Oregon Secretary of State

A Review of the Oregon Public Employees
Retirement System (PERS)

GRS

TRANSMITTAL LETTER

September 18, 2019

Secretary of State Audits Division
Secretary of State
255 Capitol Street, NE Suite 180
Salem, Oregon 97310

This report contains the results of the study of the Oregon Public Employees Retirement System (Oregon PERS). This study was conducted pursuant to the 2018 Oregon House Bill 4163, Section 11.

This report is intended to be fully responsive to the required services as described in Exhibit A "Statement of Work", PO # 1650-00000216.

This study looks at the reasonableness and consistency of the methods, assumptions, data used in the December 31, 2017 actuarial valuation. The review includes an attribution analysis to isolate the source in the growth of the unfunded accrued liability; looks at the calculation of the employer rates as well as the rate collaring policy. A review was made of the experience study and the projection models.

The work presented herein is based on data furnished by Oregon PERS and Milliman. We gratefully acknowledge the cooperation of Milliman and Oregon PERS, without whose assistance this project could not have been completed.

The work presented in this study relies on the actuarial work conducted by Oregon PERS actuaries, and is based on the actuarial assumptions approved by the Oregon PERS Board of Trustees. As with any actuarial study which engages in the prediction of future outcomes, to the extent future experience differs from the assumptions, then the actuarial outcomes will similarly differ.

This report was prepared at the request of the Secretary of State and is intended for use by the Secretary of State and those designated or approved by the Secretary of State. This report may be provided to parties other than the Secretary of State only in its entirety and only with the permission of the Secretary of State. GRS is not responsible for unauthorized use of this report.

The actuaries submitting this statement are members of the American Academy of Actuaries and meet all of the Qualification standards of the American Academy of Actuaries to render the actuarial opinion contained herein. In addition, the undersigned are experienced in performing actuarial valuations for other large public retirement systems.

Respectfully submitted,

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TABLE OF CONTENTS

Table of Contents

SECTION I

EXECUTIVE SUMMARY

Executive Summary

This in-depth look at the Oregon PERS system shows that the System is balancing its many objectives and is working toward meeting its goal of full funding over the next twenty years.

The last decade has found Oregon PERS moving from being fully funded to having a $17 billion unfunded accrued liability. The velocity of change in the expectation for future returns is unprecedented in history and the impact to employers with these fast rate increases has been mitigated (not eliminated) through the use of rate collaring.

This study has found that the rate collaring has the impact of adding to the unfunded liability, but that when looking at the long term projections through the financial (asset/liability) modeling that the plan is expected to meet its funding objectives.

We found the actuarial work to be consistent with generally accepted actuarial standards and practices. Different actuaries will differ in their approach and this report highlights areas of consideration where we feel we would differ from Milliman.

The ultimate security of the funding promise will depend on employers' ability to meet their contribution requirements, given the volatility of the capital markets and the question around what investment returns can truly be delivered to Oregon PERS.

In summary, the following are the highlights of our review:

- *The attribution analysis shows that the emergence of the UAL of the System to $17 billion over the last decade is primarily due to the capital markets performing less than expected, lowering of anticipated future investment returns; longer life expectancy and the under-contributing toward the unfunded accrued liability.*

- *The success of the funding policy rests on the validity of the actuarial assumptions working in concert with the rate collaring. Employer contribution rates are expected to continue to increase. Concern exists over certain actuarial assumptions; if the investment return (earnings into the trust) and payroll growth (the engine which delivers contributions to the trust) are set too high then the unfunded will continue to grow.*

- *We recommend Oregon PERS discuss with their actuary how and whether their funding policy should recognize that, in such a maturing plan, the contributions related to the unfunded liability should be determined solely as a dollar amount. This is due to the liability being mostly fixed (retirees) and no longer related to payroll (and its related volatility).*

- *We recommend Oregon PERS discuss with their actuary whether interest should be added to the determination of the new rates each biennium to cover the lag period between the valuation and the implementation of the new rates.*

- *The experience study recommended changes in assumptions with which the underlying trends generally concur. We understand the ultimate decision for the assumed rate of return was heavily weighted by an outside investment consultant, however, concerns still remain with the investment return assumption (7.2%, compared to Milliman's estimate of 6.7%) and the assumption for growth in total payroll of 3.5%. Both of these assumptions may be too high; and both work in the same direction (compounding underfunding should the assumptions not materialize as expected). We also recommend considering adding an assumption for data changes and for new entrants (OPSRP).*

- *Financial (asset/liability) modeling shows the System to be on target to meet its funding objectives. The meeting of the target is contingent upon employers continuing to meet increasing rate requirements. Ultimately the successful funding of the plan will depend on the employers' ability to meet the contribution requirements.*

- *Rate collaring does limit the growth in employer contributions and it is contributing to the unfunded accrued liability.*

- *Audit of the valuation indicated that Milliman and GRS match to within acceptable degrees of certainty on the total liabilities of the sample members. Some enhancements could be made to the report to improve communication of the methods, assumptions, and plan provision being used to calculate liabilities.*

- *Review of the actuarial contract indicated the work reviewed generally complies with the Statement of Work.*

- *Recommendations include the creation of a written funding policy incorporating the rate collar; a review of the economic assumptions for discount rate and payroll growth.*

- *The retiree health care plans have moved into a better funded position over the last decade.*

SECTION II

SCOPE OF REVIEW AND METHODOLOGY

Scope of Review and Methodology

Section III

How did we get here? Attribution Analysis

A decade ago there was no unfunded accrued liability-the system, including side funds, had funded ratios (the ratio of assets to the accrued liability) in excess of 100%. Over the last decade, a $17 billion unfunded liability has appeared, prompting the question of what caused the emergence of this unfunded accrued liability.

The attribution analysis examines the last decade in order to identify the key sources in the emergence of this unfunded accrued liability. Using each valuation report, variances from the expected accrued liability were isolated. Three main categories contributing to the unfunded accrued liability development were seen:

- Investment return-lower than expected during the decade and the expectations for future returns have decreased;
- Underperforming demographic assumptions;
- Contribution rate less than gross actuarially determined (i.e. uncollared rate).

Section IV

Are assumptions reasonable going forward? Experience study review

The experience study, which looks at the plan's experience by assumption, was reviewed. The key assumptions were compared to the trend for each assumption that had been detailed in each valuation report. This was done to determine whether the recommended assumptions changes were in alignment with the underlying trend in the valuations.

Section IV (continued)

Will Oregon PERS meet its objectives for full funding? Financial (asset/liability) modeling

Stress testing, deterministic modeling with set assumptions; stochastic modeling with changing assumptions, were all reviewed. These asset/liability models were conducted by the retained actuary to demonstrate the risks to the plan as well as the potential for meeting the objectives of Oregon PERS for full funding of its accrued liability. Impacts due to rate collaring are also studied, and compared to the gross actuarially determined contribution rates.

Section V

Is the funding policy working? Funding policy and rate collar review

The rate setting structure, including the rate collar, were reviewed. The financial (asset/liability) models show the impact of the rate collar. The effect of the rate collar on contributions is to primarily push the difference between the uncollared rates and the collared rates out into the future. The financial (asset/liability) models do not yet indicate an overall negative impact to the funded status of the plan; but rather show extended "higher" contribution rates for employers who defer a portion of their uncollared contribution rate increases. Recommendations for some consideration on the method have been included in Section V of this report.

Section VI

Is the valuation appropriately valuing benefits and determining costs and liabilities? Valuation Audit

Using a full replication of the selected sample lives, we have determined that the valuation is producing adequate liabilities of the Oregon PERS. Specific, non-material issues for consideration were found and are detailed in the audit section of this report. The issues are primarily associated with communication of the methods, assumptions, and plan provisions in the report.

Section VII

Is the actuarial contract being fulfilled? Actuarial Contract Review

The contract was reviewed and compared to the valuation, experience study and projection models.   We found the work to be consistent with the detailed statement of work for the retained actuary. We have made a couple of recommended additions to the statement of work for the retained actuary. First, we recommend that any actuarial audit receive a written response from the retained actuary and secondly, that a section be added for the transfer of work should the retained actuary's contract terminate.

SECTION III

ATTRIBUTION ANALYSIS

Attribution Analysis

Total System Overview

Attribution analysis – Creation of the Unfunded Accrued Liability (UAL) and Funded Ratio impact

This analysis examines a history of the actuarial condition of Oregon PERS and, based on the valuations, provides an explanation for the overall change in funded status over a recent period. For Tier 1/Tier 2, the analysis looks at a 10 year period- starting when the plan had no unfunded liability to the most recently available valuation (December 31, 2017) when the System has a $17 billion dollar unfunded accrued liability. *(Page 9 of the December 31, 2017 Actuarial Valuation)*

Brief history of the funded condition-from fully funded to 80% funded in a decade

In 2007 the Oregon PERS pension systems were fully funded. Fully funded means there was no unfunded accrued liability. When a plan is fully funded, its assets meet or exceed its accrued liabilities. Funded ratios are shown below:

Funded Ratios (including the side funds) Oregon PERS Pension Systems					
December 31,	SLGRP	School	Independent Employers	OPSRP	Total
2006	111.00%	110.60%	109.70%	131.60%	110.50%
2007	112.80%	112.90%	107.70%	135.50%	112.20%
2008	80.90%	80.30%	78.30%	80.30%	80.20%
2009	86.40%	86.10%	84.20%	83.20%	85.80%
>					
2017	79.20%	84.00%	76.80%	73.10%	80.10%

Source: Executive summaries of the valuation reports for the indicated year.

The impact of the Great Recession in 2008 on the funded status cannot be overlooked in this analysis. That was a key driver in lowering the funded ratio to 80% in 2008. But since then, the funded ratio has further deteriorated.

Funded Status-Pension System Totals

It is not merely a matter of the decline in the funded ratios; the dollar amount which must be funded has increased. In 2007 there was no unfunded accrued liability and hence no payments to be made toward an unfunded accrued liability. By 2017 the unfunded accrued liability for the total system has grown to nearly $17 billion. The accrued liability has grown to $84.056 billion; the assets combined with the side fund have grown to $67.326 billion. The difference between these two items is the unfunded accrued liability of $16.730 billion.

Accrued liabilities grow reliably over time-unless plan amendments are enacted which slow the growth rate in these liabilities. Accrued liabilities increase each year by the normal cost and interest, and decrease each year by the benefit payments. The accrued liability represents the value of all the benefits earned to date; typically legal and policy constraints make the amendment of these liabilities more difficult. This means, these liabilities are here to stay.

Assets, unlike the accrued liabilities, grow and change with variability over time. Although there are techniques to smooth out some of the "noise" in the assets, the assets will generally not directly follow the pattern in the growth of liabilities. Payments on the unfunded accrued liability can similarly change each year with the change in the assets. Changes in the unfunded accrued liability create changes in the payments on an unfunded accrued liability. Volatile assets can create volatile contribution rates.

For Oregon PERS, there has been an additional element contributing to the departure between the assets and the liabilities. The recommended contributions include a rate collar. This rate collar slows down (but does not eliminate) the contribution rate increase each biennium. This rate collaring creates an annual shortfall in the funding of the plan. This shortfall debt accrues interest at 7.2% per year.

Tier 1/Tier 2 (SLGRP; School and Independent Employers)

The primary drivers of the increase in the unfunded accrued liability

The unfunded accrued liability is the difference between the accrued liability and the assets. The payment on the unfunded accrued liability is driving up the employer rates. (Employer gross actuarially determined contribution rates are the sum of the normal cost and the payment on the unfunded accrued liability. The normal cost rate is fairly stable).

Each year the unfunded accrued liability is expected to increase by the normal cost plus administrative expenses and interest, and to decrease by the contributions.

In the case of Oregon PERS, when looking over a ten year period, the contributions have not been sufficient to pay off the normal cost plus administrative expenses and all of the interest on the unfunded accrued liability. This means the principal balance on the unfunded accrued liability is continuing to grow. A ten-year trace of this effect is shown below (numbers exclude side funds):

Item	Ten Year Cumulative Total
Unfunded Accrued Liability January 1, 2008	$ 1,273.6
Normal Cost plus Admin	6,151.1
Interest	10,650.7
Contributions	(11,189.3)
Liability (gain) or loss	1,060.6
Asset (gain) or loss	5,035.4
Assumption/Plan changes	7,797.6
Employers joining SLGRP	(6.7)
Unfunded Accrued Liability December 31, 2017	$ 20,773.0

Over the decade contributions were outrun by interest and asset losses

The expected increase (normal cost plus administrative expenses and interest) was $16.8 billion while the actual contributions made were $11.2 billion. In addition, the liability losses (discussed in detail later) totaled $1 billion. The actual asset losses over the study period were $5 billion and the losses due to the change in future expectations (assumption and plan changes) totaled $7.8 billion.

*Contributions cover normal cost and only a part of the interest on the debt*

Over the last decade, the interest on the unfunded accrued liability was $10.7 billion and the normal cost and expenses were $6.1 billion. The contributions were $11.2 billion. This implies that, of the $11.2 billion in contributions, $6.1 went for current year expenses (normal cost plus administrative expenses) and the rest went to the UAL ($5.1 billion). That leaves $5.6 billion in UAL interest that flowed back into the UAL. The table below shows the year by year comparison of total contributions to normal cost plus administrative expenses and the interest on the UAL.

Valuation Date December 31	Total Contributions (1)	Total Normal Cost Plus Admin (2)	Interest on UAL (3)	Contributions Toward Normal Cost Plus Admin (4)	Contributions Toward Interest on UAL (5)	Contributions Towards Paying Down the UAL* (6)
2008	$1,134.4	$403.5	$87.8	$403.5	$87.8	$643.1
2009	1,035.9	513.1	1,263.4	513.1	522.8	-740.6
2010	873.8	547.8	1,086.5	547.8	326.0	-760.5
2011	957.6	537.5	1,061.1	537.5	420.1	-641.0
2012	1,133.7	531.6	1,284.8	531.6	602.1	-682.7
2013	1,139.9	748.4	829.1	748.4	391.5	-437.6
2014	1,186.3	698.9	592.6	698.9	487.4	-105.2
2015	1,194.4	758.8	1,251.3	758.8	435.6	-815.7
2016	1,218.1	716.4	1,516.8	716.4	501.7	-1,015.1
2017	1,315.2	695.1	1,677.3	695.1	620.1	-1,057.2
Total	**$11,189.3**	**$6,151.1**	**$10,650.7**	**$6,151.1**	**$4,395.1**	**-$5,612.5**

*Negative values imply that contributions were not sufficient to cover at least normal cost with admin and interest on the UAL.
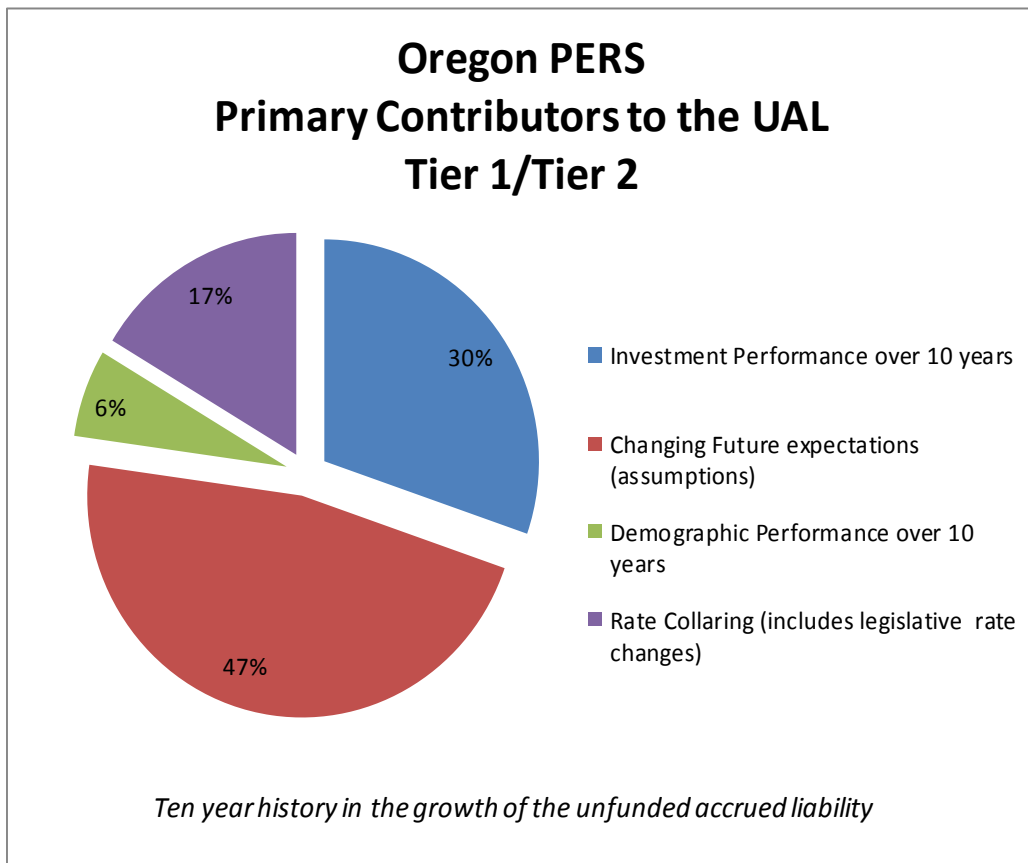
As shown, only one year in the last ten was the contributions to the plan sufficient to cover normal cost plus administrative expenses and the interest on the UAL.

**Oregon PERS Tier 1/Tier 2
UAL (in 000s) - Ten year History**
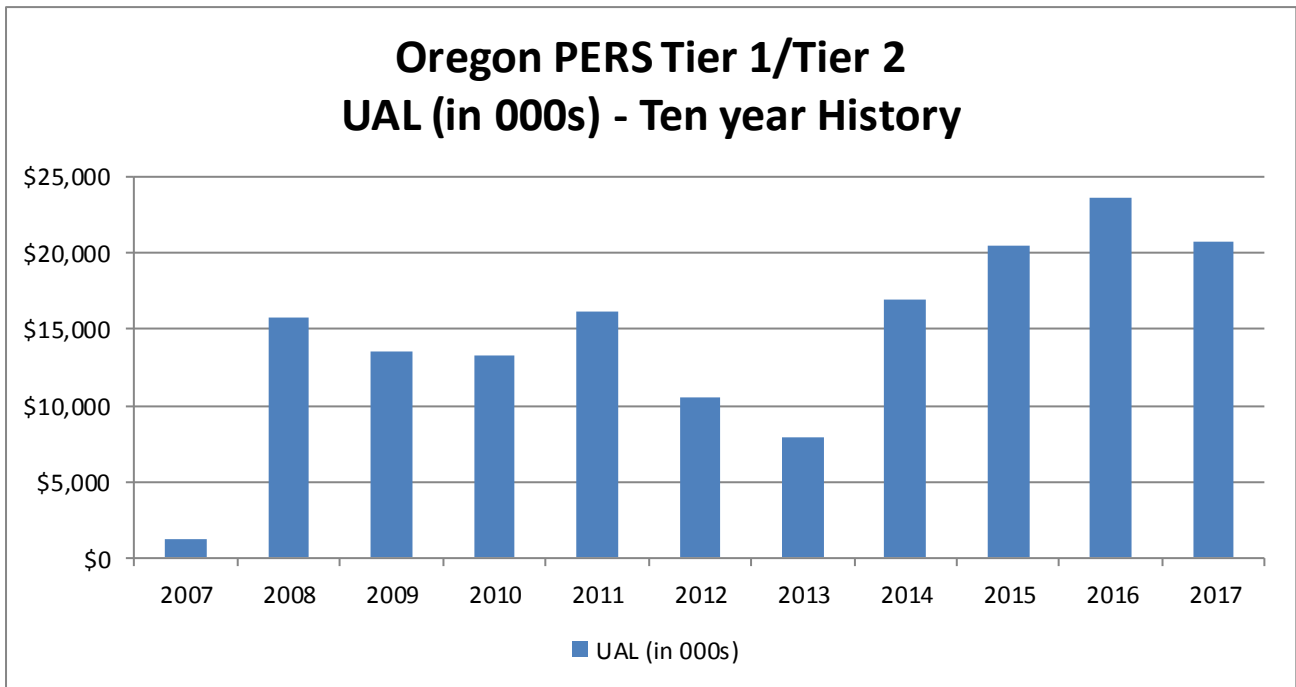
As shown in the chart above, the unfunded accrued liability has increased over the decade. The growth in the unfunded accrued liability over the last decade is due to the underperformance of the assets (relative to the actuarial assumed rate); to the change in future expectations for the assets (and some other assumptions) and to the contribution not paying off the principal balance on the UAL. If this continues the UAL could grow without bound.

Looking at the historical impact in a slightly different way, the chart below also illustrates that past and future asset performance accounts for 77% of the growth in the UAL; the rate collaring for 17% of the growth in the UAL and the balance is due to the demographic assumptions.

Oregon PERS
Primary Contributors to the UAL
Tier 1/Tier 2

- ■ Investment Performance over 10 years
- ■ Changing Future expectations (assumptions)
- ■ Demographic Performance over 10 years
- ■ Rate Collaring (includes legislative rate changes)

30%

47%

6%

17%

Ten year history in the growth of the unfunded accrued liability

Biggest driver in the development of the UAL- Asset performance less than assumed

The last decade saw nearly unprecedented velocity of changes in the expectations for long term asset performance. Nearly three-quarters of the unfunded has developed due to the underperformance of the assets (actual returns lower than assumed returns) and the decline in future expectations for the performance of the assets (assumption changes).

The largest contributor over the decade to Tier 1/ Tier 2 pension unfunded accrued liability is the change in future expectations for both the investments and the population. $7.8 billion is the value over the period for the change in actuarial assumptions and methods. This is primarily driven by the change in expectations for the amount of investment earnings that will be made in order to pay for benefits. The velocity of change in the investment earnings would need to be met with a similar velocity of increase in the contributions if the actuarial condition of the plan were to be stabilized. However, the change in the investment returns coincided with a deceleration in the increase of the employer contributions (rate collaring)-creating a funding gap (the unfunded accrued liability.)

Within the last decade, Oregon PERS, like so many other plans, has experienced a quick and not insignificant decline in the expected returns for their investments. Every time the expectations for future earnings decrease, there is an offsetting increase in the required contributions.

| Oregon PERS | | |
| Assumed Earnings and Discount Rate | | |
Year(s) Changed	Assumed Earnings Rate	Years in Effect
2017	7.20%	>1
2015	7.50%	2
2013	7.75%	2
1989	8.00%	23

Source: Public Employees Retirement System

Legislative Review of System Financing

Joint Committee on Ways and Means

Capital Construction Subcommittee

March 29, 2019

| Oregon PERS | | |
| Impact of Assumed Rate changes to the UAL* | | |
Valuation Year	Rate Change	Impact
2016	7.50% to 7.20%	$2.3 billion
2014	7.75% to 7.5%	$1.7 billion
2013	8.00% to 7.75%	$2.5 billion
Total increase to the UAL		$6.5 billion

Source: Public Employees Retirement System

Legislative Review of System Financing

Joint Committee on Ways and Means

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*These values may include other assumptions changes in addition to the assumed rate of return.

Rate collaring adds to the unfunded accrued liability

The actuarially determined contribution typically includes the normal cost, annual expenses, interest on the unfunded accrued liability and a portion of a principal payment on the unfunded accrued liability. The actuarially determined contribution may also include an "output smoothing" component. Oregon PERS uses rate collaring as an output smoothing component and thus the actuarially determined contribution, or the "collared rate" includes rate collaring. Since 2005, when the rate collaring has been in effect, the payment has been less than the sum of the component parts referenced above. This most typically means the unfunded accrued liability is paid off at slower rate than would be with the uncollared rate (or not at all in a given year), and may even result in the growth of the unfunded accrued liability in the short term.

Rate collaring may limit the amount of a rate increase in any rate-setting year. Dampening the contribution requirements has also contributed to the growth in the unfunded accrued liability. What is now a more concerning outcome is that, as of the December 31, 2017 actuarial valuation, the total interest payment required on the unfunded accrued liability is larger than the total expected contributions. The unfunded has grown so large that the actuarially determined contributions (collared rates) cannot pay off the interest on the unfunded, let alone touch the principal. How will this funding

deficit be resolved? Can Oregon PERS earn its way out of this? Will using time actually help, or is time now the enemy (with the continuing accrual of interest). These are the issues we recommend Oregon PERS continue to pursue with their retained actuary.

Milliman, in their December 31, 2017 valuation report (page 2) states "Of concern, even with the rate increase noted above the system-average uncollared employer contribution *rate remains almost 4% of payroll above the collared rate* for 2019-2021. Because of this, if actual experience is near assumption and assumptions remain unchanged in the next rate-setting valuation, we anticipate a system-average collared rate increase for the 2021-2023 biennium similar to the increase for the 2019-2021 biennium calculated in this valuation." (*Emphasis added*) Milliman is signaling that actuarially determined contributions (collared rates) are insufficient to meet the payments of normal cost, expenses, interest and principal on the unfunded accrued liability (the uncollared rates). They are also signaling additional large rate increases are to come, and that is based on assumptions being met.

The rate collaring policy as described in the valuation is not truly rate relief; the funds "not contributed" will return to the contribution requirement in later years (with interest). Essentially, employers who use rate collaring are "borrowing" at 7.2% per year. These contribution requirements will be higher, since the contribution deficit created by rate collaring will become part of the unfunded accrued liability and will grow at 7.2% per year.

Rate collaring for SLGRP and School districts has added to the unfunded accrued liability about $2.7 billion ($2.0 billion for SLGRP and $0.7 billion for the School Districts). In the chart below, the Collar Adjustment is the amount that the required contribution is reduced due to the rate collaring policy. It should also be noted that in this period the legislative actions of decreasing and later reversing benefit decreases has also impacted the funding of Oregon PERS.

SLGRP Estimated Impact of Rate Collar Valuation Date December 31,										
	2009	2010	2011	2012	2013	2014	2015	2016	2017	Nine year total
SLGRP Payroll (millions)	$4,850.1	$4,973.4	$4,935.7	$5,018.0	$5,121.9	$5,390.8	$5,594.3	$5,714.0	$5,897.8	
Collar Adjustment	3.95%	0.57%	2.20%	3.30%	1.14%	6.26%	8.35%	5.58%	4.68%	
Dollar amount of Collar Adjustment (millions)	$191.58	$28.35	$108.59	$165.59	$58.39	$337.46	$467.12	$318.84	$276.02	$1,951.94
School District Estimated Impact of Rate Collar Valuation Date December 31,										
	2009	2010	2011	2012	2013	2014	2015	2016	2017	Nine year total
School District Payroll (millions)	$2,873.7	$2,950.7	$2,786.0	$2,731.5	$2,723.5	$2,872.7	$3,060.7	$3,240.7	$3,314.2	
Collar Adjustment	4.24%	0.00%	2.23%	0.00%	0.00%	5.83%	7.48%	3.95%	1.93%	
Dollar amount of Collar Adjustment (millions)	$121.84	$0.00	$62.13	$0.00	$0.00	$167.48	$228.94	$128.01	$63.96	$772.36
Source: each year's actuarial valuation report										
Grand Total contribution deferment (excluding independent employers)										$2,724.31

Rate collaring creates a deficit which in turn becomes a part of the unfunded accrued liability and the current period deficit is spread over a longer period of time. Rate collaring takes current expenses and pays them off over 10 or more years. This creates a structural deficit to the plan and this will resolve when the actuarially required contributions exceed the uncollared actuarially determined contributions.

Plan changes had virtually no impact, as the decrease in liabilities in 2012 was nearly matched by an increase in liabilities due to plan changes in 2014. The impact due to these changes was in the decrease in funding that later had to be recovered through subsequent rate increases.
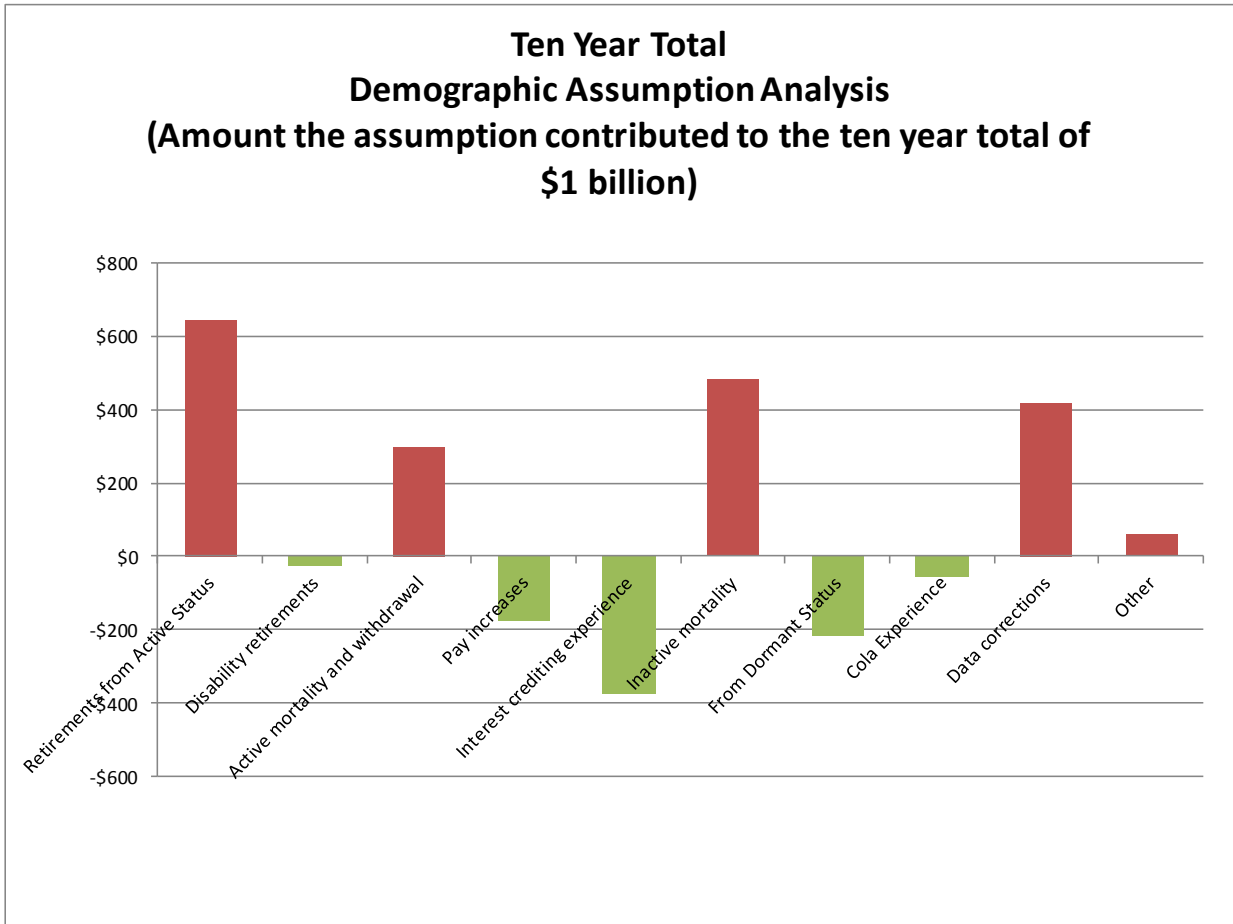
Demographic losses (primarily members living longer than expected, retiring more than expected, and data corrections)

The impact of the demographic assumptions not meeting their assumed rates over the ten year period was only 6% of the total impact to the emergence of the unfunded accrued liability. The largest contributor in the demographic assumptions to the increase in the unfunded accrued liability was the retirement assumption. The next largest contributor was the mortality (life expectancy) assumption. The third largest contribution was the data corrections, for which there is no assumption.

Over the last five years the losses from the retirement assumption have improved. It appears, from looking at the annual gain/loss by source, the retirement assumption is sometimes greater, and sometimes less than expected. Over the ten year period the loss on this assumption was $0.6 billion. Over the last five year period, that loss on the retirement assumption was $0.2 billion.

The next largest assumption that contributed to the growth in the unfunded accrued liability was the mortality assumption. The experience deviation on this assumption contributed $0.5 billion over the ten year period. In fact, there has been a loss due to this assumption for every year out of the last ten years, except for one year.

The third largest deviation from assumption was "data corrections". We understand that every year there are members who "show up" and must be added to the membership file. However, there was a significantly large data correction in 2017. The liability with this data correction was ten times greater than the "standard" amount in this category. We understand from the retained actuary that this data correction is due to certain members of State Agencies whose employers participate in the unused sick leave program but the valuations did not apply the assumed load for unused sick leave.

**Ten Year Total
Demographic Assumption Analysis
(Amount the assumption contributed to the ten year total of
$1 billion)**

Conclusions

The bulk of the reason for the actuarial condition of the plan can be found in three main sources; expectations for investments were not and will not be met; employers are deferring current period required contributions through the use of the rate collaring policy; and members are living longer and retiring with higher liabilities than expected.

OPSRP

The OPSRP plan was over 135% funded in 2008 and by 2017 the OPSRP was 73.1% funded. As of December 31, 2017 the plan had an unfunded accrued liability of $1.518 billion. *(Page 48 of the December 31, 2017 Actuarial Valuation)* Similar issues are faced by the OPSRP plan, albeit on a different scale, than for the Tier 1/Tier 2 plans.

The primary drivers of the increase in the unfunded accrued liability

As a relatively newer plan than the Tier 1/Tier 2 plan, OPSRP is subject to different pressures. The actual asset performance over the last ten years has exceeded the actuarially assumed return. For OPSRP, there has been no utilization of a rate collar.

In a number of years the contributions did not even reach the normal cost. We consider this a serious funding issue since it means the current expenses were not being met by the contributions. This is also a violation of a funding policy that requires payment of interest and principal on any unfunded accrued liability. We suggest this could be a result of the two year delay in rate implementation. One of our recommendations is to have Oregon PERS work with their retained actuary to see whether there should be interest placed on the required contributions to make up for the timing delay, or whether other circumstances exist which created this funded deficit. We understand a change in funding method contributed to this overall result of contributions not being sufficient to pay for the normal cost.

The changes in future expectations, as evidenced by the changes in the actuarial assumptions, accounts for $1 billion of the unfunded accrued liability. Another $0.5 billion is shown in the actuarial reports as coming from new entrants. These are members of OPSRP who enter the system and immediately have an unfunded accrued liability. Milliman shows these members incurring an unfunded accrued liability at around 10% of the accrued liability each year. This is a significant amount of liability being added to the plan each year. These members have had contributions made on their behalf. In our analysis of the experience study we will be recommending a review of whether an explicit assumption should be made to cover any difference between liabilities and contributions for new hires- any net liability with such a regular and significant occurrence may need to be actuarially funded and recognized.

OPSRP Change in UAL Components

- Investment Performance (Gain!) over 10 years: -$453
- Changing Future expectations (assumptions): $1,023
- Demographic Performance over 10 years: $569
- Contributions less than the expected increase: $385
- Plan Changes (Gain!): -$71
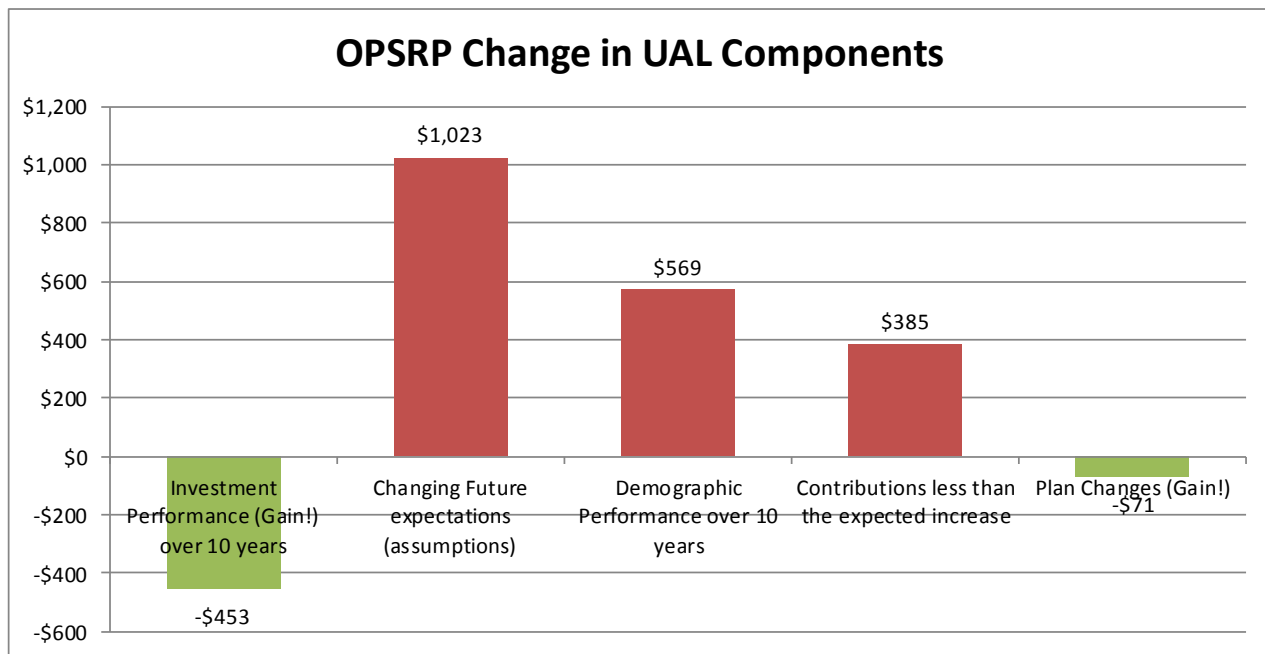
OPSRP	
	Dollar amounts in (000's)
Primary Category	**Contribution to the 10-year UAL**
Investment Performance (Gain!) over 10 years	-$453.10
Changing Future expectations (assumptions)	$1,022.50
Demographic Performance over 10 years	$568.80
Contributions less than the expected increase	$384.70
Plan Changes (Gain!)	-$70.90

Demographic Assumptions play a larger role in OPSRP

The largest source of the increase in unfunded accrued liability due to variance from expected was in the new entrant category. When members enter the plan they are coming in with some service (by the time the valuation is performed). Over the ten year period, these losses due to new entrants average about $52 million per year. Contributions have also been made on behalf of these new entrants.   We recommend that Oregon PERS work with their retained actuary to wee whether an assumption should be made for the new entrants.

The second largest source of loss is due to the salary increase assumption. Over the ten year period the expected pay increases have been underestimated (in seven years out of ten) for an increase in the unfunded of $177.5 million. In 2017 the salary "loss" (meaning the actual salary increase was "higher" and thereby added to the unfunded accrued liability) was 2% of the total beginning accrued liability. We consider this a significant deviation and warrants further explanation.

OPSRP Demographic Assumptions Contribution to the Increase in UAL
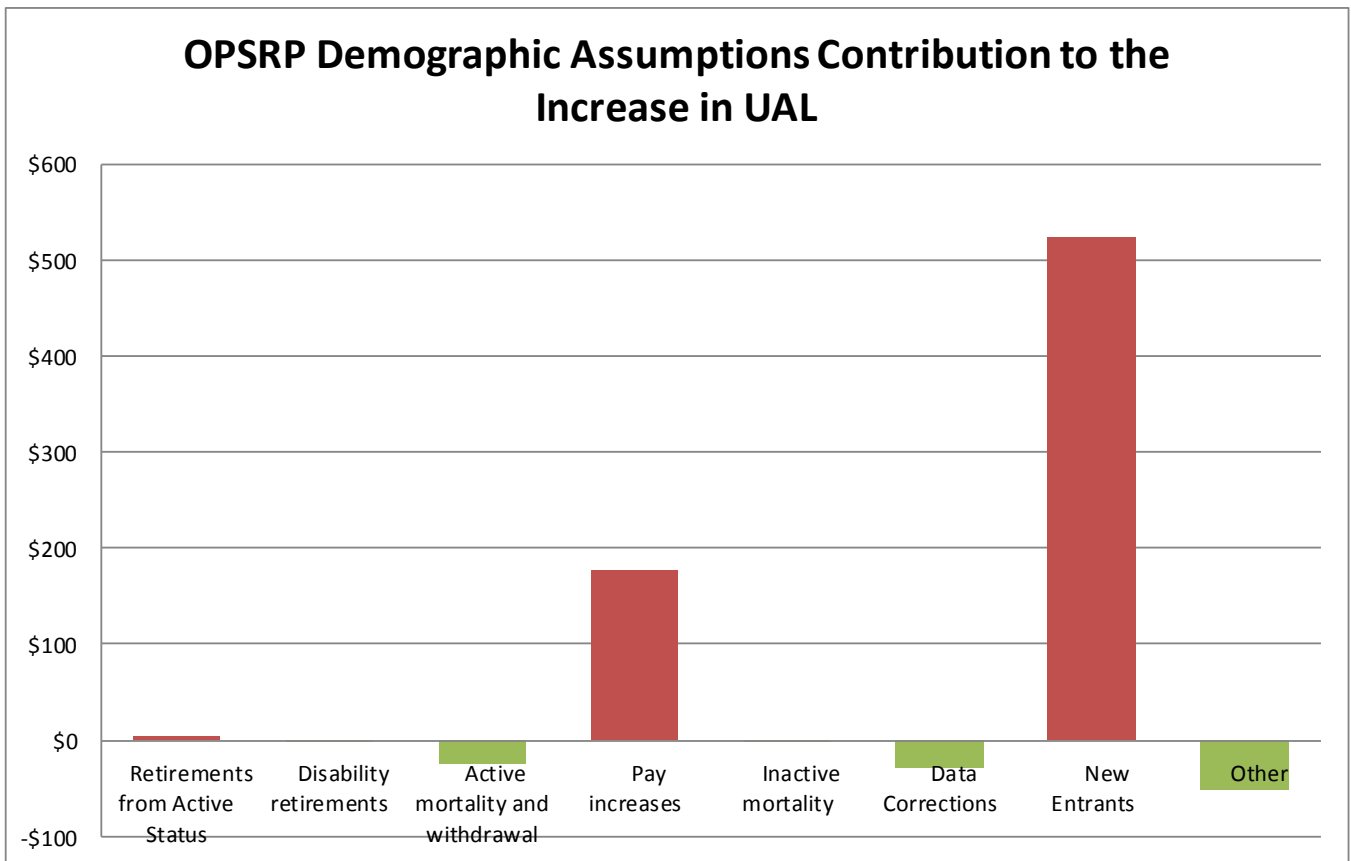
Assets, over the ten year period, returned more than expected on a dollar basis. Over the ten year period the assets were $326 million more than expected. This is a good illustration of how timing matters. In the years near the Great Recession the trust was much lower in value (and lost fewer dollars), but gains in contributions occurred during times of higher returns, bringing an overall positive value to the trust for the ten year period.

The rate collaring policy has not impacted OPSRP. Thus, the growth in the unfunded accrued liability over the last decade is primarily due to the changing expectations on future investment earnings and the additional unexpected liability associated with new entrants. Here is what Milliman (the retained actuary) had to say about the new entrant liability:

"One important point to bear in mind is that new hires do not become members until after they pass a six-month "waiting period". In OPSRP, they automatically get service credit for that waiting period time. As a result, when a new member is reported to us for the valuation, they already have between 0.5 and 1.5 years of service credit, which increases their Accrued Liability in the first valuation relative to if they did not receive credit for this waiting time period."

Since the demographic assumptions play a larger role in managing the UAL in OPSRP, we recommend that the new entrant assumption be established. New entrants are a continuing source of loss and, based on the comments from the retained actuary, are a source of loss that is expected to continue.

Retiree Medical Benefits - RHIA/RHIPA

Retiree Medical plans move to a surplus position over the decade

The retiree medical plan makes up a much smaller component of the total Oregon liabilities. The unfunded accrued liability at December 31, 2007 was $264.3 million. As of December 31, 2017 the combined RHIA and RHIPA had a **surplus** of $76.2 million. *(Page 59 of the 12/31/2017 Actuarial Valuation; RHIA has a surplus of $115.7 while RHIPA has an unfunded accrued liability of $39.5)* Over the decade contributions covered more than the current interest and expenses; there were plan changes that decreased the liabilities; assumption changes which increased liabilities and actual positive experience (which decreased the liabilities). Overall, the largest contributor to the positive result was the contributions.

RHIA and RHIPAChange in UAL Components

Component	Value
Contributions in (excess) of normal cost, expenses and interest	-$223
Liability (gain) or loss	-$183
Asset (gain) or loss	$20
Assumption/Plan changes	$45
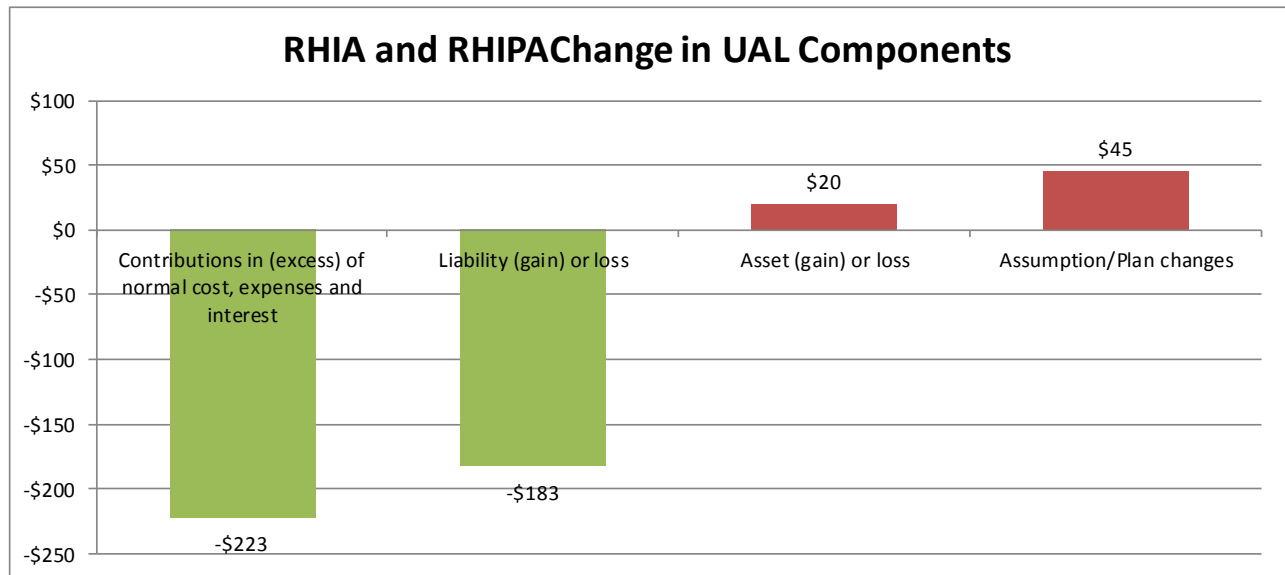
RHIA and RHIPA Item	Ten Year Cumulative Total
Unfunded Accrued Liability January 1, 2008	**$264.3**
Contributions in (excess) of normal cost, expenses and interest	-$222.7
Liability (gain) or loss	-$183.0
Asset (gain) or loss	$20.3
Assumption/Plan changes	$45.1
Unfunded Accrued Liability December 31, 2017	**-$76.2**

The contributions in excess of normal cost, expenses and interest are the portion of the contributions used to pay off the unfunded accrued liability. The amount of -$222.7 indicates the unfunded accrued liability was decreased by that amount. The assumption changes over the decade increased the unfunded accrued liability by $45.1 million, and the actual experience of all the demographic assumptions decreased the plan liabilities by $183.0 million.

Over the decade, actual asset losses (assets performing below the actuarially assumed rate) added $20.3 million to the unfunded accrued liability.

Contributions and conservative assumptions biggest driver in moving to surplus

The retiree medical plan is facing pressures similar to the pension plans; members are living longer, investment returns are not meeting expectations (so the expectations are decreasing). There is no collaring of the rates in the retiree medical plan. The unfunded liability of the retiree medical plan went on a different trajectory than the pension plan. The retiree medical plans started with an unfunded accrued liability and, a decade later, now have assets exceeding the accrued liability. Based on the data presented in the actuarial valuations, it appears this occurred primarily because the 2008 demographic assumption have turned out to be overly conservative. Actual gains on the demographic assumptions have occurred in eight of the last ten years. The reports do not break out the assumptions so it cannot be ascertained which assumptions are creating the largest gains in the plan. The experience study review will look more closely at the retiree medical plan to see whether those assumptions are detailed more fully.

SECTION IV

EXPERIENCE STUDY, ASSUMPTIONS, MODELING, DATA AND ASSETS

Experience Study, Assumptions, Modeling, Data and Assets

This is a review of the 2016 experience study, released July 26, 2017 by Milliman. This review is intended to fulfill the scope of services described under Exhibit A, Statement of Work, B. REQUIRED SERVICES, DELIVERABLES AND DELIVERY SCHEDULE, Subsection (A) Actuarial methods used; (B) Demographic and economic assumptions used; and (G) Assumed rate of return and discount rate used, which should be compared with both historical plan returns and the range of projected future scenarios from an asset/liability study. This report will look at the experience study report which reviews and recommends the actuarial methods, demographic and economic assumptions and the assumed rate of return and discount rate.

Actuarial Methods (Scope of Work Section A)

The primary actuarial methods employed include the actuarial cost method, the amortization of the unfunded accrued liability method and the rate collar.

We believe these primary actuarial methods produce valuation results that are not unreasonable. However, in the application of certain assumptions with these methods that may introduce funding risk to the plan.

We concur with the use of the entry age normal cost allocation method.

Concern exists over assuming higher future amortization payments and an unfunded lag period

In the method for amortizing the unfunded accrued liability (UAL) and developing those UAL payments we have a couple of concerns. These concerns are (1) the assumed growth rate in future amortization payments is too high (which lowers current required payments) and (2) there is a lag between the new rates and their implementation.

The payroll growth assumption serves as a proxy for growth in future amortization payments. Assuming higher payments in the future lowers the current year payment. While the method of developing the unfunded accrued liability amortization payments over an increasing payroll is a fairly standard actuarial practice, we are concerned that the payroll growth assumption of 3.5% is too high. Assuming that payroll growth is too high is the same as assuming higher future payments on the unfunded accrued liability, thereby artificially lowering the amortization payments required today.

We are also concerned that there is a timing lag between the development of the rate to fund the UAL (the "rate setting valuation") and the actual implementation of the rate. There does not appear to be any recognition of lost interest on that lag period for the lagged UAL payment.

Review of Demographic Assumptions (Scope of Work Section B)

History of demographic assumption performance

With each valuation an analysis of the gain (or loss) on the liabilities is performed on each significant actuarial assumption. In looking at the history of that assumption's performance we can get an idea of the changes that we would expect to see in the upcoming experience study.

The experience study covered the four year period 1/1/2013 through 12/31/2016. An excerpt of the assumption analysis performance for the period is shown below:

Tier 1/ Tier 2 Pension Analysis of Changes in the Actuarial Accrued Liability (Gain)/Loss					
	Cumulative for study period	2016	2015	2014	2013
Deviations from Expected Experience					
Retirements from Active Status	$95.60	-$59.60	$70.50	-$12.70	$97.40
Disability retirements	-$21.50	-$7.30	-$5.00	-$5.60	-$3.60
Active mortality and withdrawal	$166.10	$65.70	$25.30	$40.90	$34.20
Pay increases	$23.00	-$36.60	$48.30	$37.30	-$26.00
Interest crediting experience	$58.30	$5.40	-$53.50	-$18.60	$125.00
Inactive mortality	$356.30	$8.30	$114.60	$147.50	$85.90
Data corrections	$105.60	$25.60	$23.40	$37.40	$19.20
Other	-$54.00	-$33.40	$19.00	-$2.70	-$36.90
Total demographic (gains) and losses	$729.40	-$31.90	$242.60	$223.50	$295.20
New Entrants	$1.20	$0.50		$0.70	

We are looking for assumptions which are trending in one direction (they are said to have a bias) and which have an impact on the accrued liability. The yellow highlighted categories are those which present with a persistent bias. Based on the above chart we would expect to see a change on the inactive mortality/withdrawal assumption, the active mortality and withdrawal assumption, and data corrections.

In looking at the experience study we see the following recommended changes to the demographic assumptions:

- Mortality assumption (adjust for longer life expectancy)
- Retirement rate adjustments (to match experience)
- Withdrawal assumption (pre-retirement termination, lowering the rates of withdrawal generally)
- Lower disability rates

We would expect these recommendations. For example, the inactive mortality cumulative effect was a loss in every year and a total loss for the four year period of $356.30. A loss on mortality means members are living longer than expected. Thus we would expect to see the mortality assumption change to assuming members are living longer (which is does).

For withdrawal (termination prior to retirement) we see losses every year. A loss on withdrawal means people are staying longer and not leaving employment as much as assumed. Thus we would expect the assumption to change such that the rates of termination decrease. This does match what Milliman's experience study recommends.

We did not see a recommendation on data corrections as an assumption. This merits further explanation to determine whether data corrections can be expected each year and the extent to which the liability changes as a result of these corrections. Based on the analysis in the valuation reports there are data corrections every year that do create an additional liability to be funded.

The new assumptions are still a little off (but only shown for one year)

The yellow highlighted categories on the chart below show the 2017 contribution to the unfunded accrued liability for experience not meeting assumptions. Since it is just one year it could be an anomalous event. However, the data correction is a large and a contributor to the unfunded accrued liability. We recommend a discussion on planning and funding for these data corrections as they appear every year.

Tier 1/ Tier 2 Pension Analysis of Changes in the Actuarial Accrued Liability (Gain)/Loss 2017 analysis under the new assumptions					
	2017	**2016**	**2015**	**2014**	**2013**
Deviations from Expected Experience					
Retirements from Active Status	$146.80	-$59.60	$70.50	-$12.70	$97.40
Disability retirements	-$1.80	-$7.30	-$5.00	-$5.60	-$3.60
Active mortality and withdrawal	$12.50	$65.70	$25.30	$40.90	$34.20
Pay increases	$70.70	-$36.60	$48.30	$37.30	-$26.00
Interest crediting experience	$95.70	$5.40	-$53.50	-$18.60	$125.00
Inactive mortality	$18.60	$8.30	$114.60	$147.50	$85.90
Data corrections	$273.00	$25.60	$23.40	$37.40	$19.20
Other	$24.10	-$33.40	$19.00	-$2.70	-$36.90
Total demographic (gains) and losses	$639.60	-$31.90	$242.60	$223.50	$295.20
New Entrants	$1.20	$0.50		$0.70	

New Public Mortality Tables

Since the 2016 experience study was published, the Society of Actuaries has recently published a new set of mortality tables for U.S. public pension plans. These tables generally show longer life expectancy than the RP-2014 tables. It's our understanding that these tables were recommended by Milliman in the most recent 2018 experience study.

Healthcare cost trend

We recommend Milliman provide additional detail and clarification on the development of the healthcare cost trend rates be communicated in the experience study. They should disclose the underlying assumptions used, such as the model and inflation, as well as any modifications being made. They should also justify these assumptions and provide additional details on how the excise tax is being modeled in the trend rates.

Review of the Rate of Return Assumption

The investment return assumption is one of the principle assumptions used in any actuarial valuation of a retirement plan. It is used to discount future expected benefit payments to the valuation date in order to determine the liabilities of the plans. Even a small change to this assumption can produce significant changes to the liabilities and contribution rates. Currently, it is assumed that future investment returns will average 7.20% per year, net of investment expenses. The current assumption assumes inflation of 2.50% per annum and an annual real rate of return of 4.70%, net of expenses.

Comparison to Peers

The Plan exists within a peer group who all undertake this same exercise of setting their long-term investment return assumption. The following chart shows the distribution of the investment return assumptions in the Public Plans Data as of 2018.

Public Fund Data - Investment Retun Assumption
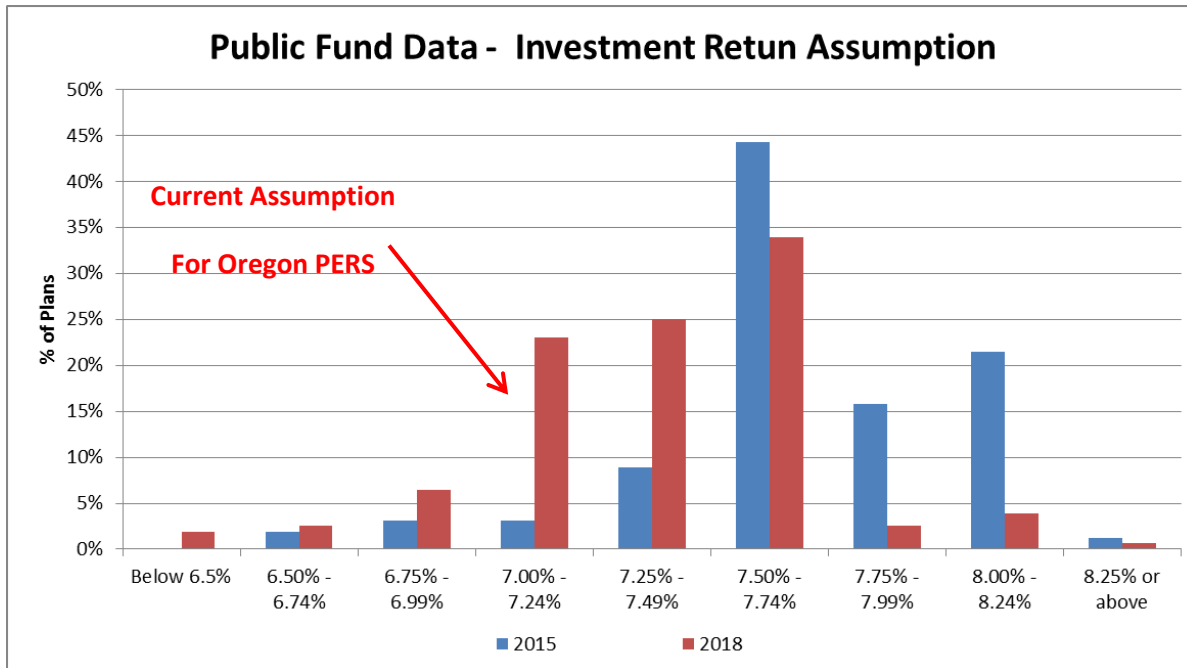
Source: 2018 Public Plans Database (n=156), with known adjustments after 2018. Median investment return assumption: 7.25% nominal return.

We have included the same information from the 2015 survey to show the national trends in this assumption. The median rate of return is 7.50% and the average is 7.58%.

Asset Allocation

The most appropriate approach to selecting an investment return assumption is to identify expected returns given the funds' asset allocation mapped to forward-looking capital market assumptions. Below is a summary of the asset allocation that was used in the analysis for Oregon PERS based on the State of Investment Objectives and Policy Framework.

Asset Class	Target Allocation
Public Equity	37.50%
Private Equity	17.50%
Fixed Income	20.00%
Real Estate	12.50%
Alternatives	12.50%
Total	**100.00%**

GRS maintains survey information on a number of investment consultants. For this analysis, the following firms were used: Aon Hewitt, Blackrock, BNY Mellon, Callan, Cambridge, JPMorgan, Marquette Associates, Meketa, Mercer, NEPC, RVK, Verus, Voya and Wilshire. We believe the benefit of performing this analysis

A Review of the Oregon Public Employees Retirement System (PERS)

using multiple investment advising firms is to recognize the uncertain nature of the items affecting the selection of the investment return assumption.

While there may be differences in asset classes, investment horizons, inflation assumptions, treatment of investment expenses, excess manager performance (i.e., alpha), etc., we have attempted to align the various assumption sets from the different investment advisors to be as consistent as possible.

Arithmetic Return (Mean 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)	Standard Deviation of Expected Return (1-Year)
(1)	(2)	(3)	(4)	(5)	(6)	(9)
1	5.22%	2.20%	3.02%	2.50%	5.52%	10.71%
2	6.95%	2.50%	4.45%	2.50%	6.95%	12.70%
3	6.52%	2.20%	4.32%	2.50%	6.82%	9.90%
4	7.31%	2.50%	4.81%	2.50%	7.31%	12.58%
5	6.78%	2.00%	4.78%	2.50%	7.28%	10.87%
6	7.64%	2.26%	5.38%	2.50%	7.88%	14.10%
7	7.50%	2.25%	5.25%	2.50%	7.75%	12.69%
8	7.56%	2.21%	5.35%	2.50%	7.85%	12.93%
9	7.66%	2.31%	5.36%	2.50%	7.86%	11.61%
10	7.53%	2.00%	5.53%	2.50%	8.03%	12.16%
11	8.43%	2.30%	6.13%	2.50%	8.63%	12.25%
12	8.34%	2.15%	6.19%	2.50%	8.69%	12.81%
13	8.05%	2.00%	6.05%	2.50%	8.55%	9.67%
14	8.11%	1.70%	6.41%	2.50%	8.91%	13.12%
Average	**7.40%**	**2.18%**	**5.22%**	**2.50%**	**7.72%**	**12.01%**

Based on averages from these surveyed institutions, the expected return for one year would be 7.72%. This expected return is based on an inflation assumption of 2.50% and an expected real return of 5.22%.

However, the above model does not yet account for the expected higher portfolio volatility. Higher volatility reduces returns, so the next analysis will look at the expectations, given the assumed levels of volatility, for Oregon PERS asset allocation.

Geometric Return (Median Return)

Given the plan's current asset allocation and the investment consultant's capital market assumptions, the development of the average compound nominal return, net of investment and administrative expenses, is provided in the following table. The table provides the 40th, 50th, and 60th percentiles of the 20-year geometric average of the expected nominal return, net of expenses, as well as the probability of exceeding the current 7.2% assumption, as well as 7.00% and 6.75% assumptions.

Expected Annual Geometric Returns and Return Probabilities
(Based on 20-Year Capital Market Assumptions)

| Investment Consultant | Distribution of 20-Year Average Geometric Net Nominal Return | | | Probability of exceeding 7.20% | Probability of exceeding 7.00% | Probability of exceeding 6.75% |
	40th	50th	60th			
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	4.38%	4.98%	5.59%	17.82%	20.06%	23.08%
2	5.49%	6.20%	6.92%	36.17%	38.85%	42.28%
3	5.81%	6.37%	6.93%	35.32%	38.73%	43.12%
4	5.88%	6.58%	7.29%	41.28%	44.08%	47.63%
5	6.12%	6.73%	7.34%	42.27%	45.53%	49.65%
6	6.19%	6.97%	7.76%	47.08%	49.63%	52.84%
7	6.30%	7.01%	7.73%	47.36%	50.20%	53.75%
8	6.36%	7.08%	7.81%	48.36%	51.15%	54.63%
9	6.59%	7.24%	7.89%	50.59%	53.69%	57.54%
10	6.67%	7.35%	8.03%	52.19%	55.15%	58.81%
11	7.26%	7.94%	8.63%	60.85%	63.67%	67.10%
12	7.23%	7.95%	8.67%	60.42%	63.13%	66.44%
13	7.58%	8.13%	8.67%	66.75%	70.09%	74.04%
14	7.40%	8.13%	8.87%	62.61%	65.22%	68.38%
Average	**6.38%**	**7.05%**	**7.72%**	**47.79%**	**50.66%**	**54.23%**

The capital market assumptions provided by the investment consultants and used in the analysis above are based on 7 to 10 year investment horizon. Investment consultants develop their forecast assumptions with this time horizon in part because most pension investment management teams use this time period for developing and monitoring their investment strategies.

The investment return assumption used in the actuarial valuation has a much longer investment horizon. Therefore, it may be necessary to identify and reflect differences in the economy and financial markets over the short-term and long-term time horizon.

Rate of Return Summary
We would recommend a rate that is between the mean return of 7.72% and the median return of 7.05%. The closer the assumption is to the median return, the higher the likelihood of achieving the rate. For example, the likelihood of achieving a return of 7.20% is 47.8% while the likelihood of achieving a return of 6.75%, which is closer to the median return, is 54.2%.

Based on this entire analysis, the current return of 7.20% is considered reasonable. However, based on Milliman's analysis, a lower rate may be more appropriate. But, it is our understanding that Oregon PERS relies more heavily on the recommendations of the Oregon Investment Council and that recommendation more than supported the current discount rate.

Review of the Payroll Growth Assumption

Lower than assumed growth in total payroll means fewer contributions

Every other year, contribution rates are developed that are assessed as a percent of payroll. These rates are intended to cover the annual cost accrual (normal cost) and the payment on the unfunded accrued liability. When payroll is lower than expected fewer contributions come into the plan than expected.

Plan costs come in two main pieces-the unfunded liability payment and the normal cost payment. If payroll is lower, normal cost is not so much affected since the normal cost in a final pay plan is a function of payroll. However, this is not true for the amortization payment. The bulk of the unfunded accrued liability (and related amortization payment) is based on benefits already in pay status. These benefits will not fluctuate with changing payroll. This portion of the plan's total cost is a fixed dollar amount, and a decline in payroll will short the plan by that amount.

The assumed growth in payroll appears high

The payroll growth assumption is high relative to its own history. We believe it is also high relative to peers and our experience with other clients.

The following chart shows the historical payroll growth rates by rate pool.
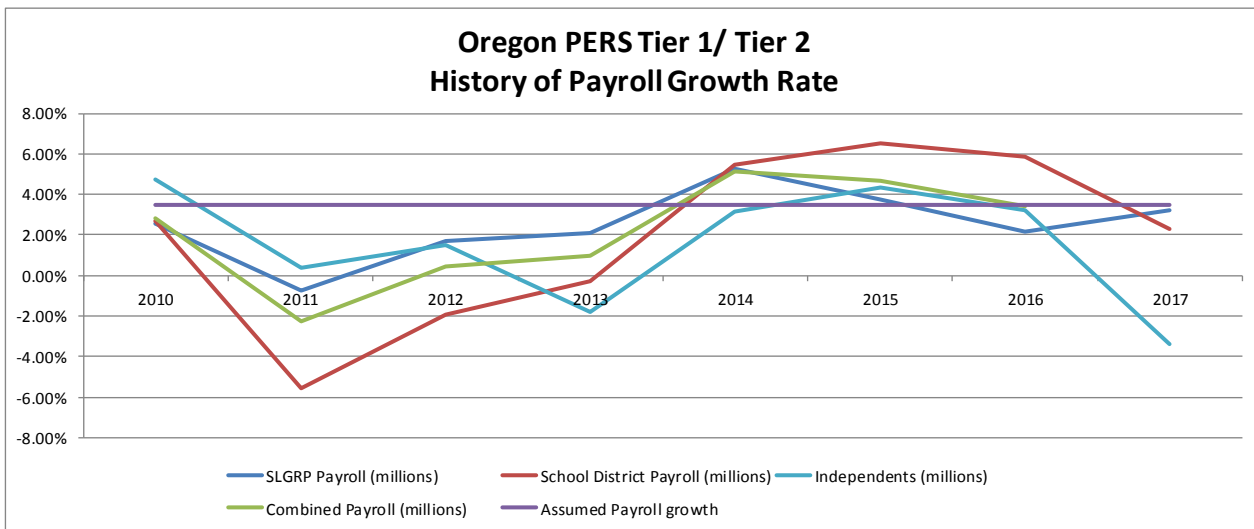
Average Payroll Growth for nine year period	
SLGRP Payroll (millions)	2.47%
School District Payroll (millions)	1.80%
Independents (millions)	1.48%
Combined Payroll (millions)	2.16%

Payroll growth is not meeting the 3.5% assumed rate of growth. In fact, only three times in the last nine years has total payroll growth met or exceeded the assumption. If this pattern continues, the plan will not receive the actuarially determined contributions and this will contribute to the growth in the unfunded accrued liability.

Recommendations regarding assumptions-rate of return; payroll growth

We recommend a continued discussion on the assumed rate of return. Milliman's work shows a long term expectation of 6.7%. Future consideration should be given to lowering the investment rate of return assumption to remove some risk from the Plan.

We recommend discussing the payroll growth assumption and considering lowering the rate in future valuations.

Asset liability modeling

The scope of work references asset liability modeling in a number of different places. This report will examine the asset liability (financial modeling) performed by Milliman and relate those results to the statement of work requested in Section A.

We found the asset/liability modeling performed does meet the requirements in the Statement of Work. The modeling incorporates the three main financial drivers, looks at a wide range of future conditions and portrays the contribution requirements for the employers and the health of the plan.

The model does not indicate that any assumptions are unreasonable, but it also cannot comment on any acceptable level of risk tolerance. This is because the risk of underperforming resides with the employers as the underperformance will be assessed through their contribution rate. The model shows a variety of scenarios and the potential changes to the contribution rate, but it cannot show what the level of tolerance is for an employer's contribution rate for the future. To fully understand the risk tolerance, the tolerance of an employer base contribution rate amount would need to be assessed.

Milliman has performed number asset liability studies. Milliman refers to these as "Financial Modeling" and this report will adopt that same language in order to maintain consistency in the naming of the work products.

Financial Modeling – General Comments

The purpose of the financial modeling is to integrate the multiple moving parts in a pension system (assets, liabilities, contribution, benefit payments, expenses etc.) and test potential outcomes under many different scenarios. For Oregon, the financial modeling will determine whether the system is headed to full funding and whether the contributions and earnings are enough to support the objectives of Oregon PERS.

The financial modeling is the process used to manage the financial objectives of Oregon PERS through an assessment of assets and liabilities in an integrated manner.

The financial model for Oregon PERS also quantifies the possible financial impacts on the employers due to transition liabilities, side fund amortization and the rate collaring policies.

The financial modeling shows potential outcomes for different rates of return. These different rates of return may be a product of different investment strategies or various market outcomes.

Ideally, the financial modeling will permit Oregon PERS to coordinate investments with plan liabilities in order to meet the financial objectives. This strategy generally involves reducing risk while maximizing investment return. Volatility management also plays a key role in Oregon PERS since variance in the funded ratios can change the size of the contribution rate collar.

Financial models typically help to assess three key areas: Return, duration and risk. For Oregon PERS these three areas have been described in the objectives as:

Return (Performance target)	Actuarial Soundness- a policy that will fully fund the system if assumptions are met
Duration	Plan should achieve full funding under the models in twenty years (the amortization period for the unfunded accrued liability)
Risk	Predictable and stable employer contribution rates and protection of the plan's funded status to enhance members' benefit security

Financial Modeling studies

In December of 2017 and December of 2018 Milliman conducted financial modeling under a variety of assumptions.

The financial model looked at both a "constant" future year rate of return (no variability) and a variable rate of return for each year. The model uses a Monte Carlo simulation and 10,000 trials to illustrate a confidence interval around the future employer contribution rates, funded ratios and the unfunded accrued liability. The Monte Carlo simulation was also used to estimate the probability of certain "stress" events occurring within the next 20 years.

The model uses the new assumptions from the 2016 experience study, including the 7.20% rate of return/discount rate. The model also employs the rate collar.

Investment Policy, Funding Policy and Benefit Policy

The model incorporates all three primary drivers simultaneously in order to provide a long term perspective on the actuarial health of the plan. In doing so, the current benefit policy is held constant and the funding policy, with its anticipated changes in contribution rates pursuant to the rate collar, is fully implemented. The investment policy, to the extent it is reflected in the long term rates of return, is modeled under a number of different scenarios.

The financial model did perform a modest variance on the funding policy. Using the "constant" return model, the future health of the plan was modeled assuming there would be no rate increases after the 2017-2019 biennium increase. If the base contribution rates for 2017-2019 are head steady, and the fund earns 7.2% per year thereafter, the funded ratio at the end of 20 years would decline to 63%. If base contribution rates for 2019-2021 are held steady, and the rate of return is 7.2% per year, the funded ratio increases to 83% over the 20 year period.

However, if the fund only earns 6.7% then the 2017-2019 rate freeze leads to a 20 year funded ratio of 56% and the 2019-2021 rate freeze leads to a 71% funded ratio.

Conclusions of the financial model

If the assumed 7.2% rate of return is met, then over the next 20 years the employer rates can be expected to increase from 20.8% in 2017-2019, to 25.2% in 2019-2021 and then up to 31.2% in 2021-2023. The average rate would remain in the low 30%'s until 2035-2037, at which point the rates start to decline as the unfunded accrued liability is paid off. This contribution pattern and the rate of return of 7.2% would lead to a funded ratio at the end of the 20 years of over 100%.

Continued concern on the assumed rate of return

However, one concern with the model is that Milliman, in the "Valuations Method & Assumptions" report presented on July 28, 2017, indicated their findings that the 20-year annualized geometric median is 6.7%. In that case, the employer rates progress very similarly to those under the above 7.2% example, expect the rates remain about 1-2% higher in all years after 2023-2025. The funded ratio would not be 100% after 20 years (but close-at about 98%).

Can the employers keep absorbing rate increases?

Risk tolerance is best demonstrated through the employer contribution rates, since the risk for paying the unfunded accrued liability resides with the employers. The model cannot predict what level of contribution rate an employer can manage; but it can predict the increases and length of time for which the contributions will remain at their level.

The model also predicts a "stress" or shock that could occur in the contribution rates. The Monte Carlo simulation asked "What is the likelihood that the employer base rate (excluding retiree healthcare) would exceed 30% of pay?" The answer is 86%. Employers should expect that sometime over the next 20 years their base rate including the collar (excluding retiree healthcare) will exceed 30% of pay. The probability that the rate will pop up to over 40% of pay in the next 20 years is 51%. On the other hand, the probability that the rate will fall below 10% sometime in the next 20 years is 41%. (This would occur after the unfunded accrued liability is paid off, and the contribution requirement is normal cost only).

Are these models enough for assessing risk?

These financial models show, on an aggregate basis, the future funding condition of the plan. But can an individual employer look at the model and determine whether the plan is affordable in the long term? With the concern over assumptions being on the optimistic side, the impact of rate collaring and the unfunded lag period, the growth in the interest on the unfunded accrued liability; it appears that employer rate increases may be in store for a very long time. When viewing the actuarial condition in the aggregate combined with projections based on optimistic assumptions, it is entirely possible that the financial reality an employer faces is obscured.

Census Data

ASOP 23 provides the actuary guidance on the use of census data. Milliman has indicated the data was supplied by PERS and Milliman is relying upon their data.

ASOP 23 Section 3.5 Reliance on Data Supplied by Others—in most situations, the data are provided to the actuary by others. The accuracy and completeness of data supplied by others are the responsibility of those who supply the data. The actuary may rely on data supplied by others, subject to the guidance in sections 3.3 and 3.4, unless it is or becomes apparent to the actuary in the course of the assignment that the data are unsuitable for use in the actuary's analysis. However, if an actuary is required by a regulator

or other governmental authority to use data that the actuary considers unsuitable for use in the actuary's analysis, the actuary may use the data subject to the disclosure requirements of section 4. The actuary should disclose reliance on data supplied by others in an appropriate actuarial communication, as described in section 4.

Milliman discloses in their cover letter that they relied," *without audit on information (some oral and some in writing) supplied by the System's staff. This information includes, but is not limited to, System benefit provisions as defined by statute, member census data, and financial information. We found this information to be reasonably consistent and comparable with information used for other purposes. The valuation results depend on the integrity of this information. If any of this information is inaccurate or incomplete our results may be different and our calculations may need to be revised".*

This level of review of the census data is in compliance with actuarial standards. Further, Milliman supplies a number of exhibits on the participant data (see the valuation section Data Exhibits) which details census data by membership category and tier. Milliman also provides a prior year to current year illustration of the data counts-which allows for an additional review of the reasonableness of the census data. We verified that the exhibits are consistent, reasonable, and complete.

Additionally, for each tier Milliman provides an age-service distribution with covered payroll for active members, which can provide another level of reasonableness check on the data. These age service distributions are divided into Tier 1, Tier 2, ; Tier 1 Police and Fire, Tier 2 Police and Fire, the SLGRP membership as well as the independent employers membership and OPSRP General and Police/Fire. The active age service distributions allow the reader to look at the data at the granular level of age combined with years of service, and adds another opportunity for a review of the reasonableness of the data. One suggestion we would make with regards to these distributions is that Milliman not disclose the covered payroll for any categories where there are fewer than 5 members included. This helps protect the personal information of these members.

Milliman also provides additional detail on the census data for the inactive members, for both terminated vested members and the retirees and beneficiaries. Counts and average monthly benefits are shown by age for tier 1/tier 2, OPSRP, and in total. This helps assist the reader in understanding the distribution of benefits and adds another review for reasonableness.

Milliman has made no disclosures (as required under the actuarial standards of practice) regarding significant concerns with the data; alterations or corrections made to the data. We recommend that if Milliman does have any concerns with the data or makes any assumptions and adjustments for the valuation that they disclose this information.

If there is interest in reviewing the reasonableness of data further, Milliman could look at the feasibility of providing a status reconciliation matrix. This type of exhibit starts with members, by status code, at the beginning of the year, and traces each member's movement to the end of the year, ending with the membership listed by status code at year end. A status reconciliation such as this can provide the reader with useful information, such as how many members retired or died over the time-period between valuations. It could also help isolate any members that are unexpectedly showing up or any large data corrections, such as those shown in the gain/loss analysis. We cannot comment on the feasibility of creating the matrix for Oregon, since we do not have the full details of the underlying data. We are not recommending this as a requirement, only suggesting it as an additional layer of data review should that be desired.

In conclusion, based on our reading of the December 31, 2017 actuarial valuation, we believe that appropriate reasonableness checks have been applied to the census data.

Valuation Assets

The valuation uses the market value of assets. This is an acceptable method for use in pension valuations.

We reviewed the assets used in the valuation to be sure the assets reconcile to the market value of assets.

We found that Milliman provides ample exhibits which tie the market value of assets to the asset value used in the valuation report.

First, Milliman illustrates the System-Wide Assets (which, according to the actuarial standards of practice, they are permitted to accept without audit). The total market value of assets reported by PERS is $69,316.4 million.   This total amount of assets is shared between the Tier 1/Tier 2; OPSRP, Side Accounts, Contingency Reserve, Capital Preservation Reserve, Rate Guarantee Reserve, RHIA, and RHIPA. Next, Milliman takes this market value and adjusts it by a transition liability receivable and the Net Pre-SLGRP liabilities for the end of year Actuarial Value of Assets.

Next, we noted the reconciliation from beginning of year to end of year for each of these categories totals to the market value system total of $69,316.4 million.

Side accounts are also part of the assets. Milliman also provides a reconciliation of the side accounts from the beginning of the year to the end of the year. We did verify that the system total for the side accounts matches side account shown in total for the System-Wide assets.

Thus we conclude that the assets used by Milliman reconcile to the market value of assets provided by PERS.

SECTION V

FUNDING POLICY AND RATE COLLARING

Funding Policy and Rate Collaring

When looking at the attribution analysis earlier in this report it has become apparent that contributions are insufficient to pay off the unfunded accrued liability. Absent future rate increases, to pay off the unfunded accrued liability the uncollared rates would need to be contributed. This observation leads to the question of whether there is a structural deficiency in the funding policy which creates these insufficient contributions.

The written portions of the funding policy have the goal to fully fund the plan. However, the data shows that the combined impact of the funding policy (with rate collaring) and underperforming assumptions is to create the growth of the unfunded accrued liability.

Setting rates

Rate setting policy supports Oregon PERS broader policy objectives for the funding of the system. These policies include paying off the unfunded accrued liability in a fixed time period (intergenerational equity). For rates to be adequate they need to appropriately measure the future benefit payments using the most reasonable assumptions and methods.

Current rate setting process

Oregon PERS operates under a two year rate setting cycle. Rates are adjusted every "odd" year, and those rates are in-force for two years. Thus there is an 18 month lag between the valuation date and the beginning of the new rate cycle, and a 42 month lag between the valuation date and the end of the new rate cycle. It is 30 months between the valuation date and the midpoint of the new rate cycle.

Normal Cost charged on its own payroll

The normal cost is charged only to its applicable payroll (i.e. OPSRP general service normal cost rate is only paid on OPSRP general service payroll).

Unfunded Accrued Liability payments charged over entire pool payroll

The unfunded accrued liability is charged over its entire pool (i.e. Tier 1/Tier 2 UAL rate for School District rate pool is charged on the entire school district payroll.

Rate collar calculated on base rate; but applied to the UAL rate

Rate increases (before side account rate relief or any transition liability) cannot exceed the greater of 20% of the current rate or 3% of payroll. This has the two-fold effect of dampening the rate increase on employers and pushing those delayed increases into the next biennium. Based on the financial modelling this is not projected to alter the payment schedule for the UAL, it is only spreading employer costs over a longer period (when compared to uncollared employer contribution rates.) As can be seen earlier in this report, the rate collar does create an increase to the unfunded accrued liability. This is due to the fact that the unfunded accrued liability increases by the amount of "missed" gross actuarially determined contributions (uncollared rates).

The amount of the collar is determined as the greater of 20% of the base rate or 3% of payroll. (There is a gradation based on funded ratios less than 70%). However, the collar is applied only to the UAL rate.

Unfunded Accrued Liability (UAL) Amortization Policy

To pay off the unfunded accrued liability, Oregon PERS uses a 20 year period for the Tier 1/Tier 2 UAL's and a 16 year period for the OPSRP UALs. These periods, when combined with the assumed earnings rate of 7.20% and growth in payroll of 3.5% are expected to pay off a portion of the principal balance each year. The policy for the UAL amortization meets the overarching principle of intergenerational equity. However, the rate collaring and offsets will have an effect on the actual amount of unfunded accrued liability paid off each year; the balances of unfunded accrued liability need to be monitored individually to determine the extent of adherence to the "pay off principal each year " implied policy. Based on the overall review of the System, this policy of paying off principal on the unfunded accrued liability is not being achieved.

In summary, the written policy for the collared base rates will lead to the policy objectives for funding the plan; but along the way the individual employer effects of collaring and offsets may cause some variances away from a policy of paying off the unfunded accrued liability. Ultimately, meeting the funding objective will depend on the employers' ability to absorb all rate increases over time.

As with all rate-based funding, the amount of contributions coming into the plan is a function of payroll. There can be a mis-match between the unfunded accrued liability (which is more of a fixed-dollar liability) and the normal cost contribution rate. This is because a large portion of the UAL is for members already in pay status-their UAL no longer is a function of payroll, but has become a fixed dollar amount. In times when payroll does not grow as expected there will be greater pressure on contribution rates since a same dollar amount needs to be funded over a smaller payroll.

In conclusion, the rates and funding of the Oregon PERS can become very sensitive to the changes in total payroll. Payroll growth is a critical assumption in the management of contribution rate volatility.

Summary

We recommend a single written funding policy document that incorporates the entire rate setting policy, including the rate collaring.

We also recommend ongoing annual monitoring of the UAL bases to see that the funding policy in practice is paying off a piece of the principal balance each year.

Oregon PERS may wish to discuss with their retained actuary whether a funding policy of a fixed dollar amount for paying off the unfunded accrued liability would be more appropriate.

We recommend re-examination of the assumed growth in payroll. This is a risky assumption because when payroll doesn't grow as expected, then contributions do not come into the trust as expected, and there is continued growth in the unfunded accrued liability.

Concerns on interaction of methods with the payroll growth assumption

Concerns rest not on the policy or rate collaring by themselves, but on the underlying assumptions used for the application of these policies and the interaction of the assumptions with the policies and practices. In particular we are concerned about the assumption for the rate of growth in payroll (which is a proxy for the assumed rate of growth in the unfunded accrued liability payment). As expressed in the experience study review, concern exists over the 3.5% payroll growth assumption.

This concern translates to an overall concern that the unfunded accrued liability rate may be too low and not enough payroll will exist in the future to support bringing in the required contributions.

SECTION VI

VALUATION REVIEW

Valuation Review

Background

We reviewed sample test cases used for the December 31, 2017 valuation report. In order to perform the review, we requested a number of sample cases from Milliman. We combined this with the methods, assumptions, and plan provisions in Milliman's report and reviewed the liability values produced by Milliman for these sample cases only.

We received eleven sample test cases this year for the following sample members:

- Tier 1/Tier 2:

    o Two active members with pension benefits – one school district member and one police & fire member

    o Two active members with RHIA benefits – one general service member and one police & fire member

    o One school district inactive vested member with pension and RHIA benefits

    o One school district retiree with pension benefits

    o One police & fire retiree with RHIA benefits

- OPSRP Members:

    o Two active members with pension benefits - one school district member and one police & fire member

    o One police & fire inactive vested member with pension benefits

    o One general service retiree with pension benefits

Note that the active test lives analyzed are not necessarily exposed to all of the possible benefits under the plans (i.e. already beyond the eligibility period for certain benefits, or not eligible for particular benefits). Therefore, findings may occur for these other benefits in future audits depending on the set of test lives chosen for review at that time. However, the vast majority of the liability for each plan is due to the retirement benefits (included for all active test lives), and retirement-related withdrawal benefits, so any future findings are also expected to be de minimus. Also, the impact for any one test life may not be representative of the impact on the total plan.

In order to review Milliman's liabilities and confirm they are valuing all benefits correctly, we separately calculated the present value of benefits for each of the test cases provided, using Milliman's methods, assumptions, and plan provisions listed in their report.

When employing Milliman's methods, assumptions, and plan provisions listed in the report, we matched the present value of benefits in total closely for the test cases submitted. In matching the present value of benefits, it is being determined that all benefits are being valued, and that the valuation of the liability for those benefits is mostly consistent with the stated assumptions and methods.

Quantitative Results

First we calculated our own independent liabilities for each sample life provided using only the methods, assumptions, and plan provisions Milliman listed in their December 31, 2017 actuarial valuation report. We would expect to closely match Milliman's liabilities, but differences between actuarial firms will always occur due to system differences and other nuances in the calculations.

As shown in the chart below, we were able to match the total present value of future benefits for all test cases to within a reasonable range.

Actuarial Review - December 31, 2017
Comparison of Present Value of Benefits

Active		Milliman	GRS	% Diff
Active	School Distirct OPSRP Pension	50,975	50,554	-0.8%
Active	General Service Tier 1 Pension	2,029,108	2,079,878	2.5%
Active	General Service Tier 1 RHIA	500	513	2.6%
Active	Police & Fire OPSRP Pension	257,633	260,436	1.1%
Active	Police & Fire Tier 2 Pension	303,023	307,962	1.6%
Active	Police & Fire Tier 1 RHIA	945	945	0.0%
Inactive		**Milliman**	**GRS**	**% Diff**
Vested Term	School District Tier 2 Pension	10,917	10,913	0.0%
Vested Term	School District Tier 2 RHIA	1,094	1,079	-1.4%
Vested Term	Police & Fire OPSRP Pension	9,896	9,916	0.2%
Retired	School District Tier 1 Pension	203,507	203,507	0.0%
Retired	Police & Fire Tier 1 RHIA	7,212	7,269	0.8%
Retired	General Service OPSRP Pension	73,892	73,893	0.0%

Findings

After completing our independent calculations shown in the chart above, we examined the detailed calculations Milliman provided with the sample lives and asked a few follow-up questions. We discovered some items that were not listed in the report and believe they explain a lot of the differences between our calculated liabilities and Milliman's. Had these items been listed in the methods, assumptions, and plan provisions sections of the report, we would have been able to more closely match the liabilities. In order to improve the ability of the report to communicate the methods, assumptions, and plan provisions, we recommend Milliman incorporate the enhancements listed below in the appropriate sections of any actuarial valuation reports for Oregon PERS going forward. We also discovered a few inconsistencies in Milliman's calculations and have included them in the list below.

Here is a summary of our findings:

- o Decrements and pay increase timing appear to be assumed to occur at the beginning of each year. Decrements also appear to be independent probabilities. We recommend Milliman include these assumptions in their report. Furthermore, we recommend considering a change to assume that decrements occur in the middle of the year. Assuming decrements will occur at the beginning of the year tends to understate the actual benefit members will receive, since it assumes the member will have the least possible service, the youngest attained age (or highest early reduction factor), and have the smallest accumulated contribution balance that they will have during the valuation year.

GRS Retirement Consulting

o It appears no 401(a)(17) salary or 415 benefit maximums are being applied. We recommend Milliman include this information in their report.

o It appears that 100% of members are assumed to be married and for unknown spouse ages, males are assumed to be 3 years older than females. We recommend Milliman include these assumptions in their report.

o It appears Milliman is assuming that members who elected a 100% joint & survivor option with pop-up are assumed to have had a 0.9 optional form reduction. We recommend Milliman include this assumption, along with any other optional form reductions assumed for other pop-up elections, in their report.

o For tier 1/tier 2 members, Milliman appears to stop applying disability rates starting at normal retirement age, but for OPSRP members, Milliman appears to stop applying disability rates at the age when the member is assumed to be 100% retired (age 65 for police & fire members and age 70 for all other members). We recommend Milliman either apply the disability rates consistently, or provide an explanation for why the disability rates are being applied differently and include that assumption in their report.

o We were not able to consistently match the different age and service amounts being used for salary increases, termination rates, and retirement eligibility dates. We recommend Milliman include an assumption for the age and service calculations being used for eligibility testing in their report.

o We were not able to match the actuarially equivalent early retirement factors (ERFs) Milliman is using in their calculations. We recommend Milliman include the assumptions they are using to calculate these ERFs for each group in their report.

o Milliman appears to be assuming the cost of living accumulation on the post retirement disability benefit for OPSRP members is 1.25%. We recommend Milliman include this assumption in their report.

o Milliman is calculating the liability for retirees using an average benefit that assumes cost of living adjustments will occur on August 1st, but it appears this method is not being used for active members or inactive vested members. We recommend Milliman use consistent COLA timing for all members in the valuation.

o For members who are assumed to take a partial lump sum, Milliman is subtracting a service purchase component from the employee and employer balances assumed to be paid, but this service purchase component and the assumptions used to calculate it are not listed in the report. We recommend Milliman include this information in their report.

- For police & fire members, it appears Milliman is assuming they have purchased a full eight units of additional police & fire benefits for $4,000. We recommend Milliman include this assumption in their report.

- It appears Milliman is assuming that the retiree healthcare participation rates also assume a surviving spouse is eligible for RHIA and RHIPA benefits. We recommend Milliman include this assumption in their report.

- We recommend Milliman disclose that the normal form for the tier 1/tier 2 full formula benefit is a refund annuity.

- The retirement rates developed by Milliman do not include an assumption for tier 1/tier 2 police & fire members who retire before age 50 with 25 or more years of service. Any tier 1/tier 2 police & fire members who are eligible for retirement before age 50 with 25 or more years of service are not having retirement rates or termination rates applied to them (one of the sample lives provided by Milliman fell into this category). We recommend Milliman develop and assume a retirement rate for tier 1/tier 2 police & fire members who retire before age 50 with 25 or more years of service.

- Milliman assumes that for purposes of determining eligibility for SB 656/HB 3349 benefit adjustments, 85% of retirees are assumed to remain Oregon residents after retirement. This 85% assumption is also being applied to lump sums, but we believe the assumption for lump sums should probably be 100%. We would expect all members are still living in Oregon at the time of retirement when they receive lump sums. We recommend Milliman examine this assumption for members who receive lump sums to determine its reasonableness.

Note

Ancillary or non-retirement benefits such as death and disability tend to be low probability events (and hence low liability) and they also tend to have many "bells and whistles" which can be valued in different ways by different actuaries.

SECTION VII

ACTUARIAL CONTRACT REVIEW

Actuarial Contract Review

We have reviewed the contract "Exhibit A-Statement of Work". We reviewed the valuation, experience study and selected projection studies. We found the work in these reports complies with the Statement of Work.

We have two recommendations for consideration regarding the Statement of Work.

First, for section 1.4 on actuarial audits, OPERS may wish to add a statement that the retained actuary will respond in writing to any actuarial audit findings. This could help "close the work" on the actuarial audits.

Second, we recommend OPERS consider adding a clause that sets out the orderly transition of records and services should the actuarial contract be terminated.

APPENDIX A

TIER 1/TIER 2 DATA SCHEDULES

Tier 1/ Tier 2 Data Schedules

Analysis of changes in the actuarial accrued liability

Tier 1/ Tier 2 Pension										
Analysis of Changes in the Actuarial Accrued Liability										
Actuarial Accrued Liability as of December 31,										
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Ten year total
AAL prior period	$52,668.10	$53,922.70	$56,275.00	$58,561.90	$60,212.00	$58,609.60	$60,350.30	$70,394.80	$72,454.10	$76,253.20	
Expected Change	$1,701.40	$1,885.80	$1,875.60	$1,719.60	$1,864.00	$1,445.50	$1,325.20	$1,816.70	$1,734.10	$1,527.30	
Assumption and Method changes	$284.80		$235.10		$1,785.60		$3,468.00		$2,096.40	$0.00	$7,869.90
Plan changes		$0.90			-$5,100.30		$5,027.00			$0.00	-$72.40
Deviations from Expected Experience											
Retirements from Active Status	$108.60	$149.60	$122.60	$68.90	-$45.40	$97.40	-$12.70	$70.50	-$59.60	$146.80	**$646.70**
Disability retirements				-$2.70	-$1.20	-$3.60	-$5.60	-$5.00	-$7.30	-$1.80	-$27.20
Active mortality and withdrawal	-$16.40	$38.00	$46.00	$19.40	$32.40	$34.20	$40.90	$25.30	$65.70	$12.50	**$298.00**
Pay increases	$80.00	$48.00	-$139.60	-$115.20	-$140.80	-$26.00	$37.30	$48.30	-$36.60	$70.70	-$173.90
Interest crediting experience	-$701.20	$191.30	$70.00	-$171.90	$81.30	$125.00	-$18.60	-$53.50	$5.40	$95.70	-$376.50
Inactive mortality	$69.70	$2.50	$15.50	$73.70	-$101.90	$121.10	$148.40	$114.40	$6.50	$34.60	**$484.50**
From Dormant Status	-$137.70	-$16.70	$14.10		-$27.70	-$35.20	-$0.90	$0.20	$1.80	-$15.90	-$218.00
Cola Experience				-$54.00							-$54.00
Data corrections		$12.60		-$27.70	$53.40	$19.20	$37.40	$23.40	$25.60	$273.00	**$416.90**
Other	-$134.60	$40.30	$47.50	$140.10	-$1.80	-$36.90	-$2.70	$19.00	-$33.40	$24.10	$61.60
Total demographic (gains) and losses	-$731.60	$465.60	$176.10	-$69.40	-$151.70	$295.20	$223.50	$242.60	-$31.90	$639.70	**$1,058.10**
New Entrants							$0.70		$0.50	$1.10	$2.30
AAL December 31,		$53,922.70	$56,275.00	$58,561.90	$60,212.00	$58,609.60	$60,350.30	$70,394.80	$72,454.10	$76,253.20	$78,421.30	

Analysis of changes in the assets

Tier 1/ Tier 2 Pension										
Analysis of Changes in the Assets										
Assets as of December 31,										
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Ten year total
Assets prior period	$51,394.60	$38,115.60	$42,793.40	$45,345.40	$44,102.60	$48,075.90	$52,459.90	$53,493.60	$51,976.70	$52,648.80	
Actual contributions for year	$1,134.40	$1,035.90	$873.80	$957.60	$1,133.70	$1,139.90	$1,186.30	$1,194.40	$1,218.10	$1,315.20	$1,315.20
Benefit payments and expenses for year	-$2,833.60	-$2,866.50	-$3,093.30	-$3,408.60	-$3,390.40	-$3,756.50	-$3,925.80	-$4,096.70	-$4,282.60	-$4,520.40	-$4,520.40
Assumed Investment Return	$4,043.60	$2,975.80	$3,334.70	$3,529.60	$3,437.90	$3,624.50	$3,959.50	$3,903.20	$3,783.30	$3,675.30	$3,675.30
Expected Actuarial Value of Assets before changes	$53,739.00	$39,260.80	$43,908.60	$46,424.00	$45,283.90	$49,083.80	$53,679.90	$54,494.50	$52,695.50	$53,118.90	
Change in actuarial value of assets due to assumption changes											$0.00
Expected actuarial value of assets at end of year	$53,739.00	$39,260.80	$43,908.60	$46,424.00	$45,283.90	$49,083.80	$53,679.90	$54,494.50	$52,695.50	$53,118.90	
Actuarial Valuation of Assets at end of year	$38,115.60	$42,809.50	$45,345.40	$44,103.30	$48,075.90	$52,461.80	$53,493.60	$51,984.30	$52,648.80	$57,615.60	
Asset gain/(loss)	-$15,623.40	$3,548.70	$1,436.80	-$2,320.70	$2,792.00	$3,378.00	-$186.30	-$2,510.20	-$46.70	$4,496.70	$4,496.70

Year by Year progression of the UAL

Tier 1/ Tier 2 Pension (SLGRP, School Districts and Independent Employers)										
Year by Year Progression of the Unfunded Accrued Liability										
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Unfunded Accrued Liability - January 1,	$ 1,273.6	$ 15,807.1	$ 13,481.6	$ 13,216.5	$ 16,109.4	$ 10,533.7	$ 7,890.4	$ 16,901.2	$ 20,477.4	$ 23,604.4
Normal Cost plus Admin	403.5	513.1	547.8	537.5	531.6	748.4	698.9	758.8	716.4	695.1
Interest	87.8	1,263.4	1,086.5	1,061.1	1,284.8	829.1	592.6	1,251.3	1,516.8	1,677.3
Contributions	(1,134.4)	(1,035.9)	(873.8)	(957.6)	(1,133.7)	(1,139.9)	(1,186.3)	(1,194.4)	(1,218.1)	(1,315.2)
Liability (gain) or loss	(731.6)	465.6	176.0	(69.4)	(151.7)	295.2	224.3	242.6	(31.3)	640.9
Asset (gain) or loss	15,623.4	(3,548.7)	(1,436.8)	2,320.7	(2,792.0)	(3,378.0)	186.3	2,510.3	46.8	(4,496.6)
Assumption/Plan changes	284.8	0.9	235.2	-	(3,314.7)	-	8,495.0	-	2,096.4	-
Employers joining SLGRP	-	16.1	-	0.6	-	1.9	-	7.6	-	(32.9)
Unfunded Accrued Liability - December 31,	$ 15,807.1	$ 13,481.6	$ 13,216.5	$ 16,109.4	$ 10,533.7	$ 7,890.4	$ 16,901.2	$ 20,477.4	$ 23,604.4	$ 20,773.0

APPENDIX B

OPSRP DATA SCHEDULES

OPSRP Data Schedules

Analysis of changes in the actuarial accrued liability

OPSRP Analysis of Changes in the Actuarial Accrued Liability Actuarial Accrued Liability as of December 31,	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Ten year total
AAL prior period	$203.00	$336.80	$535.50	$767.60	$986.40	$1,795.60	$2,243.30	$3,064.10	$3,742.50	$4,717.00	
Expected Change	$102.10	$145.70	$199.20	$244.00	$274.50	$388.90	$448.40	$583.90	$684.50	$808.30	$3,879.50
Assumption and Method changes	$1.30		-$17.90		$678.00		$188.70		$173.70	$0.00	$1,023.80
Plan changes		$1.60			-$143.20		$70.70			$0.00	-$70.90
Deviations from Expected Experience											
Retirements from Active Status	$1.10	$1.40	$1.50	$2.50	-$0.80	-$1.60	-$0.60	-$3.40	$3.90	$0.70	$4.70
Disability retirements										-$1.80	-$1.80
Active mortality and withdrawal	-$3.20	-$4.40	-$8.70	-$38.70	-$18.30	$5.40	$11.80	$19.70	$22.70	-$10.20	-$23.90
Pay increases	$13.20	$20.60	$18.20	-$15.40	-$16.30	$6.30	$32.90	$20.70	-$0.40	$97.70	**$177.50**
Interest crediting experience											$0.00
Inactive mortality										-$2.00	-$2.00
Data corrections										-$27.90	-$27.90
Other	-$11.70	-$4.70	-$3.60	$4.60	$3.80	-$4.90	-$5.60	-$25.00	$10.30	-$14.20	-$51.00
Total demographic (gains) and losses	-$0.60	$12.90	$7.40	-$47.00	-$31.60	$5.20	$38.50	$12.00	$36.50	$42.30	$75.60
New Entrants	$31.00	$38.50	$43.40	$21.80	$31.50	$53.60	$74.50	$82.50	$79.70	$67.10	**$523.60**
AAL December 31,	$336.80	$535.50	$767.60	$986.40	$1,795.60	$2,243.30	$3,064.10	$3,742.50	$4,716.90	$5,634.70	

Analysis of changes in the assets

OPSRP Analysis of Changes in the Assets Assets as of December 31,	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Ten Year Total
Assets prior period	$275.10	$270.50	$445.40	$659.00	$840.50	$1,190.00	$1,630.20	$2,024.60	$2,389.10	$3,021.40	
Actual contributions for year	$103.50	$110.80	$146.70	$171.70	$209.90	$229.30	$271.00	$335.70	$450.90	$571.10	$2,600.60
Benefit payments and expenses for year	-$7.20	-$7.50	-$7.70	-$10.60	-$10.80	-$12.10	-$15.40	-$19.70	-$23.30	-$30.50	-$144.80
Assumed Investment Return	$25.60	$25.50	$40.90	$59.20	$75.20	$100.60	$136.20	$163.70	$195.20	$237.00	$1,059.10
Expected Actuarial Value of Assets before changes	$397.00	$399.30	$625.30	$879.30	$1,114.80	$1,507.80	$2,022.00	$2,504.30	$3,011.90	$3,799.00	
Change in actuarial value of assets due to assumption changes											
Expected actuarial value of assets at end of year	$397.00	$399.40	$625.40	$879.30	$1,114.80	$1,507.90	$2,022.00	$2,504.30	$3,011.90	$3,799.00	
Actuarial Valuation of Assets at end of year	$270.50	$445.40	$659.00	$840.50	$1,190.00	$1,630.20	$2,024.60	$2,389.10	$3,021.40	$4,116.50	
Asset gain/(loss)	-$126.50	$46.10	$33.60	-$38.80	$75.20	$122.30	2.6	-$115.20	$9.50	$317.50	**$326.30**

Year by Year progression of the UAL

	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	Ten year total
OPSRP											
Analysis of Changes in the Unfunded Actuarial Accrued Liability											
Actuarial Accrued Liability as of December 31,											
UAL, December 31		$1,695.60	$1,353.60	$1,039.50	$613.20	$605.60	$145.90	$108.60	$90.10	$66.30	
Normal Cost and Expenses		482.9	412.5	361.1	279.7	252.6	191.7	179.5	152.4	$117.40	$2,429.80
Contributions		-571.1	-450.9	-335.7	-271	-229.3	-209.9	-171.7	-146.7	-$110.80	-$2,497.10
Liability (Gain) or Loss		109.4	116.2	94.5	113	58.8	-0.1	-25.2	50.8	$51.40	$568.80
Asset (Gain) or Loss		-317.6	-9.5	115.3	-2.6	-122.3	-75.2	38.5	-33.6	-$46.10	-$453.10
Assumption Changes		0	173.7	0	188.7	0	678	0	-17.9	$0.00	$1,022.50
Plan Changes		0	0	0	70.7	0	-143.2	0	0	$1.60	-$70.90
Interest		118.9	100.1	78.9	47.9	47.8	18.4	16.2	13.5	$10.30	$452.00
UAL, December 31		$1,518.10	$1,695.70	$1,353.60	$1,039.60	$613.20	$605.60	$145.90	$108.60	$90.10	

APPENDIX C

RETIREE MEDICAL (RHIA AND RHIPA) DATA SCHEDULES

Retiree Medical (RHIA and RHIPA) Data Schedules

Analysis of changes in the actuarial accrued liability

RHIA and RHIPA Analysis of Changes in the Actuarial Accrued Liability Actuarial Accrued Liability as of December 31,											
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Ten year total
AAL prior period	$522.90	$515.30	$535.70	$581.10	$495.50	$532.20	$534.70	$538.90	$533.40	$531.60	
Expected Change	$18.90	$16.30	$16.70	$19.80	$11.40	$10.60	$9.30	$7.40	$6.90	$4.50	
Assumption and Method changes	$0.00		$26.20		$33.00		$6.10		$2.20	$0.00	$67.50
Plan changes	-$22.40									$0.00	-$22.40
Total demographic (gains) and losses	-$4.00	$4.10	$2.50	-$105.40	-$7.70	-$8.10	-$11.20	-$12.90	-$10.90	-$29.20	-$182.80
AAL December 31,	$515.30	$535.70	$581.10	$495.50	$532.20	$534.70	$538.90	$533.40	$531.60	$506.90	

Analysis of changes in the assets

RHIA and RHIPA Analysis of Changes in the Assets Assets as of December 31,											
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Ten year total
Assets prior period	$258.60	$189.50	$220.50	$238.00	$244.10	$296.00	$358.80	$403.10	$430.50	$484.10	
Actual contributions for year	$29.90	$27.60	$23.60	$35.00	$51.60	$52.40	$55.80	$57.60	$60.00	$61.80	
Benefit payments and expenses for year	-$30.90	-$31.60	-$32.80	-$34.50	-$35.30	-$36.70	-$37.60	-$38.40	-$38.20	-$38.60	
Assumed Investment Ret	$20.60	$15.00	$17.30	$19.10	$20.20	$23.60	$28.50	$31.00	$33.00	$35.80	
Expected Actuarial Value of Assets before changes	$278.20	$200.50	$228.60	$257.60	$280.60	$335.30	$405.50	$453.30	$485.30	$543.10	
Actuarial Valuation of Assets at end of year	$189.50	$220.50	$238.00	$244.10	$296.00	$358.80	$403.10	$430.50	$484.10	$583.10	
Asset gain/(loss)	-$88.70	$20.00	$9.40	-$13.50	$15.40	$23.50	-$2.40	-$22.80	-$1.20	$40.00	-$20.30

Year by Year progression of the UAL

	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**Ten year total**
RHIA and RHIPA Analysis of Changes in the Unfunded Actuarial Accrued Liability											
UAL Beginning of year	$264.30	$325.80	$315.30	$343.00	$251.40	$236.10	$175.90	$135.80	$102.90	$47.50	
Normal Cost and Expense	$8.60	$7.50	$7.40	$8.60	$7.80	$7.00	$6.70	$6.50	$6.30	$6.10	$72.50
Contributions	-$29.90	-$27.70	-$23.70	-$34.90	-$51.60	-$52.40	-$55.90	-$57.50	-$59.90	-$61.80	-$455.30
Liability (gain) or loss	-$4.10	$4.10	$2.40	-$105.40	-$7.70	-$8.00	-$11.20	-$13.00	-$10.90	-$29.20	-$183.00
Asset (gain) or loss	$88.70	-$20.00	-$9.50	$13.40	-$15.40	-$23.40	$2.40	$22.90	$1.20	-$40.00	$20.30
Assumption changes	-$22.40		$26.20	$0.00	$33.00	$0.00	$6.10	$0.00	$2.20	$0.00	$45.10
Interest	$20.50	$25.50	$24.90	$26.70	$18.60	$16.80	$11.70	$8.30	$5.70	$1.40	$160.10
UAL End of Year	$325.80	$315.30	$343.00	$251.40	$236.10	$175.90	$135.80	$102.90	$47.50	-$76.20	