

Michigan Public School Employees' Retirement System

October 1, 2012 – September 30, 2017
Experience Study



Agenda

- Introduction
- Experience Study Process
- Demographic Assumptions
- Economic Assumptions
- Actuarial Methods
- Effect on Valuation Results

Introduction

Introduction

- Each year the actuarial liabilities of MPSEERS are calculated as part of the September 30th valuation
- In order to perform the valuation, we must make assumptions about the future experience of the System with regard to various risk areas
- The results of the liability calculations depend upon those assumptions

Introduction – Risk Areas

- Demographic Risk Areas
 - Rates of withdrawal
 - Rates of disability
 - Rates of retirement
 - Rates of mortality
- Economic Risk Areas
 - Investment return
 - Inflation
 - Patterns of salary increases
 - Payroll growth

Introduction

- Assumptions should be carefully chosen and continually monitored
 - Continued use of outdated assumptions can lead to ...

Introduction

- Understated costs resulting in:
 - Sharp increases in required contributions at some point in the future leading to a large burden on future taxpayers
 - In extreme cases, an inability to pay benefits when due

Introduction

- Overstated costs resulting in:
 - Benefit levels that are kept below the level that could be supported by the employer and member contribution rates
 - An unnecessarily large burden on the current generation of members, employers and taxpayers

Introduction

- No single set of assumptions will be suitable indefinitely
- Things change, and our understanding of things (whether or not they are changing) also changes
- In general, the suggested time period for reviewing assumptions is about every 4 or 5 years
- A systematic review of assumptions is called an “Experience Study”

Experience Study Process

Experience Study Process

- Our analysis was based upon data submitted for the 2012 through 2017 annual valuations
- We compared trends with those observed in prior studies
- Generally, we give confirmed trends more credibility than non-confirmed trends
- Philosophy: Do not overreact to results from any single experience period
 - It is better to make a series of small changes in the right direction, rather than a single large change that could turn out with hindsight to be in the wrong direction

Experience Study Process – Liability Weighting

- Decrement assumptions have traditionally been developed based on population weighted crude rates
- In a plan with two members the same age, if one of them leaves, the rate of withdrawal at that age is 50% (very simplified example)
- However, certain decrements have continued to generate small gains or losses despite adjusting rates in previous experience studies
- This year, we analyzed the data to see if this could be due to a tendency for human behavior to be influenced by the relative value of liabilities
- This concept is called Liability Weighting

Experience Study Process – Liability Weighting Example

- Consider the same plan with only two members (who are both the same age) and the withdrawal rate of 50%
- Suppose one member has liability of \$10k and the other has liability of \$90k
- Even though the decrement rate of withdrawal is 50%, the net gain or loss to the system will be less if the \$10k liability member leaves than if the \$90k liability member leaves
- Perhaps if the person with \$10k liability leaves, we should set the withdrawal rate at 10% since only 10% of the liability has left

Experience Study Process – Liability Weighting

- The analysis seemed to indicate that people with lower accrued benefit levels and lower liabilities are more likely to quit than other people of the same age
- In recognition of these results, we developed age-based withdrawal rates based on relative liability weighting in addition to pure population statistics

Experience Study Process – Benefits Weighting

- An analogous benefits-weighted approach was employed in the analysis of post-retirement mortality
- The analysis seemed to indicate that people with higher accrued benefit levels generally live longer than other people of the same age
- In recognition of these results, we developed post-retirement mortality rates based on a benefits weighting analysis

Experience Study Process

- Per Section 41(1) of the MPSERS statute (Act 300 of the Public Acts of 1980, as amended) the actuarial assumptions are adopted by the Retirement Board and the Department of Technology, Management and Budget after consultation with the actuary and the State Treasurer
- The recommended changes are proposed for the September 30, 2018 and later valuations

Demographic Assumptions

Demographic Assumptions – Rates of Retirement

- The retirement assumptions were analyzed both for unreduced and reduced retirements:
 - Reduced retirements were analyzed separately for Basic and MIP employees
 - Unreduced retirements were analyzed separately for Basic/MIP and Teacher/Non-Teacher employees
 - Unreduced retirements for MIP employees were studied separately for Age 60+ retirements and 30 & Out service retirements
- Generally speaking, more retirements being observed over the 5-year period than anticipated by the actuarial assumptions results in an actuarial loss

Demographic Assumptions – Rates of Retirement

- For unreduced retirements, the following experience was observed over the past 5 years
 - Basic Teachers: More retirements than expected
 - Basic Non-Teachers: Fewer retirements than expected
 - MIP (age 60+) Teachers: More retirements than expected
 - MIP (age 60+) Non-Teachers: Fewer retirements than expected
 - MIP (30 & Out) Teachers: Fewer retirements than expected
 - MIP (30 & Out) Non-Teachers: Fewer retirements than expected

Demographic Assumptions – Rates of Retirement

- For reduced retirements, there were less retirements than expected over the past 5 years for both Basic and MIP employees
- The following changes are being recommended:
 - Increase the unreduced retirement rates for Basic Teachers and MIP Teachers (age 60+)
 - Decrease the unreduced retirement rates for all other groups
 - Decrease the reduced retirement rates for both Basic and MIP employees

Demographic Assumptions – Withdrawal

- The withdrawal assumption is analyzed based both on age and service
 - Withdrawal is analyzed separately for Teacher/Non-Teacher and Full-Time/Part-Time employees
 - For this purpose, employees whose annual pay exceeds \$20,000 are considered full-time
- The use of a select (i.e., first 5 years of service) and ultimate (i.e., age-based for service greater than 5 years) approach is still reasonable
- Generally speaking, more withdrawals being observed over the 5-year period than anticipated by the actuarial assumptions results in an actuarial gain
- Currently, population-weighted select and ultimate withdrawal rates have been used in the MPSERS actuarial valuations

Demographic Assumptions – Withdrawal

- For the current experience study, recommending that ultimate withdrawal rates be developed based on a liability-weighted approach
- For withdrawals in the first 5 years, the following experience was observed over the past 5 years
 - Full-Time, Teacher: Fewer withdrawals than expected
 - Full-Time, Non-Teacher: Approximately the same withdrawals as expected
 - Part-Time, Teacher: Fewer withdrawals than expected
 - Part-Time, Non-Teacher: More withdrawals than expected
- For withdrawals after 5 years of service, the following experience was observed over the past 5 years (liability-weighted approach)
 - Full-Time, Teacher: Fewer withdrawals than expected
 - Full-Time, Non-Teacher: Fewer withdrawals than expected
 - Part-Time, Teacher: More withdrawals than expected
 - Part-Time, Non-Teacher: More withdrawals than expected

Demographic Assumptions – Withdrawal

- The following changes are recommended for the select withdrawal rates:
 - Decrease the withdrawal rates for Teachers (full-time and part-time)
 - No change in the withdrawal rates for Full-Time, Non-Teachers
 - Increase the withdrawal rates for Part-Time, Non-Teachers
- The following changes are recommended for the ultimate withdrawal rates:
 - Decrease the withdrawal rates for Full-Time employees (Teachers and Non-Teachers)
 - Increase the withdrawal rates for Part-Time employees (Teachers and Non-Teachers)
- The same withdrawal rates will be used for both the pension and retiree health actuarial valuations

Demographic Assumptions – Disability

- Experience related to disabilities was close to assumed experience
- Therefore, no changes are being recommended to the disability rates

Demographic Assumptions – Summary of Changes (# Counts)

Decrement Risk Area	Actual Number	Expected Number		
		Present Assumptions	Proposed Assumptions	Change
<i>Age and Service Retirement</i>				
Basic - Teachers	4,352	3,935.1	4,138.5	203.4
- Non-Teachers	4,171	5,247.6	4,757.0	(490.6)
MIP (age 60+) - Teachers	4,825	4,610.9	4,749.5	138.6
- Non-Teachers	9,693	13,706.4	12,313.9	(1,392.5)
MIP (30 & out) - Teachers	3,216	3,573.2	3,371.3	(201.9)
- Non-Teachers	1,476	2,013.6	1,753.4	(260.2)
<i>Early Retirement</i>				
Basic	642	833.8	660.8	(173.0)
MIP	2,800	3,878.1	3,093.2	(784.9)

Demographic Assumptions – Summary of Changes (# Counts)

Decrement Risk Area	Actual Number	Expected Number		
		Present Assumptions	Proposed Assumptions	Change
<i>Withdrawal</i>				
First 5 Years of Service				
Members > \$20,000 Pay - Teachers	3,344	4,078.0	3,679.9	(398.1)
- Non-Teachers	4,158	4,077.4	4,077.4	0.0
Members < \$20,000 Pay - Teachers	3,748	4,638.0	4,068.1	(569.9)
- Non-Teachers	57,598	52,921.1	54,495.7	1,574.6

Demographic Assumptions – Summary of Changes (# Counts)

Decrement Risk Area	Actual Number	Expected Number		
		Present Assumptions	Proposed Assumptions	Change
<i>Withdrawal</i>				
Over 5 Years of Service - Population-Weighted Results				
Members > \$20,000 Pay - Teachers	5,211	4,731.1	3,901.5	(829.6)
- Non-Teachers	3,432	2,773.1	2,394.2	(378.9)
Members < \$20,000 Pay - Teachers	1,284	815.6	1,049.0	233.4
- Non-Teachers	9,180	5,392.2	7,085.3	1,693.1
Over 5 Years of Service - Liability-Weighted Results				
Members > \$20,000 Pay - Teachers	4,276	6,143.9	5,026.0	(1,117.9)
- Non-Teachers	2,144	2,877.6	2,493.1	(384.5)
Members < \$20,000 Pay - Teachers	311	174.1	224.9	50.8
- Non-Teachers	1,203	824.1	1,087.4	263.3

Demographic Assumptions – Summary of Changes (# Counts)

Decrement Risk Area	Actual Number	Expected Number		
		Present Assumptions	Proposed Assumptions	Change
<i>Disability</i>	833	843.4	843.4	0.0

Demographic Assumptions – Retiree Mortality

- Post-retirement mortality is an important, but relatively stable ingredient in cost calculations. This assumption should be updated from time to time to reflect longevity improvements.
- ASOP No. 35 states with regard to the mortality assumption:
 - “The disclosure of the mortality assumption should contain sufficient detail to permit another qualified actuary to understand the provision made for future mortality improvement. If the actuary assumes zero mortality improvement after the measurement date, the actuary should state that no provision was made for future mortality improvement.”
- Based on the previous experience study, the current, assumed mortality rates assume 10% fewer deaths for males and 5% fewer deaths for females than those observed during the period 2007-2012 on a population-weighted basis.

Demographic Assumptions – Retiree Mortality

- The proposed rates take a different approach and assume that future mortality rates will continue to decline with each generation
 - For this “generational” approach, we remove any static margin from the base tables and apply a mortality improvement scale to project rates getting lower each year in the future. This means that next year’s 65-year-old will have a slightly longer life expectancy than this year’s, etc.
- The approach we have taken is based on the RPEC_2014 model described by the Society of Actuaries (SOA). The base mortality tables we select from are the RP-2014 mortality tables. That is, our starting point was the RP-2014 tables adjusted for mortality improvement back to the observation period base year of 2006. The improvement scales we consider are the 2-dimensional MP-2017 mortality improvement scales.

Demographic Assumptions – Retiree Mortality

- It is anticipated that the SOA will release new improvement scales annually. For purposes of MPSERS valuations, we recommend maintaining the MP-2017 improvement scales until the next experience study.
- The first step in this procedure is to select the appropriate version of the RP-2014 mortality tables
 - We compared the experience of the healthy retiree to the RP-2014 adjusted tables. We observed that the healthy retiree MPSERS population has experienced significantly better mortality than that incorporated in the RP-2014 mortality table.
 - Using limited fluctuation credibility, we scale the RP-2014 mortality tables to better fit the MPSERS mortality experience during 2012-2017
 - We recommend adopting 82% of the male and 78% of the female RP-2014 Healthy Annuitant Mortality Tables, adjusted for mortality improvement using projection scale MP-2017 from 2006.

Demographic Assumptions – Retiree Life Expectancy

Sample Attained Ages	Future Life Expectancy (years)							
	Present		Proposed 2017*		Proposed 2022*		Proposed 2027*	
	Men	Women	Men	Women	Men	Women	Men	Women
45	38.25	40.84	41.23	44.35	41.73	44.81	42.23	45.28
50	33.54	36.08	36.25	39.27	36.75	39.74	37.24	40.20
55	28.92	31.39	31.42	34.27	31.91	34.72	32.38	35.17
60	24.49	26.82	26.78	29.42	27.22	29.83	27.67	30.27
65	20.27	22.44	22.35	24.76	22.74	25.14	23.15	25.54
70	16.31	18.35	18.15	20.29	18.50	20.65	18.87	21.02
75	12.68	14.62	14.22	16.08	14.55	16.42	14.88	16.77
80	9.48	11.27	10.70	12.27	10.98	12.56	11.27	12.87

* Life expectancy in future years are determined by the fully generational MP-2017 projection scale.

Demographic Assumptions – Disabled and Active Mortality

- Disabled mortality experience during the study period was not sufficient to adjust the published tables. We recommend adopting 100% of the male and female RP-2014 Disabled Annuity Mortality Tables, adjusted for mortality improvement using projection scale MP-2017 from 2006.
- Active mortality experience during the study period was not sufficient to adjust the published tables. We recommend adopting 100% of the male and female RP-2014 Employee Mortality Tables, adjusted for mortality improvement using projection scale MP-2017 from 2006.

Demographic Assumptions – Summary of Mortality Experience Results

Decrement Risk Area	Actual Number	Expected Number		
		Present Assumptions	Proposed Assumptions	Change
<i>Mortality - Population-Weighted Results</i>				
Non-Disabled Retired Lives - Male	7,850	7,478.9	6,821.6	(657.3)
- Female	15,120	14,713.6	13,249.7	(1,463.9)
Disabled Retired Lives - Male	356	341.3	329.5	(11.8)
- Female	752	787.6	688.5	(99.1)
<i>Mortality - Benefits-Weighted Results</i>				
Non-Disabled Retired Lives - Male	4,606	4,975.1	4,582.7	(392.4)
- Female	5,427	6,044.9	5,423.2	(621.7)
Disabled Retired Lives - Male	108	105.0	108.0	3.0
- Female	186	176.9	168.9	(8.0)

Demographic Assumptions – Impact of Demographic Changes on Liability

- Impact of proposed demographic changes on actuarial accrued liabilities

Decrement Risk Area	Relative Liability Impact
<i>Age and Service Retirement</i>	
Basic - Teachers	Small Increase
- Non-Teachers	Small Decrease
MIP (age 60+) - Teachers	Small Increase
- Non-Teachers	Small Decrease
MIP (30 & out) - Teachers	Small Decrease
- Non-Teachers	Small Decrease
<i>Early Retirement</i>	
Basic	Small Decrease
MIP	Small Decrease

Demographic Assumptions – Impact of Demographic Changes on Liability

- Impact of proposed demographic changes on actuarial accrued liabilities

Decrement Risk Area	Relative Liability Impact
<i>Withdrawal</i>	
First 5 Years of Service	
Members > \$20,000 Pay - Teachers	Small Increase
- Non-Teachers	No Change
Members < \$20,000 Pay - Teachers	Small Increase
- Non-Teachers	Small Decrease
Over 5 Years of Service	
Members > \$20,000 Pay - Teachers	Small Increase
- Non-Teachers	Small Increase
Members < \$20,000 Pay - Teachers	Small Decrease
- Non-Teachers	Small Decrease

Demographic Assumptions – Impact of Demographic Changes on Liability

- Impact of proposed demographic changes on accrued liability

Decrement Risk Area	Relative Liability Impact
<i>Disability</i>	No Change
<i>Mortality</i>	
Non-Disabled Retired Lives - Male	Large Increase
- Female	Large Increase
Disabled Retired Lives - Male	Small Increase
- Female	Small Increase
Pre-Retirement Lives - Male	Small Decrease
- Female	Small Decrease

Economic Assumptions

Economic Assumptions – Current

- The economic assumptions currently in place are presented below:
 - Investment Returns
 - Pension (Non-Hybrid): 7.05%
 - Pension (Pension Plus Plan): 7.00%
 - Retiree Health: 7.15%
 - All pension and retiree health investment returns net of administrative and investment expenses
 - Wage Inflation – 3.50%
 - Price Inflation – 2.50%
 - Payroll Growth Assumption – 3.50%

Economic Assumptions – ASOP No. 27

- Guidance regarding the selection of economic assumptions is governed by Actuarial Standard of Practice (ASOP) No. 27
- ASOP No. 27 requires that the selected economic assumptions be individually reasonable and consistent with one another
- That is, the selection of the price inflation assumption should be consistent with the selection of the wage inflation and investment return assumptions

Economic Assumptions – Data

- Sources of information used to establish economic assumption recommendations:
 - Price Inflation
 - Cleveland Federal Reserve’s inflation expectations
 - Philadelphia Federal Reserve quarterly survey of Society of Professional Forecasters
 - Comparison of Treasury yields and TIPS
 - Capital market expectations of surveyed investment consultants
 - Investment Return
 - Capital market expectations of plan’s investment consultant
 - Capital market expectations of other investment consultants
 - Wage Inflation, Merit and Seniority and Payroll Growth
 - Actual MPSERS experience over the last 5 years (i.e., merit and seniority pay increases)
 - Historical observations of inflation statistics (both price and wage) both nationally and for MPSERS

Economic Assumptions – Price Inflation

- Cleveland Federal Reserve publishes inflation expectations over various time horizons
 - April 2018 expectations
 - 10-year inflation expectation is 1.98%
 - 20-year inflation expectation is 2.14%
 - 30-year inflation expectation is 2.26%
- Philadelphia Federal Reserve survey provides an expectation for the next 10 years
 - Most recent survey results (first quarter of 2018) indicates a 2.25% expectation
- As of April 2, 2018, comparison of 20-year Treasury yields and 20-year TIPS provide an approximation for market price inflation expectations over the next 20 years
 - Indicates a 2.04% expectation

Economic Assumptions – Price Inflation

- Average of eight investment consultants' price inflation expectations is 2.27%
- GRS' preferred price inflation assumption is 2.25%

Economic Assumptions – Wage Inflation

- Wage inflation consists of two components
 - a portion due to pure price inflation (i.e., increases due to changes in the CPI), and
 - increases in average salary levels in excess of pure price inflation

Economic Assumptions – Wage Inflation

- Below shows the difference between the increase in National Average Earnings and price inflation over various 10-year periods:
 - December 31, 2017: 0.8%
 - December 31, 2007: 1.3%
 - December 31, 1997: 0.7%
 - December 31, 1987: 0.1%
 - December 31, 1977: 0.3%

Economic Assumptions – Wage Inflation

- We are generally comfortable with the wage inflation assumption exceeding the price inflation assumption by 0.50% to 1.00%
- Given our preferred price inflation assumption of 2.25%, our preferred assumption is for the wage inflation assumption to exceed the price inflation assumption by 0.50%
- This would result in a wage inflation assumption of 2.75%
 - Payroll growth assumption for amortization purposes would be a separate assumption

Economic Assumptions – Ultimate Health Care Trend Rate

- For retiree health valuation purposes, the ultimate health care trend rate is sometimes set equal to the wage inflation assumption
- However, we are somewhat uncomfortable having an ultimate health care trend rate below 3.00%
- GRS' recommendation for an ultimate health care trend rate is 3.00%

Economic Assumptions – Merit and Seniority

- Total pay increases for an individual consist of a portion due to wage inflation and a portion due to an individual's on the job performance (i.e., merit and seniority)
- The merit and seniority portion of the pay increase assumption was analyzed over the 5-year period
- Continued use of the current age-based structure of the assumption was deemed to remain appropriate based upon the analysis performed
- Minor changes are being recommended to reduce the merit and seniority assumptions based upon the experience of the last 5 years

Economic Assumptions – Payroll Growth

- Payroll growth is used in the determination of the amortization payments required to amortize the unfunded actuarial accrued liability (UAAL)
- UAAL contributions are collected over total MPERS payroll (defined benefit plus defined contribution)
- Payroll growth is primarily dependent on two factors:
 - Wage inflation assumption
 - Size of the active population
- Actual MPERS payroll growth for periods ending September 30, 2017:
 - Last 5 years: -1.0%
 - Last 10 years: -1.7%
 - Last 15 years: -1.0%
 - Last 20 years: 0.2%

Economic Assumptions – Payroll Growth

- Decline in the MPERS active population is primary factor in the realized payroll growth
- GRS' preferred assumption is 0.00%
 - However, if the Board and DTMB expect that the active membership will not decline from its current level going forward, we would be comfortable with a payroll growth assumption up to the wage inflation assumption of 2.75%

Economic Assumptions – Payroll Growth

- Michigan Legislature is currently considering House Bill No. 5355 (HB 5355) to address the payroll growth assumption
 - HB 5355 proposes a 3.50% payroll growth assumption to be used for the September 30, 2018 actuarial valuation (current assumption) with an annual 50 basis point decrease in the payroll growth assumption in subsequent valuations
 - An ultimate payroll growth assumption of 0.00% (i.e., level \$) would be achieved by the September 30, 2025 actuarial valuation under certain conditions

Economic Assumptions – Investment Return

- The investment return assumption is the actuarial assumption that has the largest effect on actuarial valuation results
- As more of the actuarial accrued liabilities are related to non-active members, the nominal (as opposed to real) investment return assumption becomes a more prominent factor
- Since one of MPSEERS' fundamental financial objectives is the receipt of level contributions from one year to the next, the discount rate assumption is based upon the investment return assumption

Economic Assumptions – Investment Return

- Based upon MPERS' current target asset allocations, future return expectations of various investment consultants (including MPERS current investment consultant) were analyzed
- The next few slides show the results of the analysis
 - Capital market expectations are already net of passive investment expenses; going forward, administrative expenses to be funded through normal cost addition
 - 0.30% of payroll for pension
 - 0.05% of payroll for retiree health
 - Final expected nominal investment return results are based upon a 2.25% price inflation assumption

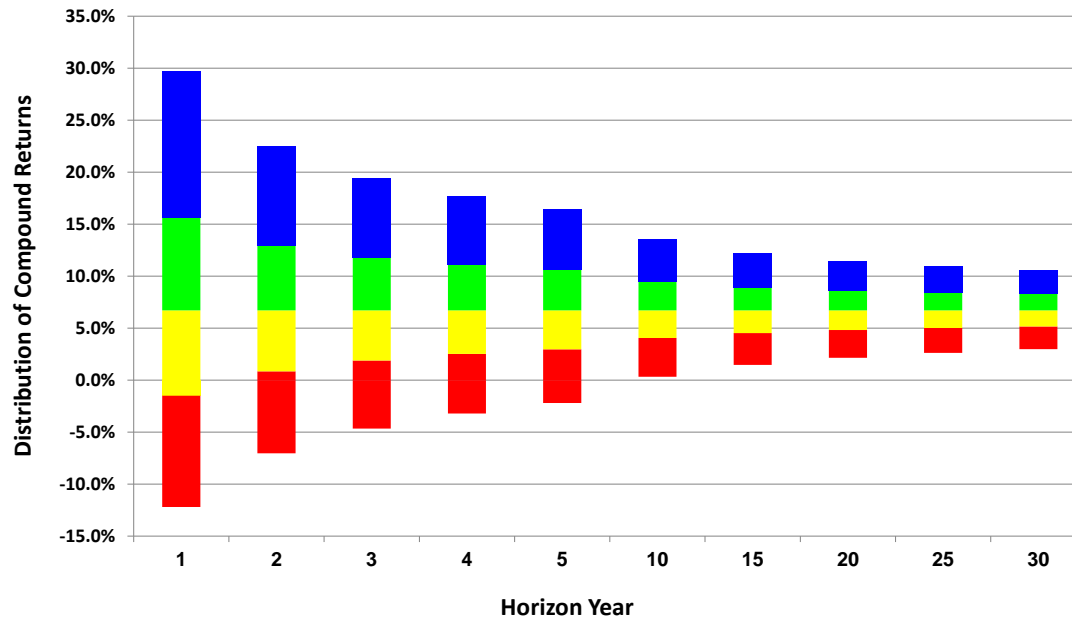
Economic Assumptions – Investment Return

Investment Consultant	Investment Consultant Expected Nominal Return	Investment Consultant Inflation Assumption	Expected Real Return (2)-(3)	Actuary Inflation Assumption	Expected Nominal Return (4)+(5)	Plan Incurred Administrative and Active Management Expenses	Recognized Value for Active Management	Expected Nominal Return Net of Expenses (6)-(7)+(8)	Standard Deviation of Expected Return (1-Year)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	6.29%	2.20%	4.09%	2.25%	6.34%	0.00%	0.00%	6.34%	12.37%
2	6.56%	2.00%	4.56%	2.25%	6.81%	0.00%	0.00%	6.81%	11.70%
3	6.92%	2.26%	4.66%	2.25%	6.91%	0.00%	0.00%	6.91%	11.34%
4	7.23%	2.50%	4.73%	2.25%	6.98%	0.00%	0.00%	6.98%	13.91%
5	7.38%	2.50%	4.88%	2.25%	7.13%	0.00%	0.00%	7.13%	13.32%
6	8.18%	2.21%	5.97%	2.25%	8.22%	0.00%	0.00%	8.22%	14.41%
7	8.29%	2.25%	6.04%	2.25%	8.29%	0.00%	0.00%	8.29%	10.95%
8	8.58%	2.25%	6.33%	2.25%	8.58%	0.00%	0.00%	8.58%	17.27%
Average	7.43%	2.27%	5.16%	2.25%	7.41%	0.00%	0.00%	7.41%	13.16%

Economic Assumptions – Investment Return

Investment Consultant	Distribution of 20-Year Average Geometric Net Nominal Return			Probability of exceeding 7.05%
	40th	50th	60th	
(1)	(2)	(3)	(4)	(5)
1	4.94%	5.63%	6.32%	30.29%
2	5.52%	6.18%	6.84%	36.88%
3	5.67%	6.31%	6.95%	38.46%
4	5.31%	6.09%	6.87%	37.78%
5	5.57%	6.32%	7.06%	40.19%
6	6.47%	7.27%	8.08%	52.79%
7	7.12%	7.74%	8.36%	61.18%
8	6.27%	7.23%	8.19%	51.87%
Average	5.86%	6.59%	7.33%	43.68%

Economic Assumptions – Investment Return



Percentile	Year									
	1	2	3	4	5	10	15	20	25	30
95th	29.71%	22.50%	19.44%	17.65%	16.44%	13.51%	12.23%	11.47%	10.96%	10.58%
75th	15.60%	12.93%	11.76%	11.07%	10.60%	9.45%	8.94%	8.64%	8.43%	8.28%
50th	6.71%	6.71%	6.71%	6.71%	6.71%	6.71%	6.71%	6.71%	6.71%	6.71%
25th	-1.49%	0.84%	1.89%	2.53%	2.96%	4.05%	4.53%	4.82%	5.02%	5.16%
5th	-12.21%	-7.04%	-4.66%	-3.21%	-2.21%	0.33%	1.47%	2.16%	2.63%	2.98%
Geometric Average	7.47%	7.09%	6.96%	6.90%	6.86%	6.79%	6.76%	6.75%	6.74%	6.74%

Economic Assumptions – Investment Return – ASOP No. 27

- The preferred assumption in the actuarial community is the forward-looking expected geometric return (i.e., 50th percentile)
 - Based on the average of each of the investment consultants' expectations, this would lead to an investment return assumption of 6.59%
 - For BOI's investment consultant, this would lead to an investment return assumption of 6.71%
- A less preferred and more aggressive assumption is the forward-looking expected arithmetic return (i.e., expected nominal return)
 - Based on the average of each of the investment consultants' expectations, this would lead to an investment return assumption of 7.41%
 - For BOI's investment consultant, this would lead to an investment return assumption of 7.47%

Economic Assumptions – Investment Return

- Based upon the analysis performed, GRS' preferred investment return assumption would be 6.75%, based upon a price inflation assumption of 2.25%
- GRS does believe that the current investment return assumptions remain reasonable for actuarial valuation purposes
- The Board has adopted the Dedicated Gains Policy which may result in an investment return assumption of 6.75% or below for actuarial valuation purposes
- The higher the selected investment return assumption by the Board, the less margin that would exist for actuarial standards reasonability purposes in future years if capital market assumptions are lowered from their current levels

Actuarial Methods

Actuarial Methods – Recommendations

- Continue use of the entry age actuarial cost method for all benefits
- Continue use of the current amortization policy of reducing the amortization period each year by one year
- Continue use of the current asset valuation method with a 30% corridor for pension valuation purposes
 - Adopt the same asset valuation method for the OPEB valuation beginning with the September 30, 2018 valuation

Effect on Valuation Results

Effect on Valuation Results

- In this section, September 30, 2017 pension and retiree health (i.e., OPEB) actuarial valuation results are presented based on the proposed demographic assumptions and proposed alternate economic assumptions
- It is our expectation that the proposed set of actuarial assumptions would first be used for the September 30, 2018 valuation

Effect on Valuation Results – Pension Valuation as of September 30, 2017

	Present Assumptions	Alternate #1 Assumptions	Alternate #2 Assumptions
Investment Return Assumption ⁽¹⁾	7.05% / 7.00%	7.05% / 7.00%	6.75% / 6.75%
Wage Inflation Assumption	3.50%	2.75%	2.75%
Payroll Growth Assumption	3.50%	2.75%	2.75%
Mortality Assumptions	Present	Proposed	Proposed
All Other Assumptions	Present	Proposed	Proposed
Total Normal Cost of Benefits % (as a % of member pay) ⁽²⁾	10.62%	10.40%	11.08%
Member Contribution % (weighted average)	<u>4.94%</u>	<u>4.95%</u>	<u>4.95%</u>
Employer Normal Cost %	5.68%	5.45%	6.13%
Employer Normal Cost \$ (in millions)	\$496.1	\$466.0	\$523.8
Total Actuarial Accrued Liability (in millions)	\$76,693.5	\$79,753.0	\$82,408.1
Funding Value of Assets (in millions)	<u>47,255.3</u>	<u>47,255.3</u>	<u>47,255.3</u>
Unfunded Actuarial Accrued Liability (in millions)	29,438.2	32,497.7	35,152.8
Funded Percentage - Total	61.6%	59.3%	57.3%
Funded Percentage - Pension Plus Plan Only	101.6%	105.3%	100.0%
Total Amortization Payment % ⁽²⁾	24.07%	29.01%	30.76%
Total Amortization Payment \$ (in millions)	\$2,188.0	\$2,580.6	\$2,736.3
Total Computed Employer Contribution \$ (in millions)	\$2,684.1	\$3,046.6	\$3,260.0

(1) The Non-Hybrid investment return assumption is listed first, and the Pension Plus Plan investment return assumption is listed second.

(2) The employer normal cost percent is expressed as a percentage of the defined benefit payroll, while the amortization payment is expressed as a percentage of total payroll (i.e., including both DB and DC active member payroll).

Effect on Valuation Results – OPEB Valuation as of September 30, 2017

	Present Assumptions	Alternate #1 Assumptions	Alternate #2 Assumptions
Investment Return Assumption	7.15%	7.15%	6.75%
Wage Inflation Assumption	3.50%	2.75%	2.75%
Payroll Growth Assumption	3.50%	2.75%	2.75%
Ultimate Trend Rate	3.50%	3.00%	3.00%
Mortality Assumptions	Present	Proposed	Proposed
All Other Assumptions	Present	Proposed	Proposed
Total Normal Cost of Benefits % (as a % of member pay) ⁽¹⁾	3.52%	3.40%	3.69%
Member Contribution % (weighted average)	3.00%	3.00%	3.00%
Employer Normal Cost %	0.52%	0.40%	0.69%
Employer Normal Cost \$ (in millions)	\$34.2	\$26.0	\$44.8
Total Actuarial Accrued Liability (in millions)	\$13,587.7	\$13,800.0	\$14,406.1
Funding Value of Assets (in millions)	<u>5,177.8</u>	<u>5,177.8</u>	<u>5,177.8</u>
Unfunded Actuarial Accrued Liability (in millions)	8,409.9	8,622.2	9,228.3
Funded Percentage	38.1%	37.5%	35.9%
Total Amortization Payment % ⁽¹⁾	6.65%	7.42%	7.71%
Total Amortization Payment \$ (in millions)	\$604.2	\$659.7	\$686.2
Total Computed Employer Contribution \$ (in millions)	\$638.4	\$685.7	\$731.0

(1) The employer normal cost percent is expressed as a percentage of the defined benefit payroll, while the amortization payment is expressed as a percentage of total payroll (i.e., including both DB and DC active member payroll).

Disclosures

- This presentation shall not be construed to provide tax advice, legal advice or investment advice.
- Mita Drazilov and Louise Gates are Members of the American Academy of Actuaries and meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinions contained herein.
- Additional information regarding actuarial assumptions and methods, and important additional disclosures are provided in the report titled “5-Year Experience Study – October 1, 2012 through September 30, 2017.”
- If you need additional information to make an informed decision about the contents of this presentation, or if anything appears to be missing or incomplete please contact us before using this presentation.