPS	0.02	-0.01	0.02	0.15	0.10	0.12	0.28	0.14	0.61	0.77	0.67	0.72	1.00										
High Yield	0.59	0.61	0.62	0.69	0.70	0.68	0.55	0.58	0.12	0.23	-0.01	0.23	0.29	1.00									
Bank Loans	0.44	0.44	0.46	0.51	0.51	0.52	0.32	0.47	-0.10	-0.04	-0.29	-0.05	0.15	0.76	1.00								
EMD (Local)	0.55	0.45	0.54	0.76	0.68	0.49	0.42	0.36	0.33	0.37	0.16	0.31	0.47	0.60	0.36	1.00							
Core Real Estate	0.22	0.16	0.22	0.27	0.29	0.17	0.24	0.20	-0.05	-0.04	-0.06	-0.01	0.10	0.07	0.18	0.10	1.00						
Non-Core Real Estate	0.15	0.08	0.13	0.08	0.10	0.05	-0.11	0.07	-0.12	-0.07	-0.05	-0.03	0.05	-0.04	0.03	-0.09	0.70	1.00	]				
Custom Hedge Funds	0.61	0.62	0.64	0.74	0.74	0.75	0.43	0.49	0.07	0.10	-0.10	0.09	0.19	0.64	0.61	0.50	0.21	0.13	1.00				
Private Equity	0.73	0.73	0.74	0.70	0.75	0.69	0.33	0.40	-0.14	-0.26	-0.40	-0.26	-0.19	0.42	0.38	0.40	0.42	0.23	0.71	1.00			
Commodities	0.30	0.31	0.32	0.49	0.44	0.34	0.27	0.41	0.06	0.02	-0.06	-0.01	0.27	0.36	0.39	0.52	0.22	0.06	0.39	0.49	1.00		
Cash Equivalents	0.03	0.00	0.02	-0.06	-0.05	-0.02	-0.14	0.04	0.50	0.26	0.35	0.13	0.07	-0.05	-0.05	0.05	0.11	0.08	0.12	0.06	0.07	1.00	
US Inflation	0.01	0.00	-0.01	0.07	0.06	0.07	-0.03	0.18	0.04	-0.11	-0.06	-0.18	0.07	0.07	0.32	0.11	0.21	0.07	0.15	0.12	0.26	0.37	1.00

Correlation greater than 0.50
Correlation between 0.00 and 0.50
Correlation less than 0.00



# **US Equity Valuations**

### Shiller P/E vs. Forward Returns

### **Trendline at 12/31/2018 = 1.6% Real Return**







# **US Fixed Income Valuations**

### **Current Yield vs. Forward Returns**



Barclays US Aggregate Bond Index YTW (Annualized, %)

Trendline = 0.9321x + 0.007



# **Private Equity Valuations**

Private Equity valuations are moderately elevated relative to historical multiples, however US private appears attractive in comparison to US public equities.



Public vs. Private Valuations\*

\*Multiples reflect EV (Enterprise Value) / LTM (Last 12 Months) EBITDA Source: Neuberger Berman / S&P Leveraged Buyout Quarterly Review Public multiples based on Russell 2000 for the US and FTSE All World Developed Europe Index for Europe



# **Appendix: Estimated Asset Class Yields**

Asset Class	Dec-2018 Yield (%)	Dec-2017 Yield (%)	One Year Adjustment		
MLPs	8.88	7.60	+1.28		
Bank Loans	8.07	6.55	+1.52		
EMD (Local)	6.62	6.10	+0.52		
Preferred Stock	5.85	6.11	-0.26		
Non-Core Real Estate	5.46	5.69	-0.23		
Core Real Estate	4.31	4.61	-0.30		
Long Duration Fixed Income	4.07	3.50	+0.57		
Broad International Equity	3.46	2.86	+0.60		
US Aggregate Fixed Income	3.28	2.72	+0.56		
TIPS	2.81	2.34	+0.47		
Low Duration Fixed Income	2.75	2.03	+0.72		
Int. Duration Gov't Fixed Income	2.54	2.09	+0.45		
Cash Equivalents	2.38	1.36	+1.02		
Broad US Equity	2.11	1.79	+0.32		
Small Cap US Equity	1.67	1.26	+0.41		
Convertibles	1.64	1.45	+0.19		
Private Equity	0.00	0.00			
Custom Hedge Funds	0.00	0.00			

As of December 31, 2018.

Estimated asset class yields are benchmark specific, with the exception of real estate and diversified hedge funds which are specific to Wyoming's current managers. Fixed income yields are yield to maturity.



# **Appendix: Investing in Gold**

### **Benefits**

### 1. Storage of Value

 Price tends to hold up in times of severe market distress.

### 2. Inflation Hedge

Similar to other commodities, prices typically rise in inflationary periods.

### **Constraints**

- 1. No Income Generation
  - Does not generate income, value is gained/lost only when the asset is sold.

### 2. Historical Volatility

 Prices are often subject to extreme volatility due to speculative trading.

### 3. Relatively Poor Long-Term Performance

 Long-term historical performance has significantly lagged US stocks and bonds.



Growth of \$100

## **Asset Allocation Modeling & Recommendations**



## **Summary of Asset Allocation Recommendations**

ASE T CLASS         CURRENT         FC PROPOSED         IC         CURRENT         FC PROPOSED         IC         CURRENT         FC PROPOSED         IC         IC        IC		тот	AL RETURN			INCOME				POOL A		WORKER	S' COMPENSA	TION	LSRA
Bread US cuty         100         110         +10         80         80         -         7.5         7.5         -         9.0         80         -10         7.0           Bread Cap US Equty         30         3.0         -	ASSET CLASS	CURRENT	IFC PROPOSED	+/-	CURRENT	IFC PROPOSED	+/-		CURRENT	IFC PROPOSED	+/-	CURRENT	IFC PROPOSED	+/-	IFC PROPOSED
Small Cayly         3.0         3.0         -         2.0         2.0         -         1.0         1.0         2.0         1.0	Broad US Equity	10.0	11.0	+1.0	8.0	8.0	-		7.5	7.5	-	9.0	8.0	-1.0	7.0
Broad international Equity         13.0         14.0         +10.0         20.0         10.0         +10.0         10.0         - <th< td=""><td>Small Cap US Equity</td><td>3.0</td><td>3.0</td><td>-</td><td>2.0</td><td>2.0</td><td>-</td><td></td><td>1.0</td><td>1.0</td><td>-</td><td>1.0</td><td>2.0</td><td>+1.0</td><td>2.0</td></th<>	Small Cap US Equity	3.0	3.0	-	2.0	2.0	-		1.0	1.0	-	1.0	2.0	+1.0	2.0
Preference Slock         -	Broad International Equity	13.0	14.0	+1.0	9.0	10.0	+1.0		7.5	7.5	-	10.0	10.0	-	9.0
MLPs         4.5         5.5         +10         6.0         7.0         +10         5.0         5.0         5.0            4.0           Care Real Estate         6.0         6.0   -	Preferred Stock	-	-	-	2.0	3.0	+1.0		2.0	7.0	+5.0	-	-	-	-
Prevale Equity         8.0         8.0         -	MLPs	4.5	5.5	+1.0	6.0	7.0	+1.0		5.0	5.0	-	3.0	4.5	+1.5	4.0
Core Real Estate         6.0         6.0         15.0         11.0         4.0           Non-Core Real Estate         4.0         5.0         1.0         2.0         3.0         4.5         +.5           Hedge Funds         7.5         7.5               3.0         4.5         +.5         0.0         6.0           US Agg Fixed Foome               3.0         4.5         +.5         0.0         6.0           US Agg Fixed Foome                3.0         4.5         +.5         0.0         0.0         0.0         0.0         1.0         4.0         3.0         4.5         0.0 <td>Private Equity</td> <td>8.0</td> <td>8.0</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td></td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td>	Private Equity	8.0	8.0	-	-	-	-		-	-	-	-	-	-	-
Non-Core Real Estate         4.0         5.0         +1.0         2.0         3.0         +1.0         -         8.0         +1.0         4.0         +3.0         -           Low Duration Fixed Income         - <td< td=""><td>Core Real Estate</td><td>6.0</td><td>6.0</td><td>-</td><td>15.0</td><td>11.0</td><td>-4.0</td><td></td><td>-</td><td>-</td><td>-</td><td>3.0</td><td>4.5</td><td>+1.5</td><td>-</td></td<>	Core Real Estate	6.0	6.0	-	15.0	11.0	-4.0		-	-	-	3.0	4.5	+1.5	-
Hedge Funds       7.5       7.5       -       -       -       -       -       -       -       -       -       -       0.0         US Agg Fixed hoome       200       29.0       -       37.0       37.0       37.0       -	Non-Core Real Estate	4.0	5.0	+1.0	2.0	3.0	+1.0		-	8.0	+8.0	1.0	4.0	+3.0	-
Low Duration Fixed holome         2         -         -         -         -         -         -         -         -         -         34.0           Long Duration Fixed holome         2         29         29         -	Hedge Funds	7.5	7.5	-	-	-	-		-	-	-	-	-	-	6.0
US Agg Fixed hoome       29.0       29.0       -       37.0       37.0       -       49.0       49.0       -       33.0       30.0       10.0	Low Duration Fixed Income	-	-	-	-	-	-		-	-	-	-	-	-	34.0
Long Duration Fixed houme         - <td>US Agg Fixed Income</td> <td>29.0</td> <td>29.0</td> <td>-</td> <td>37.0</td> <td>37.0</td> <td>-</td> <td></td> <td>49.0</td> <td>49.0</td> <td>-</td> <td>33.0</td> <td></td> <td>-33.0</td> <td>34.0</td>	US Agg Fixed Income	29.0	29.0	-	37.0	37.0	-		49.0	49.0	-	33.0		-33.0	34.0
Liability Hedging Fixed homes*         . <th< td=""><td>Long Duration Fixed Income</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td></td><td>-</td><td>-</td><td>-</td><td>27.0</td><td></td><td>-27.0</td><td>-</td></th<>	Long Duration Fixed Income	-	-	-	-	-	-		-	-	-	27.0		-27.0	-
Bank Loans         5.0         6.0         +1.0         12.0         12.0         10.0         10.0         -3.0         4.0           Trep 5         5.0         -	Liability Hedging Fixed Income*	-	-	-	-	-	-		-	-	-	-	62.0	+62.0	-
TPS         5.0         -         -         -         -         -         -         0.0         -         5.0         -         5.0         -         5.0         -         5.0         -         5.0         -         5.0         -         5.0         -         5.0         -         5.0         -         5.0         -         5.0         -	Bank Loans	5.0	6.0	+1.0	12.0	12.0	-		10.0	10.0	-	3.0	-	-3.0	4.0
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	TIPS	5.0	-	-5.0	-	-	-		8.0	-	-8.0	5.0	-	-5.0	-
Cash Equivalents         .	Emerging Markets Debt (Local)	5.0	5.0	-	7.0	7.0	-		5.0	-	-5.0	5.0	5.0	-	-
Total         100.0 <th< td=""><td>Cash Equivalents</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td></td><td>5.0</td><td>5.0</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></th<>	Cash Equivalents	-	-	-	-	-	-		5.0	5.0	-	-	-	-	-
Consist of 61% Long Duration Flored Income and 30% US Agg Privad Income with an estimated duration of 11.4 years.           Asset Class Composition - Asset classes defined by their primary category Fixed Income & Cash         44         40         4         77         64         13         73         67         6         28           Public Equity & Alternatives         56         60         14         44         44         44         123         36         113         73         67         66         28           Capital Appreciation         43         46         43         66         0 <t< td=""><td>Total</td><td>100.0</td><td>100.0</td><td>-</td><td>100.0</td><td>100.0</td><td>-</td><td></td><td>100.0</td><td>100.0</td><td>-</td><td>100.0</td><td>100.0</td><td>-</td><td>100.0</td></t<>	Total	100.0	100.0	-	100.0	100.0	-		100.0	100.0	-	100.0	100.0	-	100.0
Hued Income & Casin       44       40       -4       56       56       -       77       64       -13       73       67       -6       72         Public Equity RX Alternatives       56       60       44       44       44       -       23       36       +13       27       33       +6       28         Thematic Composition - Asset classes defined by their primary investment objective       -       23       36       +13       27       33       +6       28         Capital Appreciation       43       46       +3       30       33       +33       -5       54       54       54       54       60       622       +2       68       8       -       18         Capital Preservation       21       18       -33       30       -3       -3       33       30       -3       23       15       -8       14       9       -5       8         Exported Risk (Standard Deviation)       9.07       9.60       +0.53       5.77       +0.08       4.94       5.25       +0.31       6.50       5.67       40.94       4.33       4.33       4.80       +0.15       4.80         Expected Risk (Standard Deviation)       9.0	*Consists of 61% Long Duration Fixed Income and 39 Asset Class Composition - Asset classes	% US Agg Fixed	Income with an es	timated dur tegory	ation of 11.4 year	s.		1							
Public logury & Alternatives         56         60         44         <	Fixed Income & Cash	44	40	-4	56	56	-		//	64	-13	73	67	-6	72
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	Public Equity & Alternatives	56	60	+4	44	44	-		23	36	+13	27	33	+6	28
Capital Appreciation       43       46       +3       30       33       +3       23       31       +8       56       29       +3       18         Capital Preservation       29       29       -       37       37       37       37       54       54       54       54       54       54       54       54       54       54       56       62       +22       62       62       +23       60       62       +23       66       62       +23       68         RVK 2019 Capital Market Assumptions - Return, standard deviation, and yield       5.62       5.70       +0.08       4.94       5.25       +0.31       5.00       5.19       +0.19       4.80         Expected Return (Compound)       5.78       5.92       +0.14       4.56       4.63       +0.06       4.75       5.06       +0.31       4.73       4.88       +0.15       4.80         Liability-Driven Risk Metrics - Applicable to Workers' Compensation only       -	Thematic Composition - Asset classes de	fined by their	r primary inves	tment ob	jective					1			T		
Capital Preservation         29         29         -         37         37         -         54         54         -         60         62         +22         68           Alpha         8         8         -         0         0         -         33         30         -3         23         15         -8         14         9         -5         8           RVK 2019 Capital Market Assumptions - Return, standard deviation, and yield         Expected Risk (Standard Deviation)         9.07         9.60         +0.63         7.28         7.50         +0.08         4.94         5.25         +0.31         5.00         5.19         +0.19         4.80           Expected Risk (Standard Deviation)         9.07         9.60         +0.53         +0.22         6.26         6.26         -         7.51         8.05         +0.54         4.65           Expected Risk (Starplate Volatility)         3.41         3.55         +0.14         4.56         4.63         +0.06         4.08         4.26         +0.17         3.90         4.02         +0.12         3.22           Liability-Driven Risk Metrics - Applicable to Workers' Compensation only         Expected Risk (Stanglat Market Assumptions - Risk metrics         -         -         -         -<	Capital Appreciation	43	46	+3	30	33	+3		23	31	+8	26	29	+3	18
Alpha88-00-00-6Inflation2118-33330-32315-8149-58Expected Retum (Arithmetic)6.176.35+0.185.625.70+0.084.945.25+0.315.005.19+0.194.80Expected Retum (Compound)5.785.92+0.145.625.70+0.026.266.264.734.88+0.154.65Expected Risk (Standard Deviation)9.079.60+0.535.625.70+0.026.266.264.734.805.674.65Expected Risk (Surplus Volatility) <td>Capital Preservation</td> <td>29</td> <td>29</td> <td>-</td> <td>37</td> <td>37</td> <td>-</td> <td></td> <td>54</td> <td>54</td> <td>-</td> <td>60</td> <td>62</td> <td>+2</td> <td>68</td>	Capital Preservation	29	29	-	37	37	-		54	54	-	60	62	+2	68
Inflation       21       18       -3       33       30       -3       23       15       -8       14       9       -5       8         RVK 2019 Capital Market Assumptions - Return, standard deviation, and yield       6.17       6.35       40.18       7.28       7.50       40.08       4.94       5.25       +0.31       5.00       5.19       +0.19       4.80         Expected Return (Compound)       5.78       5.92       +0.14       4.56       4.63       +0.06       4.75       5.06       +0.31       4.73       4.88       +0.15       4.65       4.65       4.08       4.26       +0.17       6.22       6.11       -0.12       4.65       4.65       4.66       +0.06       4.08       4.26       +0.17       3.00       4.02       +0.12       3.22       3.22       3.22       5.00       5.19       +0.19       4.80       5.67       4.65       4.65       4.65       4.66       +0.06       4.08       4.02       +0.17       4.73       4.88       +0.15       3.22       2.2       5.00       5.19       +0.19       4.65       3.22       5.67       4.61       4.03       +0.06       4.75       5.06       +0.17       6.22       6.11       -0.12 <td>Alpha</td> <td>8</td> <td>8</td> <td>-</td> <td>0</td> <td>0</td> <td>-</td> <td></td> <td>0</td> <td>0</td> <td>-</td> <td>0</td> <td>0</td> <td>-</td> <td>6</td>	Alpha	8	8	-	0	0	-		0	0	-	0	0	-	6
RVK 2019 Capital Market Assumptions - Return, standard deviation, and yield         Expected Return (Arithmetic)       6.17       6.35       +0.18         Expected Risk (Standard Deviation)       9.07       9.60       +0.53       5.62       5.70       +0.08       6.26       6.26       -       4.75       5.06       +0.31       4.80       5.67       4.08       4.65       4.65       4.65       4.75       5.06       +0.31       4.73       4.88       +0.15       3.90       4.02       +0.12       3.22       4.65         Liability-Driven Risk Metrics - Applicable to Workers' Compensation only       -	Inflation	21	18	-3	33	30	-3		23	15	-8	14	9	-5	8
Expected Return (Arithmetic) $6.17$ $6.35$ $+0.18$ $5.62$ $5.70$ $+0.08$ $4.94$ $5.25$ $+0.31$ $5.00$ $5.19$ $+0.19$ $4.80$ Expected Risk (Standard Deviation) $9.07$ $9.60$ $+0.53$ $7.50$ $+0.22$ $6.26$ $6.26$ $ 4.73$ $8.80$ $4.65$ $4.65$ $4.62$ $6.26$ $ 4.73$ $8.80$ $4.65$ <td>RVK 2019 Capital Market Assumptions - F</td> <td>Return, stand</td> <td>ard deviation,</td> <td>and yield</td> <td></td>	RVK 2019 Capital Market Assumptions - F	Return, stand	ard deviation,	and yield											
Expected Risk (Standard Deviation)       9.07       9.60       +0.53         Expected Return (Compound)       5.78       5.92       +0.14         Est. Yield (12/31/18)       3.41       3.55       +0.14         Lability-Driven Risk Metrics - Applicable to Workers' Compensation only       5.78       5.43       +0.06         Expected Risk (Suplus Volatility)       -<	Expected Return (Arithmetic)	6.17	6.35	+0.18	5.62	5.70	+0.08		4.94	5.25	+0.31	5.00	5.19	+0.19	4.80
Expected Return (Compound)       5.78       5.92 $+0.14$ 5.37       5.43 $+0.06$ $4.75$ 5.06 $+0.31$ $4.73$ $4.88$ $+0.15$ $3.22$ Est. Vield (12/31/18)       3.41       3.55 $+0.14$ $4.56$ $4.63$ $+0.06$ $4.75$ $5.06$ $+0.31$ $4.73$ $4.88$ $+0.15$ $3.22$ Liability-Driven Risk Metrics - Applicable to Workers' Compensation only       Expected Risk (Surplus Volatility) $  -$	Expected Risk (Standard Deviation)	9.07	9.60	+0.53	7.28	7.50	+0.22		6.26	6.26	-	7.51	8.05	+0.54	5.67
Est. Yield (12/31/18)       3.41       3.55       +0.14       4.56       4.63       +0.06       4.08       4.26       +0.17       3.90       4.02       +0.12       3.22         Liability-Driven Risk Metrics - Applicable to Workers' Compensation only       Expected Risk (Surplus Volatility)       -	Expected Return (Compound)	5.78	5.92	+0.14	5.37	5.43	+0.06		4.75	5.06	+0.31	4.73	4.88	+0.15	4.65
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Est. Yield (12/31/18)	3.41	3.55	+0.14	4.56	4.63	+0.06		4.08	4.26	+0.17	3.90	4.02	+0.12	3.22
Expected Risk (Surplus Volatility)       -	Liability-Driven Risk Metrics - Applicable t	o Workers' C	ompensation	only											
Est. Interest Hedge Ratio       -<	Expected Risk (Surplus Volatility)	-	-	-	-	-	-		-	-	-	6.22	6.11	-0.11	-
Est. Funded Status - 2 STDEV Event**       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       -       140%       140%       -       -       -       -       -       -       -       -       -       140%       140%       -       -       -       -       -       -       -       140%       140%       -       -       -       -       -       -       -       140%       140%       -       -       -       -       -       -       -       -       -       140%       140%       -       -       -       -       -       -       -       -       -       -       140%       140%       -       -       -       -       -       -       -       140%       140%       -       -       -       -       -       -       140%       140%       -       -       -       -       -       -       -       140%       140%       -       -       -       -       140%       140%       140%       0.02       0.03       10.02       10.03       10.02       10.03	Est. Interest Hedge Ratio	-	-	-	-	-	-		-	-	-	91%	103%	+12%	-
**( <i>Current Est. WC Funded Status</i> = 160%) <b>RVK 2019 Capital Market Assumptions - Risk metrics</b> Expected Arithmetic Return/Risk Ratio 0.68 0.66 -0.02 Expected Sharpe Ratio (RF = 3%) 0.35 0.35 - RVK Expected Eq Beta (LCUS = 1) 0.46 0.48 +0.02 RVK Liquidity Metric (T-Bills = 100) 67 65 -2 Monte Carlo Analysis 1st Percentile 1 Year Nominal Return 1.9.70 -21.10 -1.40 50th Percentile 10 Year Nominal Return 5.99 6.14 +0.15 South Percentile 10 Year Nominal Return 5.99 6.14 +0.15 <b>August 2 10 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 </b>	Est. Funded Status -2 STDEV Event**	-	-	-	-	-	-		-	-	-	140%	140%	-	-
Expected Arithmetic Return/Risk Ratio       0.68       0.66       -0.02       0.77       0.76       -0.01       0.79       0.84       +0.05       0.67       0.64       -0.02       0.85         Expected Sharpe Ratio (RF = 3%)       0.35       0.35       -       0.36       0.36       -       0.31       0.36       +0.05       0.27       0.27       +0.01       0.32         RVK Expected Eq Beta (LCUS = 1)       0.46       0.48       +0.02       69       71       +2       -       0.77       0.64       -0.13       0.30       0.29       -0.01       0.18         RVK Liquidity Metric (T-Bills = 100)       67       65       -2       69       71       +2       -       -       0.77       0.64       -0.13       0.30       0.29       -0.01       0.18       0.26       0.18       0.27       0.27       0.27       0.21       0.18       0.25       0.18       0.22       0.27       0.29       -0.01       0.18       0.25       0.28       0.28       0.27       0.27       0.21       0.18       0.22       0.21       0.18       0.22       0.21       0.21       0.21       0.21       0.21       0.21       0.21       0.21       0.21	<pre>**(Current Est. WC Funded Status = 160%) RVK 2019 Capital Market Assumptions - F</pre>	Risk metrics													
Expected Sharpe Ratio (RF = 3%)       0.35       0.35       -       0.36       0.36       -       0.31       0.36       +0.05       0.27       0.27       +0.01       0.32         RVK Expected Eq Beta (LCUS = 1)       0.46       0.48       +0.02       0.33       0.35       +0.02       0.77       0.64       -0.13       0.30       0.29       -0.01       0.18         RVK Liquidity Metric (T-Bills = 100)       67       65       -2       69       71       +2       82       77       -5       82       79       -3       82         Monte Carlo Analysis	Expected Arithmetic Return/Risk Ratio	0.68	0.66	-0.02	0.77	0.76	-0.01		0.79	0.84	+0.05	0.67	0.64	-0.02	0.85
RVK Expected Eq Beta (LCUS = 1)       0.46       0.48       +0.02       0.33       0.35       +0.02       0.77       0.64       -0.13       0.30       0.29       -0.01       0.18         RVK Liquidity Metric (T-Bills = 100)       67       65       -2       69       71       +2       82       77       -5       82       79       -3       82         Monte Carlo Analysis       15t Percentile 1 Year Nominal Return       -19.70       -21.10       -1.40       -19.82       -20.05       -0.23       -15.62       -17.76       -2.14       -18.68       -20.19       -1.51       -11.91         50th Percentile 10 Year Nominal Return       5.99       6.14       +0.15       5.51       5.59       +0.08       4.90       5.23       +0.33       4.96       5.11       +0.15       4.79	Expected Sharpe Ratio (RF = 3%)	0.35	0.35	-	0.36	0.36	-		0.31	0.36	+0.05	0.27	0.27	+0.01	0.32
RVK Liquidity Metric (T-Bills = 100)       67       65       -2       69       71       +2       82       77       -5       82       79       -3       82         Monte Carlo Analysis       1st Percentile 1 Year Nominal Return       -19.70       -21.10       -1.40       -19.82       -20.05       -0.23       -15.62       -17.76       -2.14       -18.68       -20.19       -1.51       -11.91         50th Percentile 10 Year Nominal Return       5.99       6.14       +0.15       5.51       5.59       +0.08       4.90       5.23       +0.33       4.96       5.11       +0.15       4.79	RVK Expected Eq Beta (LCUS = 1)	0.46	0.48	+0.02	0.33	0.35	+0.02		0.77	0.64	-0.13	0.30	0.29	-0.01	0.18
Monte Carlo Analysis           1st Percentile 1 Year Nominal Return         -19.70         -21.10         -1.40           50th Percentile 10 Year Nominal Return         5.99         6.14         +0.15         5.51         5.59         +0.08         4.90         5.23         +0.33         4.96         5.11         +0.15         4.79	RVK Liquidity Metric (T-Bills = 100)	67	65	-2	69	71	+2		82	77	-5	82	79	-3	82
1st Percentile 1 Year Nominal Return         -19.70         -21.10         -1.40           50th Percentile 10 Year Nominal Return         5.99         6.14         +0.15         5.51         5.59         +0.08         -15.62         -17.76         -2.14         -18.68         -20.19         -1.51         -11.91           50th Percentile 10 Year Nominal Return         5.99         6.14         +0.15         5.51         5.59         +0.08         4.90         5.23         +0.33         4.96         5.11         +0.15         4.79	Monte Carlo Analysis				-							-			
50th Percentile 10 Year Nominal Return 5.99 6.14 +0.15 5.51 5.59 +0.08 4.90 5.23 +0.33 4.96 5.11 +0.15 4.79	1st Percentile 1 Year Nominal Return	-19.70	-21.10	-1.40	-19.82	-20.05	-0.23		-15.62	-17.76	-2.14	-18.68	-20.19	-1.51	-11.91
	50th Percentile 10 Year Nominal Return	5.99	6.14	+0.15	5.51	5.59	+0.08		4.90	5.23	+0.33	4.96	5.11	+0.15	4.79



# **Efficient Frontier: Return and Standard Deviation**

The figure below illustrates relationship between risk and return. The line connecting the points represents the optimal portfolios subject to the given constraints for the Total Return Focus portfolio and is known as the "efficient frontier".

• Other allocations may not fall exactly on the efficient frontier line due to strategic asset allocation differences, such as the Income Focus and Pool A inclusion of preferred stock and exclusion of private equity and hedge funds.





# **Correlation to Mineral Income**

						W	vomina Mir	neral Incom	e			Curre	nt Asset Cla	15565	
	Correlation Matrix	Total Fund	PMTF	TR Focus Recom.	Total Minerals	Crude Oil	Natural Gas	Coal	Trona <sup>1</sup>	Others <sup>2</sup>	Russell 3000	MSCI ACW Ex US	B US Agg Bond	NCREIF ODCE (AWA)	S&P MLP
	Total Fund	1.00													
	Permanent Mineral Trust Fund	0.96	1.00												
	TR Focus Recommended	0.61	0.85	1.00											
	Total Minerals	0.20	0.32	0.33	1.00										
	Crude Oil	0.20	0.45	0.54	0.74	1.00									
Wyoming	Natural Gas	0.18	0.30	0.26	0.92	0.51	1.00								
Income	Coal	0.16	0.04	-0.07	0.35	0.10	0.22	1.00							
	Trona <sup>1</sup>	-0.03	0.24	0.48	0.23	0.52	0.00	0.14	1.00						
	Others <sup>2</sup>	0.09	0.23	0.19	0.09	-0.01	0.16	0.24	-0.16	1.00					
	Russell 3000	0.58	0.74	0.74	0.01	-0.01	0.01	-0.04	0.13	0.20	1.00				
Current	MSCI ACW Ex US	0.45	0.72	0.76	0.17	0.26	0.15	-0.06	0.15	0.22	0.71	1.00			
Asset	B US Agg Bond	0.31	0.03	-0.13	-0.02	-0.17	0.03	0.24	0.10	0.18	-0.10	-0.43	1.00		
Classes	NCREIF ODCE (AWA)	0.56	0.68	0.65	0.27	0.30	0.20	0.01	0.10	0.13	0.47	0.48	-0.30	1.00	
	S&P MLP	0.73	0.73	0.34	0.44	0.24	0.46	0.30	-0.03	-0.05	0.29	0.24	0.40	0.19	1.00

#### Footnotes:

<sup>1</sup>Trona: Sodium Carbonate, Washing Soda, Soda Ash

<sup>2</sup>Others: Uranium, Bentonite, Sand, Gravel, Quarried Rock

Annual return calculations are based on fiscal years ending June 30.

Correlations calculated using annual periodicity of underlying data and longest common time period available.

Results of individual minerals may be impacted by increases or decreases in the taxation rates and production levels of a particular mineral.

Data is calculated from annual fiscal year returns for the period 1987-2018, with the following exceptions due to lack of sufficient return history:

-Wyoming STO "Total Fund": 1997-2018

-PMTF (Historical): 2001-2018

-Total Return Focus Target: 1998-2018

-MSCI ACW Ex US: 1988-2018 -S&P MLP Index (backfilled with Alerian MLP Index): 1996-2018

KVK

## Asset Allocation Modeling Permanent Funds: Total Return Focus

- -Permanent Mineral Trust Fund
- -Permanent Land Fund
- -University Permanent Land Fund
- -Hathaway Scholarship Fund

### **Efficient Allocations**

The table below shows the range of possible optimal allocations given the selected asset classes and constraints listed under "Min" and "Max." This range illustrates the tradeoff between return and risk; additional return can only be achieved by undertaking additional risk. Frontier 1

	Min	Max	1	2	3	4	5	6	7	8	9	10	Current Total Return Focus	New Total Return Focus
Broad US Equity	0	50	0	0	0	1	3	6	9	12	15	22	10	11
Small Cap US Equity	0	10	0	0	0	0	1	2	2	3	4	6	3	3
Broad International Equity	0	50	0	0	0	1	4	8	11	15	19	28	13	14
MLPs	0	6	0	2	5	6	6	6	6	6	6	6	5	6
Private Equity	0	8	3	6	8	8	8	8	8	8	8	8	8	8
Core Real Estate	0	8	8	6	5	5	5	5	5	5	5	0	6	6
Non-Core Real Estate	0	5	2	4	5	5	5	5	5	5	5	0	4	5
Custom Hedge Funds	0	8	8	8	8	8	8	8	8	8	8	0	8	8
US Agg Fixed Income	0	100	68	64	59	50	48	41	34	27	20	19	29	29
Bank Loans	0	6	6	6	6	6	6	6	6	6	6	6	5	6
TIPS	0	0	0	0	0	0	0	0	0	0	0	0	5	0
Emerging Markets Debt (Local)	0	5	0	0	0	4	5	5	5	5	5	5	5	5
Cash Equivalents	0	5	5	5	5	5	0	0	0	0	0	0	0	0
Total			100	100	100	100	100	100	100	100	100	100	100	100
Total Fixed Income & Cash			79	75	70	65	59	52	45	38	31	30	44	40
Capital Appreciation			5	9	13	20	27	34	41	48	55	69	43	46
Capital Preservation			73	69	64	55	48	41	34	27	20	19	29	29
Alpha			8	8	8	8	8	8	8	8	8	0	8	8
Inflation	_		14	14	16	17	17	17	17	17	17	12	21	18
Expected Arithmetic Return			4.38	4.68	4.97	5.27	5.56	5.86	6.15	6.45	6.74	7.04	6.17	6.35
Expected Risk (Standard Deviation			4.68	4.83	5.22	5.88	6.74	7.73	8.83	9.99	11.20	13.62	9.07	9.60
Expected Compound Return			4.28	4.57	4.84	5.11	5.35	5.58	5.78	5.98	6.16	6.18	5.78	5.92
Expected Return (Arithmetic)/Risk Ra			0.94	0.97	0.95	0.90	0.82	0.76	0.70	0.65	0.60	0.52	0.68	0.66
RVK Expected Eq Beta (LCUS Eq = 1			0.13	0.16	0.20	0.25	0.31	0.38	0.44	0.51	0.57	0.71	0.46	0.48
RVK Liquidity Metric (T-Bills = 100)			71	68	66	65	64	65	65	66	66	78	67	65

Group Constraints: (i) Broad US equity must be at least 80% of total US equity. (ii) Total US equity must be at least 50% of total public equity. (iii) Total equity (including MLPs, private equity, real estate, and hedge funds) must not exceed 70% of the total portfolio. (iv) Real estate must not exceed 10% of the total portfolio. (v) Core real estate must be at least 50% of total real estate. Please see the Glossary for statistics descriptions.



#### **Efficient Frontier**

The figure below illustrates the relationship between risk and return. The risk of each alternative allocation is plotted against the horizontal axis, while the return is measured on the vertical axis. The line connecting the points represents all the optimal portfolios subject to the given constraints and is known as the "efficient frontier." The upward slope of the efficient frontier indicates the direct relationship between return and risk.



🙏 RVK

The table below shows the expected nominal a) { approximation approximation of the 1, 3, 5, and 10 year periods.

1 Year	1	2	3	4	5	6	7	8	9	10	Current Tota Return Focus	New Total Return Focus
1st Percentile	-10.06	-10.17	-10.61	-11.90	-13.86	-16.54	-19.17	-21.74	-25.06	-30.29	-19.70	-21.10
5th Percentile	-2.59	-2.60	-2.70	-3.29	-4.38	-5.43	-6.71	-8.33	-9.87	-13.37	-7.34	-7.92
25th Percentile	2.40	2.62	2.72	2.60	2.26	1.89	1.47	1.00	0.57	-0.76	1.29	1.13
50th Percentile	4.88	5.14	5.39	5.65	5.94	6.20	6.43	6.70	6.95	7.15	6.43	6.58
75th Percentile	7.07	7.42	7.91	8.58	9.39	10.28	11.21	12.17	13.18	14.97	11.43	11.87
95th Percentile	10.23	10.73	11.51	12.78	14.57	16.54	18.57	20.88	23.19	27.84	19.31	20.22
99th Percentile	12.69	13.32	14.26	15.98	18.32	21.01	23.93	26.77	29.78	36.58	24.93	26.05
3 Years												
5th Percentile	-0.20	-0.06	-0.05	-0.36	-1.00	-1.82	-2.68	-3.51	-4.42	-6.86	-3.04	-3.31
25th Percentile	3.07	3.30	3.48	3.53	3.47	3.33	3.14	2.95	2.77	1.90	3.03	2.99
50th Percentile	4.68	4.96	5.24	5.50	5.76	5.99	6.23	6.44	6.70	6.81	6.21	6.37
75th Percentile	6.08	6.39	6.79	7.29	7.92	8.55	9.20	9.84	10.52	11.58	9.33	9.68
95th Percentile	8.00	8.44	8.94	9.78	10.89	12.11	13.39	14.74	16.08	18.66	13.74	14.36
5 Years												
5th Percentile	0.75	0.89	0.94	0.80	0.37	-0.17	-0.78	-1.48	-2.26	-4.39	-1.08	-1.32
25th Percentile	3.29	3.51	3.72	3.80	3.80	3.73	3.64	3.53	3.38	2.65	3.54	3.54
50th Percentile	4.58	4.86	5.13	5.40	5.66	5.92	6.16	6.37	6.58	6.61	6.14	6.29
75th Percentile	5.71	6.05	6.41	6.86	7.36	7.87	8.43	8.98	9.58	10.34	8.53	8.81
95th Percentile	7.23	7.62	8.12	8.80	9.71	10.65	11.68	12.75	13.84	15.82	11.96	12.44
10 Years												
5th Percentile	1.63	1.87	1.99	1.95	1.69	1.36	0.96	0.43	-0.11	-1.67	0.73	0.57
25th Percentile	3.51	3.76	3.97	4.11	4.16	4.17	4.16	4.11	4.04	3.49	4.06	4.11
50th Percentile	4.47	4.76	5.03	5.30	5.56	5.78	6.00	6.22	6.41	6.47	5.99	6.14
75th Percentile	5.32	5.64	5.99	6.38	6.82	7.25	7.70	8.17	8.60	9.17	7.78	8.03
95th Percentile	6.47	6.83	7.25	7.83	8.55	9.31	10.11	10.92	11.75	13.07	10.29	10.68



The table below shows the **percentage** chance of achieving or exceeding the given real æ} \* æÅeturn for each portfolio on Frontier 1 f[ the 1, 3, 5, and 10 year periods.

1 Year	1	2	3	4	5	6	7	8	9	10	Current Total Return Focus	New Total Return Focus
Target 1%	61	63	65	65	65	65	65	64	64	62	64	64
Target 2%	52	55	57	58	59	59	60	60	60	58	59	60
Target 2.5%	48	50	53	54	56	56	57	57	58	57	57	57
Target 3%	43	46	48	50	52	53	54	55	56	55	54	55
Target 3.5%	39	41	44	47	49	50	52	53	53	53	52	52
Target 4%	34	37	40	42	45	47	49	50	51	51	49	50
3 Years												
Target 1%	65	68	70	72	72	72	71	70	70	67	71	71
Target 2%	51	55	58	61	62	63	64	64	64	62	63	64
Target 2.5%	44	48	52	55	57	59	60	60	61	59	59	60
Target 3%	37	41	45	49	52	54	56	57	58	57	55	56
Target 3.5%	30	34	38	43	47	49	52	53	54	54	52	52
Target 4%	24	28	32	37	41	45	47	49	51	52	48	49
5 Years												
Target 1%	67	70	73	75	75	75	74	74	73	70	74	74
Target 2%	50	55	59	62	64	65	66	66	66	64	65	66
Target 2.5%	41	47	51	55	58	60	61	62	62	60	61	62
Target 3%	33	38	43	47	51	54	56	57	58	57	56	57
Target 3.5%	25	29	35	40	44	48	50	52	54	54	50	52
Target 4%	18	22	27	32	38	42	45	48	50	51	45	47
10 Years												
Target 1%	70	75	79	81	81	80	80	79	78	74	79	79
Target 2%	48	55	60	64	67	69	69	70	70	67	68	69
Target 2.5%	36	43	49	54	58	61	63	64	65	63	62	63
Target 3%	24	31	38	44	49	53	56	58	59	58	55	57
Target 3.5%	16	21	27	34	40	45	49	52	54	54	49	51
Target 4%	9	13	18	24	31	37	41	45	48	49	42	44



### Asset Allocation Modeling Permanent Funds: Income Focus -Common School Permanent Land Fund -Higher Education Endowment Fund



### **Efficient Allocations**

The table below shows the range of possible optimal allocations given the selected asset classes and constraints listed under "Min" and "Max." This range illustrates the tradeoff between return and risk; additional return can only be achieved by undertaking additional risk.

					Fro	ntier 1								
	Min	Max	1	2	3	4	5	6	7	8	9	10	Current Income Focus	New Income Focus
Broad US Equity	0	30	0	1	2	3	5	7	9	12	16	23	8	8
Small Cap US Equity	0	10	0	0	1	1	2	2	3	4	5	8	2	2
Broad International Equity	0	30	0	1	2	4	7	9	12	16	21	30	9	10
Preferred Stock	0	10	0	1	1	2	4	6	8	10	3	0	2	3
MLPs	0	7	0	2	5	7	7	7	7	7	7	7	6	7
Core Real Estate	0	15	13	13	15	15	15	15	15	15	15	2	15	11
Non-Core Real Estate	0	3	0	3	3	3	3	3	3	3	3	2	2	3
US Agg Fixed Income	0	100	66	59	51	43	39	30	20	12	8	8	37	37
Bank Loans	0	15	15	15	15	15	15	15	15	15	15	15	12	12
Emerging Markets Debt (Local)	0	7	0	0	1	2	4	6	7	7	7	7	7	7
Cash Equivalents	0	5	5	5	5	5	0	0	0	0	0	0	0	0
Total			100	100	100	100	100	100	100	100	100	100	100	100
Total Fixed Income & Cash			86	79	72	65	58	50	42	34	30	30	56	56
Capital Appreciation			0	5	9	15	24	33	43	51	55	69	30	33
Capital Preservation			71	64	56	48	39	30	20	12	8	8	37	37
Alpha			0	0	0	0	0	0	0	0	0	0	0	0
Inflation			28	30	35	37	37	37	37	37	37	24	33	30
Expected Arithmetic Return			4.25	4.57	4.88	5.19	5.51	5.82	6.13	6.45	6.76	7.07	5.62	5.70
Expected Risk (Standard Deviation			4.61	4.77	5.20	5.85	6.72	7.72	8.84	10.04	11.34	13.67	7.28	7.50
Expected Compound Return			4.15	4.46	4.75	5.03	5.30	5.54	5.76	5.98	6.16	6.21	5.37	5.43
Expected Return (Arithmetic)/Risk Ra			0.92	0.96	0.94	0.89	0.82	0.75	0.69	0.64	0.60	0.52	0.77	0.76
RVK Expected Eq Beta (LCUS Eq = 1			0.10	0.13	0.17	0.23	0.29	0.35	0.42	0.48	0.56	0.70	0.33	0.35
RVK Liquidity Metric (T-Bills = 100)			72	70	69	69	68	68	68	68	69	79	69	71

Group Constraints: (i) Broad US equity must be at least 75% of total US equity. (ii) Total US equity must be at least 50% of total public equity. (iii) Total equity (including MLPs, preferred stock, and real estate) must not exceed 70% of the total portfolio. (iv) Core real estate must be at least 50% of total real estate. Please see the Glossary for statistics descriptions.



#### **Efficient Frontier**

The figure below illustrates the relationship between risk and return. The risk of each alternative allocation is plotted against the horizontal axis, while the return is measured on the vertical axis. The line connecting the points represents all the optimal portfolios subject to the given constraints and is known as the "efficient frontier." The upward slope of the efficient frontier indicates the direct relationship between return and risk.





The table below shows the expected nominal a) { approximation approximation of the 1, 3, 5, and 10 year periods.

1 Year	1	2	3	4	5	6	7	8	9	10	Current Incom Focus	New Income Focus
1st Percentile	-13.99	-14.73	-15.64	-16.84	-19.71	-22.17	-25.63	-28.79	-29.33	-34.24	-19.82	-20.05
5th Percentile	-3.61	-3.98	-4.63	-5.49	-6.71	-8.08	-9.64	-11.47	-12.78	-14.73	-7.30	-7.32
25th Percentile	2.12	2.16	2.12	2.00	1.79	1.44	1.05	0.54	-0.13	-1.16	1.40	1.50
50th Percentile	4.81	5.10	5.37	5.66	5.98	6.28	6.56	6.79	6.94	7.04	5.96	6.04
75th Percentile	7.31	7.88	8.53	9.18	10.00	10.98	11.97	13.04	13.96	15.19	10.44	10.50
95th Percentile	10.76	11.67	12.98	14.31	16.12	18.18	20.32	22.61	25.00	28.43	17.44	17.48
99th Percentile	13.39	14.40	16.09	17.77	20.25	22.91	25.63	28.67	32.73	38.16	21.73	21.85
3 Years												
5th Percentile	-0.96	-1.05	-1.27	-1.67	-2.37	-3.27	-4.19	-5.19	-5.91	-7.30	-2.72	-2.60
25th Percentile	2.77	2.90	2.98	3.01	2.93	2.83	2.63	2.39	2.08	1.36	2.79	2.88
50th Percentile	4.52	4.82	5.12	5.40	5.67	5.96	6.20	6.43	6.58	6.69	5.71	5.80
75th Percentile	6.11	6.53	7.03	7.57	8.19	8.87	9.56	10.25	10.86	11.63	8.44	8.51
95th Percentile	8.17	8.77	9.65	10.47	11.61	12.93	14.23	15.60	16.97	19.00	12.29	12.40
5 Years												
5th Percentile	-0.12	-0.12	-0.25	-0.49	-1.02	-1.70	-2.43	-3.27	-3.69	-5.08	-1.18	-1.13
25th Percentile	2.99	3.16	3.23	3.29	3.28	3.17	3.10	2.93	2.78	2.28	3.17	3.26
50th Percentile	4.42	4.71	5.01	5.29	5.57	5.80	6.03	6.25	6.44	6.47	5.60	5.66
75th Percentile	5.70	6.12	6.56	7.05	7.57	8.14	8.72	9.30	9.81	10.41	7.78	7.87
95th Percentile	7.37	7.94	8.65	9.40	10.29	11.35	12.42	13.47	14.58	16.11	10.82	10.88
10 Years												
5th Percentile	1.03	1.14	1.08	0.97	0.63	0.20	-0.25	-0.85	-1.14	-2.11	0.48	0.56
25th Percentile	3.24	3.47	3.61	3.73	3.79	3.79	3.74	3.65	3.58	3.30	3.74	3.82
50th Percentile	4.35	4.66	4.92	5.18	5.46	5.72	5.93	6.14	6.28	6.35	5.51	5.59
75th Percentile	5.30	5.67	6.07	6.50	6.96	7.42	7.89	8.36	8.77	9.26	7.12	7.18
95th Percentile	6.52	6.99	7.55	8.21	8.94	9.73	10.57	11.43	12.22	13.27	9.31	9.38



The table below shows the **percentage** chance of achieving or exceeding the given real æ} \* æÅeturn for each portfolio on Frontier 1 for the 1, 3, 5, and 10 year periods.

1 Year	1	2	3	4	5	6	7	8	9	10	Current Incom Focus	New Income Focus
Target 1%	59	61	63	63	64	64	64	64	63	61	63	63
Target 2%	51	54	56	57	58	59	59	60	59	58	58	58
Target 2.5%	47	49	52	54	55	56	57	57	57	57	55	55
Target 3%	43	46	48	50	52	54	55	55	55	55	52	52
Target 3.5%	39	42	45	47	49	51	52	53	53	53	49	50
Target 4%	35	38	41	44	46	48	50	51	51	51	46	47
3 Years												
Target 1%	62	65	67	68	69	69	68	68	67	66	68	69
Target 2%	49	53	56	59	60	62	62	63	62	61	60	60
Target 2.5%	42	47	50	53	56	57	58	59	59	59	55	56
Target 3%	36	40	44	47	51	53	55	56	56	56	51	52
Target 3.5%	30	34	39	42	46	49	51	53	53	53	47	47
Target 4%	24	28	33	37	41	44	47	49	50	51	42	43
5 Years												
Target 1%	63	67	69	70	71	71	71	71	69	68	70	71
Target 2%	47	52	56	59	61	62	63	63	63	62	61	62
Target 2.5%	39	44	49	53	55	57	58	59	60	59	55	56
Target 3%	31	36	42	46	50	52	54	55	56	56	50	51
Target 3.5%	24	29	34	40	44	47	50	52	53	53	45	45
Target 4%	18	22	28	33	38	42	45	48	49	49	39	40
10 Years												
Target 1%	67	72	74	76	77	76	76	75	75	73	76	77
Target 2%	45	51	57	61	64	65	66	66	67	66	64	65
Target 2.5%	34	41	47	52	56	59	61	62	62	62	57	58
Target 3%	24	30	37	43	48	52	55	56	57	57	49	50
Target 3.5%	16	21	28	34	40	44	48	51	52	53	41	43
Target 4%	9	14	20	26	32	37	42	45	47	48	34	35



### Asset Allocation Modeling -LSRA

### **Efficient Allocations**

The table below shows the range of possible optimal allocations given the selected asset classes and constraints listed under "Min" and "Max." This range illustrates the tradeoff between return and risk; additional return can only be achieved by undertaking additional risk.

				<u> </u>	Ontion	<u>.</u>							
	Min	Max	1	2	3	4	5	6	7	8	9	10	New LSRA
Broad US Equity	0	10	0	1	1	2	3	4	5	6	8	10	7
Small Cap US Equity	0	4	0	0	0	0	1	1	1	2	2	3	2
Broad International Equity	0	10	0	1	2	2	3	5	6	8	9	10	9
MLPs	0	5	0	1	2	4	5	5	5	5	5	5	4
Custom Hedge Funds	0	6	6	6	6	6	6	6	6	6	6	6	6
Low Duration Fixed Income	33	60	59	56	53	50	47	44	43	43	40	33	34
US Agg Fixed Income	25	100	25	25	25	25	25	25	25	25	25	29	34
Bank Loans	0	5	5	5	5	5	5	5	5	5	5	5	4
Cash Equivalents	0	5	5	5	5	5	5	5	3	0	0	0	0
Total			100	100	100	100	100	100	100	100	100	100	100
Total Fixed Income & Cash			94	91	88	85	82	79	76	73	70	67	72
Capital Appreciation			0	2	3	5	7	10	13	16	19	23	18
Capital Preservation			89	86	83	80	77	74	71	68	65	62	68
Alpha			6	6	6	6	6	6	6	6	6	6	6
Inflation			5	6	7	9	10	10	10	10	10	10	8
Expected Arithmetic Return			3.76	3.90	4.04	4.18	4.33	4.47	4.61	4.75	4.89	5.03	4.80
Expected Risk (Standard Deviation)			3.68	3.74	3.87	4.06	4.30	4.61	4.97	5.36	5.79	6.34	5.67
Expected Compound Return			3.69	3.83	3.97	4.10	4.24	4.37	4.49	4.61	4.73	4.84	4.65
											/		
Expected Return (Arithmetic)/Risk Rati			1.02	1.04	1.04	1.03	1.01	0.97	0.93	0.89	0.84	0.79	0.85
RVK Expected Eq Beta (LCUS Eq = 1)			0.00	0.02	0.03	0.05	0.07	0.10	0.13	0.16	0.19	0.23	0.18
RVK Liquidity Metric (T-Bills = 100)			81	81	81	81	81	82	81	81	81	82	82

Group Constraints: (i) Broad US equity must be at least 80% of total US equity. (ii) Total US equity must be at least 50% of total public equity. (iii) Total equity (including MLPs and hedge funds) must not exceed 70% of the total portfolio. Please see the Glossary for statistics descriptions.



#### **Efficient Frontier**

The figure below illustrates the relationship between risk and return. The risk of each alternative allocation is plotted against the horizontal axis, while the return is measured on the vertical axis. The line connecting the points represents all the optimal portfolios subject to the given constraints and is known as the "efficient frontier." The upward slope of the efficient frontier indicates the direct relationship between return and risk.



🙏 RVK

The table below shows the expected nominal a) { approximation approximation of the 1, 3, 5, and 10 year periods.

1 Year	1	2	3	4	5	6	7	8	9	10	New LSRA
1st Percentile	-5.30	-5.97	-6.47	-6.88	-7.80	-8.72	-9.64	-10.74	-12.07	-13.69	-11.91
5th Percentile	-1.05	-1.10	-1.22	-1.45	-1.69	-2.15	-2.66	-3.24	-3.87	-4.67	-3.76
25th Percentile	2.14	2.27	2.38	2.43	2.46	2.39	2.31	2.16	2.02	1.81	2.03
50th Percentile	4.02	4.18	4.33	4.49	4.65	4.83	4.98	5.10	5.26	5.39	5.19
75th Percentile	5.75	5.97	6.19	6.47	6.77	7.17	7.58	8.04	8.48	9.02	8.31
95th Percentile	8.22	8.49	8.84	9.27	9.77	10.47	11.25	12.11	12.97	14.06	12.66
99th Percentile	10.03	10.30	10.63	11.25	11.99	12.88	13.92	15.09	16.47	18.21	15.88
3 Years											
5th Percentile	0.79	0.84	0.79	0.69	0.58	0.32	0.01	-0.32	-0.69	-1.21	-0.61
25th Percentile	2.75	2.87	2.98	3.04	3.10	3.11	3.08	3.04	2.98	2.86	2.95
50th Percentile	3.87	4.02	4.15	4.30	4.44	4.57	4.70	4.83	4.96	5.09	4.88
75th Percentile	4.95	5.13	5.32	5.54	5.77	6.02	6.31	6.61	6.90	7.26	6.77
95th Percentile	6.46	6.66	6.92	7.23	7.58	8.03	8.54	9.10	9.66	10.35	9.44
5 Years											
5th Percentile	1.46	1.51	1.52	1.48	1.40	1.23	1.04	0.81	0.55	0.18	0.53
25th Percentile	2.96	3.08	3.19	3.28	3.34	3.35	3.36	3.35	3.33	3.26	3.30
50th Percentile	3.83	3.97	4.12	4.26	4.40	4.53	4.67	4.80	4.93	5.06	4.84
75th Percentile	4.67	4.84	5.03	5.23	5.44	5.69	5.94	6.19	6.46	6.77	6.34
95th Percentile	5.89	6.07	6.29	6.55	6.86	7.25	7.64	8.11	8.60	9.18	8.40
10 Years											
5th Percentile	2.00	2.05	2.10	2.13	2.11	2.02	1.93	1.78	1.67	1.40	1.61
25th Percentile	3.16	3.28	3.39	3.47	3.55	3.60	3.64	3.68	3.69	3.67	3.63
50th Percentile	3.80	3.93	4.08	4.23	4.37	4.49	4.63	4.76	4.87	4.98	4.79
75th Percentile	4.41	4.58	4.75	4.93	5.12	5.33	5.55	5.77	6.00	6.25	5.89
95th Percentile	5.26	5.45	5.66	5.88	6.13	6.45	6.78	7.14	7.51	7.95	7.34



The table below shows the **percentage** chance of achieving or exceeding the given real  $\Rightarrow$   $\hat{}$   $\hat{}$ 

1 Year	1	2	3	4	5	6	7	8	9	10	New LSRA
Target 0%	64	65	66	67	68	68	68	68	68	67	68
Target 1%	54	55	57	58	59	60	60	61	61	62	61
Target 1.5%	49	50	52	53	55	56	57	57	58	58	58
Target 2%	43	45	47	49	50	51	53	54	54	55	54
Target 2.5%	38	40	42	44	45	47	48	50	51	52	50
Target 3%	34	36	37	39	41	43	44	46	47	48	47
3 Years											
Target 0%	72	73	74	76	76	77	77	76	76	75	76
Target 1%	56	58	60	62	63	64	65	66	66	66	65
Target 1.5%	47	50	52	54	56	58	59	60	61	61	60
Target 2%	38	41	43	46	48	51	52	54	55	56	54
Target 2.5%	30	33	35	38	41	43	46	48	49	51	48
Target 3%	24	26	28	31	33	36	38	41	43	45	42
5 Years											
Target 0%	76	78	79	81	81	81	81	81	81	80	81
Target 1%	57	60	62	65	67	68	69	69	70	70	69
Target 1.5%	45	48	52	55	57	59	61	62	63	63	62
Target 2%	35	38	41	44	47	50	53	54	56	57	55
Target 2.5%	26	28	31	34	37	41	43	46	48	50	47
Target 3%	18	20	23	26	29	32	35	38	40	43	39
10 Years											
Target 0%	83	85	86	87	88	88	88	88	87	86	87
Target 1%	59	62	66	69	71	73	74	75	75	75	74
Target 1.5%	43	48	52	56	59	61	63	65	67	67	66
Target 2%	29	33	37	41	45	49	52	55	57	59	56
Target 2.5%	16	20	24	28	32	36	40	43	46	49	45
Target 3%	9	11	13	17	21	24	29	33	36	39	34



### Asset Allocation Modeling -Pool A

#### **Efficient Allocations**

The table below shows the range of possible optimal allocations given the selected asset classes and constraints listed under "Min" and "Max." This range illustrates the tradeoff between return and risk; additional return can only be achieved by undertaking additional risk.

					Fro	ntier 1								
	Min	Max	1	2	3	4	5	6	7	8	9	10	Current Pool A	New Pool A
Broad US Equity	0	20	0	1	2	4	6	8	10	12	14	20	8	8
Small Cap US Equity	0	5	0	0	1	1	2	3	3	4	5	5	1	1
Broad International Equity	0	20	0	1	2	5	8	11	13	16	19	20	8	8
Preferred Stock	0	7	4	5	5	7	7	7	7	7	7	7	2	7
MLPs	0	5	1	3	5	5	5	5	5	5	5	5	5	5
Non-Core Real Estate	0	8	7	8	8	8	8	8	8	8	8	8	0	8
US Agg Fixed Income	0	100	73	67	62	55	49	45	44	38	32	25	49	49
Bank Loans	0	10	10	10	10	10	10	10	10	10	10	10	10	10
TIPS	0	0	0	0	0	0	0	0	0	0	0	0	8	0
Emerging Markets Debt (Local)	0	0	0	0	0	0	0	0	0	0	0	0	5	0
Cash Equivalents	0	5	5	5	5	5	5	4	0	0	0	0	5	5
Total			100	100	100	100	100	100	100	100	100	100	100	100
Total Fixed Income & Cash			88	82	77	70	64	59	54	48	42	35	77	64
Capital Appreciation			11	15	18	25	31	36	41	47	53	60	23	31
Capital Preservation			78	72	67	60	54	49	44	38	32	25	54	54
Alpha			0	0	0	0	0	0	0	0	0	0	0	0
Inflation			11	13	15	15	15	15	15	15	15	15	23	15
Exported Arithmetic Poturn			1 20	1 52	4 77	5.01	5 25	5 40	5 72	5.07	6 22	6 4 6	4.04	5 25
Expected Antimetic Return			4.20	4.33	5.20	5.62	5.25	5.49	7.72	9.57	0.22	10.50	6.26	5.25
Expected Kisk (Standard Deviation			4.90	4.97	5.20	1.02	5.07	0.93	5.45	5.62	5.40	5.04	0.20	5.06
			4.17	4.41	4.04	4.00	5.07	5.20	5.45	5.05	<b>J.00</b>	5.94	4.73	5.00
Expected Return (Arithmetic)/Risk Ra			0.87	0.91	0.92	0.89	0.85	0.79	0.74	0.70	0.66	0.61	0.79	0.84
RVK Expected Eq Beta (LCUS Eq = 1			0.88	0.82	0.77	0.70	0.64	0.59	0.54	0.48	0.42	0.35	0.77	0.64
RVK Liquidity Metric (T-Bills = 100)			77	76	76	77	77	77	77	77	78	78	82	77

Group Constraints: (i) Broad US equity must be at least 75% of total US equity. (ii) Total US equity must be at least 50% of total public equity. (iii) Total equity (including MLPs and preferred stock) must not exceed 70% of the total portfolio. Please see the Glossary for statistics descriptions.



#### **Efficient Frontier**

The figure below illustrates the relationship between risk and return. The risk of each alternative allocation is plotted against the horizontal axis, while the return is measured on the vertical axis. The line connecting the points represents all the optimal portfolios subject to the given constraints and is known as the "efficient frontier." The upward slope of the efficient frontier indicates the direct relationship between return and risk.





### The table below shows the expected nominal a) \* a A et al percentile for each portfolio on Frontier 1 for the 1, 3, 5, and 10 year periods.

1 Year	1	2	3	4	5	6	7	8	9	10	Current Pool A	New Pool A
1st Percentile	-12.92	-13.12	-14.17	-15.89	-17.75	-19.09	-21.22	-23.20	-25.90	-28.27	-15.62	-17.76
5th Percentile	-3.35	-3.60	-4.02	-4.89	-5.88	-6.73	-7.85	-9.00	-10.20	-11.50	-5.30	-5.87
25th Percentile	2.41	2.54	2.48	2.34	2.10	1.70	1.40	1.00	0.56	0.02	1.79	2.07
50th Percentile	4.88	5.15	5.39	5.61	5.82	6.00	6.20	6.39	6.51	6.67	5.28	5.82
75th Percentile	7.10	7.45	7.87	8.52	9.14	9.86	10.61	11.35	12.14	13.09	8.64	9.17
95th Percentile	10.15	10.74	11.40	12.58	14.00	15.51	17.14	18.85	20.61	22.85	13.56	14.02
99th Percentile	12.15	12.90	13.81	15.22	17.21	19.39	21.50	23.82	26.32	29.30	16.85	17.29
3 Years												
5th Percentile	-0.64	-0.68	-0.76	-1.32	-1.76	-2.30	-2.91	-3.53	-4.27	-5.13	-1.52	-1.78
25th Percentile	2.98	3.11	3.18	3.16	3.12	3.01	2.87	2.71	2.53	2.29	2.86	3.11
50th Percentile	4.63	4.85	5.06	5.29	5.47	5.63	5.84	6.03	6.20	6.35	5.10	5.48
75th Percentile	6.03	6.36	6.70	7.16	7.64	8.14	8.64	9.15	9.68	10.24	7.20	7.66
95th Percentile	7.95	8.38	8.94	9.67	10.57	11.57	12.55	13.60	14.70	15.99	10.08	10.60
5 Years												
5th Percentile	0.19	0.18	0.14	-0.14	-0.47	-0.85	-1.38	-1.92	-2.44	-3.23	-0.24	-0.48
25th Percentile	3.12	3.29	3.41	3.43	3.41	3.36	3.28	3.19	3.07	2.88	3.17	3.41
50th Percentile	4.50	4.74	4.94	5.17	5.38	5.56	5.77	5.95	6.13	6.28	5.01	5.37
75th Percentile	5.68	5.97	6.29	6.67	7.07	7.48	7.92	8.37	8.82	9.32	6.65	7.09
95th Percentile	7.17	7.54	8.03	8.69	9.40	10.14	10.94	11.80	12.66	13.62	8.93	9.43
10 Years												
5th Percentile	1.19	1.26	1.25	1.09	0.87	0.63	0.35	-0.05	-0.47	-1.03	0.98	0.85
25th Percentile	3.33	3.51	3.68	3.73	3.74	3.77	3.77	3.75	3.71	3.59	3.55	3.74
50th Percentile	4.39	4.61	4.85	5.06	5.23	5.42	5.62	5.79	5.95	6.09	4.90	5.23
75th Percentile	5.28	5.56	5.86	6.23	6.58	6.96	7.33	7.70	8.08	8.47	6.17	6.60
95th Percentile	6.44	6.79	7.15	7.65	8.20	8.80	9.43	10.07	10.72	11.45	7.76	8.23



The table below shows the **percentage** chance of achieving or exceeding the given real  $\Rightarrow$   $\hat{}$   $\hat{}$ 

1 Year	1	2	3	4	5	6	7	8	9	10	Current Pool A	New Pool A
Target 0%	68	69	69	69	69	69	68	68	67	66	67	69
Target 1%	60	61	62	63	64	63	64	63	63	62	61	64
Target 1.5%	55	57	59	60	61	61	61	61	61	60	58	61
Target 2%	51	53	55	56	57	58	58	58	58	58	54	57
Target 3%	43	45	47	49	51	52	53	54	54	55	47	50
Target 4%	35	37	39	42	44	45	47	48	50	50	41	44
3 Years												
Target 0%	75	76	77	77	77	76	76	75	74	73	75	77
Target 1%	64	66	67	69	69	69	69	69	68	67	66	69
Target 1.5%	57	60	62	63	64	65	65	65	65	65	61	64
Target 2%	50	53	56	58	59	61	61	61	62	62	56	59
Target 3%	36	40	43	46	49	51	53	54	55	55	45	49
Target 4%	24	27	31	35	38	41	44	46	47	48	34	39
5 Years												
Target 0%	78	80	81	81	80	80	79	79	78	77	79	80
Target 1%	65	68	70	71	72	72	72	71	71	70	69	72
Target 1.5%	57	61	63	65	66	67	67	67	67	67	63	66
Target 2%	49	52	56	58	60	61	62	63	63	63	56	60
Target 3%	32	36	40	44	47	50	52	54	55	56	42	47
Target 4%	17	21	25	30	34	38	41	44	46	48	29	34
10 Years												
Target 0%	84	85	86	86	86	86	85	84	83	82	85	86
Target 1%	68	71	74	75	76	77	77	76	76	75	73	76
Target 1.5%	57	62	65	68	70	70	71	71	71	71	66	70
Target 2%	46	51	56	59	62	64	65	66	66	66	57	62
Target 3%	24	29	35	40	44	48	51	53	55	56	38	45
Target 4%	9	12	16	22	27	32	37	40	43	45	22	28



# **Asset Allocation Modeling**

-Workers' Compensation Fund



# Workers' Compensation Fund: Key Terms

**Funded Status:** the fair value of a Plan's assets divided by the projected benefit obligation. A fully funded Plan is one in which the fair value of the assets is enough to cover at least 100 percent of the projected benefits.

**Duration of Liabilities:** the sensitivity of Plan liabilities to a change in interest rates. A duration of 10 years implies that for every 1.00% change in interest rates, the liability would change by 10.00% in the inverse direction.

**Surplus Volatility:** the funded status volatility or tracking error of the investment return relative to the change in present value of the Plan liabilities.

**Interest Hedge Ratio:** the estimate of how well a Plan's investment portfolio is hedged against changes in interest rates – a primary driver of funded status movements. This is calculated by dividing the dollar-weighted values of both the Plan asset duration by the liability duration and multiplying by the estimated funded status. An estimated plan hedge ratio of zero indicates that the Plans' liabilities have not been hedged, whereas a value of one indicates fully hedged.

**Estimated Funded Status – 2 STDEV Event:** the estimated funded status of a Plan in one year assuming investment returns during that year are 2 standard deviations below the mean. The value assumes interest plus service costs are equal to expected return.



## **Efficient Frontier: Return and Surplus Volatility**

The table below shows the possible allocation for a "new" efficient frontier that considers assets relative to liabilities. The plan is assumed to be 160% funded and Long Duration Fixed Income is considered the liability-matching asset class. Therefore, liabilities are expected to have a similar standard deviation and correlations to long bonds.

	Min	Max	1	2	3	4	5	6	7	8	9	10	Current WC	New WC
Broad US Equity 0 30		10	8	3	4	5	6	6	7	8	8	9	8	
Small Cap US Equity	0	5	0	0	1	1	2	2	2	2	3	3	1	2
Broad International Equity	0	30	0	0	4	5	7	8	9	10	11	11	10	10
MLPs	0	5	1	4	4	5	5	5	5	5	5	5	3	5
Core Real Estate	0	5	5	3	3	3	3	3	3	3	3	3	3	5
Non-Core Real Estate	Non-Core Real Estate 0 4		1	3	3	3	3	3	3	3	3	3	1	4
Custom Liability Hedging Fixed Income	0	62	62	62	62	62	62	62	62	62	62	57	0	62
Long Duration Fixed Income 0 0		0	0	0	0	0	0	0	0	0	0	27	0	
JS Agg Fixed Income 0 10		10	10	10	10	10	7	5	2	0	0	33	0	
Bank Loans	Bank Loans 0 5		5	5	5	2	0	0	0	0	0	5	3	0
Emerging Markets Debt (Local)	0	5	5	5	5	5	4	4	5	5	5	5	5	5
TIPS	0	0	0	0	0	0	0	0	0	0	0	0	5	0
Total			100	100	100	100	100	100	100	100	100	100	100	100
Total Equity Expected Equity Beta (LC US Eq = 1)			18 0.20	18 0.19	18 0.18	21 0.20	25 0.23	26 0.25	28 0.27	31 0.29	33 0.31	33 0.32	27 0.30	33 0.29
RVK Liquidity Metric (Cash = 100)			79	78	78	79	80	80	80	80	80	78	82	79
Expected Return (Arithmetic)			4.48	4.57	4.66	4.75	4.84	4.93	5.03	5.12	5.21	5.30	5.00	5.19
Risk (Surplus Volatility)			4.15	4.21	4.34	4.54	4.82	5.17	5.53	5.89	6.26	6.83	6.22	6.11
Return (Compound)				4.31	4.41	4.49	4.57	4.65	4.73	4.81	4.89	4.99	4.73	4.88
Risk (Standard Deviation)			7.38	7.33	7.28	7.45	7.63	7.74	7.88	8.04	8.21	8.09	7.51	8.05
Est. Interest Hedge Ratio			111%	111%	111%	111%	110%	108%	107%	105%	103%	95%	91%	103%
Est. Funded Status -2 STDEV Event (Current = 160%)*			147%	147%	146%	145%	145%	143%	142%	141%	140%	138%	140%	140%

Custom Liability Hedging Fixed Income = 61% Long Duration Fixed Income + 39% US Agg Fixed Income

Group Constraints: (i) Broad US equity must be at least 75% of total US equity. (ii) Total US equity must be at least 50% of total public equity. (iii) Total public equity must not exceed 35% of the total portfolio. (iv) Total real estate must not exceed 5% of the total portfolio. (v) Core real estate must be at least 50% of total real estate. \*Assumes interest and service costs are approximately equal to expected return



# **Efficient Frontier: Return and Surplus Volatility**

The figure below illustrates the relationship between surplus volatility and return. The surplus volatility of each alternative allocation is plotted against the horizontal axis, while the return is measured on the vertical axis. The line connecting the points represents all the optimal portfolios subject to the given constraints and is know as the "efficient frontier". The upward slope of the efficient frontier indicates the direct relationship between return and risk.



# **Summary of Asset Allocation Recommendations**

The recommended target portfolios have higher expected returns than current targets, achieved through increasing capital appreciation assets and reducing inflation protection assets.

### **Total Return Focus**

- ☑ Increase Broad US Equity (+1%), Broad International Equity (+1%), MLPs (+1%), Non-Core Real Estate (+1%), and Bank Loans (+1%)
- ☑ Eliminate TIPS (-5%)

### **Income Focus**

- ☑ Increase Broad International Equity (+1%), Preferred Stock (+1%), MLPs (+1%), and Non-Core Real Estate (+1%)
- ☑ Decrease Core Real Estate (-4%)

### Pool A

- ☑ Increase Preferred Stock (+5%) and Non-Core Real Estate (+8%)
- ☑ Eliminate TIPS (-8%) and Emerging Markets Debt (-5%)

### **Workers Compensation**

- ☑ Transition fixed income (currently core and long duration) to custom liability hedging mandate
- Remainder of portfolio allocated in same proportion as Total Return Focus (excluding Hedge Funds and Private Equity)

### LSRA

- ☑ 34% Low Duration Fixed Income, 34% Core Fixed Income
- Remainder of portfolio allocated in same proportion as Total Return Focus (excluding Private Equity)



