



# Oregon

Kate Brown, Governor

## Public Employees Retirement System

Headquarters:  
11410 S.W. 68<sup>th</sup> Parkway, Tigard, OR  
Mailing Address:  
P.O. Box 23700  
Tigard, OR 97281-3700  
888-320-7377  
TTY (503) 603-7766  
[www.oregon.gov/pers](http://www.oregon.gov/pers)

October 8, 2019

Kip Memmott, Director  
Secretary of State, Audits Division  
255 Capitol St. NE, Suite 500  
Salem, OR 97310

Dear Mr. Memmott,

This letter provides a written response to the Audits Division's report titled **A Review of the Oregon Public Employees Retirement System**.

Thank you for sharing this report that looked at the reasonableness and consistency of the methods, assumptions and data used in the December 31, 2017 actuarial valuation. The Public Employees Retirement System (PERS) Executive Management appreciates the collaborative approach taken by the Audits Division and their subcontractor conducting the review, GRS Retirement Consulting.

Given this was the first independent actuarial review conducted pursuant to House Bill 4163, Section 11 (2018), PERS looked upon the report process as a learning experience and an opportunity to continue to mature, in concert with our consulting actuary, our actuarial practices.

PERS agrees with many of these findings. However, there are certain aspects where PERS and its consulting actuary, Milliman, have a different perspective than those set out within the report's recommendations. Some of those differences will be highlighted in our responses to the recommendations attached (Attachment A).

We also note that some of the wording and phrasing within the report could lead a non-expert reader to misinterpret the results of the report. We did raise these concerns when reviewing drafts of the report, however, our concerns were not incorporated into the final report.

That said, we are pleased the report found that:

- "...when looking at the long term projections through the financial (asset/liability) modeling that the plan is expected to meet its funding objectives"; and
- "We found the actuarial work to be consistent with generally accepted actuarial standards and practices."

The PERS Mission is to pay the right person the right benefit at the right time. Having a well defined funding policy that is reviewed in public session by the PERS Board, stress tested by our retained actuaries regularly, and includes the appropriate use of associated actuarial methods, assumptions and data is paramount to ensuring PERS can achieve its mission.

As is noted above, the report was based upon the methods, assumptions and data used in the December 31, 2017 actuarial valuation. Subsequent to that valuation, PERS conducted a 2018 experience study and, as a result of the study, approved changes to the actuarial methods, assumptions and data that were used in the December 31, 2018 actuarial valuation.

The 2018 actuarial valuation also took into account legislative changes resulting from the passing of SB1049 in the 2019 session, including mandating that the Tier One and Tier Two Unfunded Actuarial Liability be re-amortized over a twenty-two year period. A secondary change arising from SB1049 was for the PERS Board to report to the Legislature at least 30 days prior to formally adopting the Methods and Assumptions. This report (Attachment B) was provided to the Legislature and accepted by the Interim Ways and Means Committee in September Legislative Days.

Attached is our response to each recommendation in the review as well as other supporting documentation.

We look forward to having subsequent actuarial reviews as per House Bill 4163, Section 11 (2018), demonstrate that PERS has implemented those recommendations PERS agrees with, while ensuring other highlighted issues such as rate collaring, payroll growth assumptions and the assumed rate of return continue to be regularly reviewed for appropriateness and soundness by the PERS Board in public session as one of their principal fiduciary duties to PERS members.

Please contact Kevin Olineck, Director at (503) 603-7695 with any questions.

Sincerely,



Kevin Olineck,  
Director

**Attachment A** – PERS Responses to GRS Recommendations

**Attachment B** – Report to Oregon Legislative Assembly – Preliminary Adoption of Actuarial Methods and Assumptions

#	Statement/Recommendation	Page in GRS Report	Response	Expected Completion Date	Notes								
<b>Executive Summary</b>													
1	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.	2	PERS agrees, in part, with the three primary drivers that drove the emergence of the UAL. However, there should also be distinct recognition of the impact and timing of legislative changes and court decisions over the period of time this report encompasses. Within the report, of the 17% of the UAL increase attributed to rate collaring, PERS has estimated that 7% is attributable to legislative changes and judicial decisions with the other 10% attributable to rate collaring.	Complete	The information on page 16 (13) is incorrect in the chart entitled: <i>Impact of Assumed Rate changes to the UAL</i> . The correct numbers are: <table border="1"> <thead> <tr> <th>Valuation Year</th> <th>Impact</th> </tr> </thead> <tbody> <tr> <td>2016</td> <td>\$2.3 B</td> </tr> <tr> <td>2014</td> <td>\$1.7 B</td> </tr> <tr> <td>2013</td> <td>\$1.1 B</td> </tr> </tbody> </table>	Valuation Year	Impact	2016	\$2.3 B	2014	\$1.7 B	2013	\$1.1 B
Valuation Year	Impact												
2016	\$2.3 B												
2014	\$1.7 B												
2013	\$1.1 B												
2	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.	2	The PERS Board, as part of its 2018 experience study, reviewed the rate of return assumption and confirmed that 7.2% is appropriate based on all available information, including the Oregon Investment Council's consultant estimating a 7.3% rate of return in April 2019. Additionally, the PERS Board reviewed the payroll growth assumption and confirmed that 3.5% is appropriate based on all available information. This is particularly true over a longer timeframe than what was reviewed as part of this report.	Complete	It should be noted that the audit report recommends an assumption between 7.05% and 7.72%. As is evidenced by the <a href="#">NASRA Issue Brief: Public Pension Plan Investment Return Assumptions (February 2019)</a> , PERS has adopted very reasonable investment return assumptions that are completely in line with public sector peers. In the time frame 2010 to 2019, PERS has moved from 8.0% to 7.2%, while our peers have, over the same time period, moved from 7.91% to 7.28%, on average.								
3	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).	2	We do not agree with the statement that this change "should" be made for a maturing plan. Contributions to amortize the unfunded liability are spread across combined Tier 1/Tier 2 and OPSRP payroll, which reduces the volatility of the payroll base, reflects the long-term nature of the program, and is consistent with the vast majority of peer systems.	July 2021 as part of the 2020 Experience Study									

#	Statement/Recommendation	Page in GRS Report	Response	Expected Completion Date	Notes
			This can be explored as part of the 2020 Experience Study, but a fixed dollar amortization approach may be impractical given the logistics of the hundreds of employers in the system and a contribution infrastructure predicated on contribution rates defined as a percentage of payroll.		
4	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.	2	This can be explored as part of the 2020 Experience Study. Simply adding interest to the contribution rates may not be appropriate given that contributions (at different rates) are already being received during the 18 month lag period. In the rising contribution rate environment of the past few biennia, rates during the lag period have typically been lower than the rates that come into effect after 18 months, but this relationship would not be expected to persist in a stable or decreasing contribution rate environment.	July 2021 as part of the 2020 Experience Study	
5	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).	2	See Response to Recommendation #2 above and #12 below.	Complete	

#	Statement/Recommendation	Page in GRS Report	Response	Expected Completion Date	Notes
6	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.	3	PERS agrees that our modeling shows that the system is on target to meet its funding objectives.	Complete	
7	Rate collaring does limit the growth in employer contributions and it is contributing to the unfunded accrued liability.	3	<p>As part of setting elements of the funding policy in 2004, the PERS Board reviewed options to assist in smoothing volatile contribution rates in order to meet their funding objective of having predictable and stable rates.</p> <p>There are two methods plans can adopt to achieve that objective. The first is through the smoothing of inputs such as asset smoothing, which the majority of public sector plans use and is referenced in the audit report. Another common input smoothing technique is to phase-in changes in the investment assumption, with the board adopting an assumption that is higher than the best estimate of the system's consultants.</p> <p>The other option is on the output side, which is the rate collaring approach. Analysis at the time of adopting rate collaring compared both methods and found, over the long-term, very similar results with regard to the funding impact.</p> <p>The Board believes the rate collaring approach, which uses the fair market asset value and a best estimate assumption for investment return, is a more transparent means of dealing with contribution rate smoothing and confirmed this approach as part of its 2018 experience study.</p>	Complete	
8	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.	3	PERS is pleased that GRS matches with Milliman's calculations of liabilities and has asked that Milliman provide greater disclosure, in certain circumstances.	Complete	

#	Statement/Recommendation	Page in GRS Report	Response	Expected Completion Date	Notes
9	Review of the actuarial contract indicated the work reviewed generally complies with the Statement of Work.	3	PERS is pleased that the work done is in accordance with the Statement of Work.	Complete	
10	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.	3	PERS will take elements of the funding policy that have been adopted over the years and encapsulate in a single written funding policy.	July 2020	Certain elements of a complete funding policy, particularly the asset management components, are under the purview of the Oregon Investment Council.
11	The retiree health care plans have moved into a better funded position over the last decade.	3	PERS is pleased that the changes made to the funding and assumptions has led to a better funded position over the last decade.	Complete	
<b>Section III Attribution Analysis</b>					
12	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.	21	<p>The amount shown on page 21 of the audit report as an increase in UAL due to new entrants over a ten-year period is incorrect; that amount is actually the increase in Accrued Liability. To assess the effect on the UAL from new entrants, the Accrued Liability increase would need to be compared to the contributions that were made for new entrants in the year they entered the plan. This point was clarified for GRS after their initial draft, and they revised page 20 to reflect this, adding the statement “contributions have also been made on behalf of these new entrants.” However, they did not seem to incorporate this information into page 21, where they continued to represent the full Accrued Liability increase amount as a UAL loss.</p> <p>Granular data isn’t available to isolate the portion of OPSRP assets due to contributions on new entrants to make a precise comparison, but Milliman could estimate this amount for the current and upcoming valuations to see if there is any justification to introducing a new entrant assumption. If so, such an assumption could be adopted with the 2020 Experience Study.</p>	July 2021 as part of the 2020 Experience Study	
<b>Section IV Experience Study, Assumptions, Modeling, Data and Assets</b>					

#	Statement/Recommendation	Page in GRS Report	Response	Expected Completion Date	Notes
13	We recommend a discussion on planning and funding for these data corrections as they appear every year.	26	PERS will ensure that discussion on data corrections be incorporated into all future experience studies and actuarial valuation reconciliation analysis.	July 2021 as part of the 2020 Experience Study	
14	We recommend Milliman provide additional detail and clarification on the development of the healthcare cost trend rates be communicated in the experience study.	27	Milliman will expand its discussion of this assumption beginning with the 2020 Experience Study.	July 2021 as part of the 2020 Experience Study	
15	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.	32	The PERS Board, as part of its 2018 experience study reviewed the rate of return assumption and confirmed that 7.2% is appropriate based on all available information, including the Oregon Investment Council's outside consultant projecting a 7.3% average future long-term annual return in April 2019. The Board will continue to evaluate the assumed rate of return every two years as part of the next rate setting cycle.	Complete	
16	We recommend discussing the payroll growth assumption and considering lowering the rate in future valuations.	32	The PERS Board, as part of its 2018 experience study, reviewed the payroll growth assumption and confirmed that 3.5% is appropriate based on all available information. This is particularly true over a longer timeframe than what was reviewed as part of this report.	Complete	
17	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.	35	There is no requirement under Actuarial Standards of Practice to note the absence of significant concerns or corrections. Milliman did not make any disclosures of significant data concerns in recent reports because there were no known significant concerns. (As disclosed in the reports, Milliman did not audit the data, but did find it to be consistent with information provided for other purposes.) In years where significant data alterations or corrections did apply, they were noted in the report. For example, data exhibits in the December 31, 2014 actuarial valuation report noted that estimated adjustments were made to monthly benefits for retirees and	December 2019	

#	Statement/Recommendation	Page in GRS Report	Response	Expected Completion Date	Notes
			beneficiaries whose benefits had not yet been updated to reflect the <i>Moro</i> decision. Starting with the December 31, 2018 actuarial valuation report, Milliman will add a specific paragraph related to the existence or absence of any significant data concerns or adjustments in the appendix summarizing actuarial methods.		
<b>Section V Funding Policy and Rate Collaring</b>					
18	We recommend a single written funding policy document that incorporates the entire rate setting policy, including the rate collaring.	39	PERS will take elements of the funding policy that have been adopted over the years and encapsulate in a single written funding policy.	July 2021 as part of the 2020 Experience Study	Certain elements of a complete funding policy, particularly the asset management components, are under the purview of the Oregon Investment Council.
19	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.	39	We agree that ongoing monitoring of unfunded liabilities is important. Changes in the UAL from one year to the next are reconciled in the annual actuarial valuation report, and projections of expected future changes to the UAL are included as part of the annual financial modelling work performed by Milliman that stress tests the funding policy under a wide variety of potential scenarios for actual future investment return.	Ongoing	
20	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.	39	This can be explored as part of the 2020 Experience Study, but a fixed dollar amortization approach may be impractical given the logistics of the hundreds of employers in the system and a contribution infrastructure predicated on contribution rates defined as a percentage of payroll. Such an approach would also be at variance with the majority of our peer systems.	July 2021 as part of the 2020 Experience Study	
21	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.	39	The payroll growth assumption is reexamined every two years as part of the experience study. It is set on a forward-looking basis based on expectations about macroeconomic variables (inflation and general productivity/wage growth). It is also reviewed compared to actual historical PERS pay growth for an added perspective on	July 2021 as part of the 2020 Experience Study	

#	Statement/Recommendation	Page in GRS Report	Response	Expected Completion Date	Notes
			<p>the assumption's consistency and appropriateness. Any historical comparison such as this depends greatly on the endpoints of the analysis, and so the average over any one selected period should not be considered determinative of the appropriateness of the assumption. The GRS audit report cites a specific nine-year period with an average combined payroll growth of 2.16% in expressing their concern that the current Board-selected assumption of 3.50% may be too high. However, the nine-year period chosen happens to represent among the lowest averaging periods that could have been selected. The trailing ten-year average at the time the 2016 Experience Study was conducted was 3.46%. For the 2018 Experience Study, the trailing ten-year average was 2.72% and the trailing five-year average was 3.29%. More recently, the data provided for the December 31, 2018 valuation showed a one-year increase of about 7.4%.</p> <p>The payroll growth assumption is important, and will continue to be monitored closely going forward, but the Board-adopted assumption should not be viewed as "risky" or "optimistic" based on the results of one specific selected historical period.</p>		
<b>Section VI Valuation Review</b>					
22	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 (#23-38) in the appropriate sections of any actuarial valuation reports for Oregon PERS going forward.	43	Milliman responds to each specific recommendation below. Actuarial standards require that an actuarial report should "identify the methods, procedures, assumptions, and data used by the actuary with sufficient clarity that another actuary qualified in the same practice area could make an objective appraisal of the reasonableness of the actuary's work as presented in the actuarial report." Some of the recommendations in the audit report go far beyond the required standard to add a level of detail that would only be relevant when an	Complete	

#	Statement/Recommendation	Page in GRS Report	Response	Expected Completion Date	Notes
			auditing actuary is trying to replicate results, and would not be expected to provide any benefit to intended report users. Milliman is happy to provide extensive detail for auditing actuaries, as was done for GRS, but may not view it as practical to include some of the recommended detail in the annual valuation report.		
23	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.	43	This level of technical detail is beyond what is required by actuarial standards and is of questionable value to intended users. It is not routinely included in actuarial valuation reports and is not expected to be added at this time.	Complete	
24	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.	44	Applying decrements at either the beginning of year or middle of year is well-established, acceptable actuarial practice. There are advantages and disadvantages to either approach. In this case, Milliman applies decrements at beginning of year and does not currently intend to change the practice. The audit report states that beginning of year decrements tend to produce a lower projected benefits for members at decrement, which is true, but this does not necessarily translate into a lower actuarial liability because there are many other factors involved in the calculations, particularly under the Entry Age Normal cost allocation method used for this valuation. For example, beginning of year decrements tend to produce higher liabilities for active members who are eligible for immediate unreduced retirement benefits, as is the case for many long-service Tier 1/Tier 2 members (including those with benefits determined under the Money Match formula).	Complete	
25	It appears no 401(a)(17) salary or 415 benefit maximums are being applied. We recommend Milliman include this information in their report.	44	Historically, PERS has applied the 401(a)(17) limits to salary fields in the data for affected members (Tier 2 and OPSRP) before providing Milliman the census files. Milliman also reflects 401(a)(17) limits when calculating Final Average Salary for affected members (note that Tier 1 members are not subject to 401(a)(17) limits).	Complete	

#	Statement/Recommendation	Page in GRS Report	Response	Expected Completion Date	Notes
			415 limits are not explicitly applied in the valuation. Milliman will add a description of this handling to the report beginning with the December 31, 2018 actuarial valuation. Note that the 401(a)(17) limit will not impact salary starting in 2020, because the \$195,000 (indexed) limit introduced by SB 1049 will supersede it.		
26	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.	44	Milliman will add a description to the report beginning with the December 31, 2018 actuarial valuation.	December 2019	
27	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.	44	Milliman will add a description to the report beginning with the December 31, 2018 actuarial valuation.	December 2019	
28	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.	44	Milliman's treatment is actually the opposite of what is stated in GRS's report: assumed disability rates are applied until 100% retirement age for Tier 1/Tier 2 members, but are stopped at normal retirement age for OPSRP members. This is because OPSRP disability benefits are replaced with retirement benefits once a disabled member reaches normal retirement age, so there is no clear distinction between OPSRP members who leave active PERS employment due to retirement or due to disability after normal retirement age. Milliman will add a description to the report beginning with the December 31, 2018 actuarial valuation.	December 2019	
29	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.	44	This level of technical detail is beyond what is required by actuarial standards and is of questionable value to intended users. It is not routinely included in actuarial valuation reports and is not expected to be added at this time.	Complete	

#	Statement/Recommendation	Page in GRS Report	Response	Expected Completion Date	Notes
30	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.	44	The ERFs used in the valuation reflect the published actuarial equivalency factors adopted by the Board. Milliman will add a description to the report beginning with the December 31, 2018 actuarial valuation.	December 2019	
31	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.	44	This description is incorrect. Milliman uses the Board-adopted 2.50% inflation assumption to reflect the assumed cost of living adjustment applied when calculating a disabled member's normal retirement benefit. Milliman will add a description to the report beginning with the December 31, 2018 actuarial valuation.	December 2019	
32	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.	44	Milliman reflects the known August 1 effective date of annual cost of living increases for members who are in pay status as of the valuation date. The most appropriate COLA timing assumption for members who are not yet in pay status as of the December 31 valuation date is less obvious, since the member's first COLA will occur on August 1 regardless of the date on which the member commences benefits. Milliman will review the COLA timing assumption for members not yet in pay status with the 2020 Experience Study and will determine if a change to the current treatment is recommended at that time.	July 2021 as part of the 2020 Experience Study	
33	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.	44	The report currently includes a description of the percentage of Tier 1/Tier 2 members assumed to purchase the six-month waiting period. The additional level of specific detail recommended is beyond what is required by actuarial standards, given the small share of liability associated with service purchases on partial lump sums, but Milliman will review the existing description and expects to add some additional clarification to the report beginning with the December 31, 2018 actuarial valuation.	December 2019	

#	Statement/Recommendation	Page in GRS Report	Response	Expected Completion Date	Notes
34	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.	45	Milliman reflects a \$4,000 assumed cost to the employer for matching an active member's future police & fire unit purchase under certain circumstances. Milliman will add a description to the report beginning with the December 31, 2018 actuarial valuation.	December 2019	
35	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.	45	Milliman will add a description to the report beginning with the December 31, 2018 actuarial valuation.	December 2019	
36	We recommend Milliman disclose that the normal form for the tier 1/tier 2 full formula benefit is a refund annuity.	45	Milliman's actuarial valuation reports already specify this in the Summary of Plan Provisions appendix.	Complete	
37	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.	45	Tier 1/Tier 2 Police and Fire members cannot retire prior to age 50 with less than 30 years of service [see ORS 238.280(4)]. As a result, it would not be appropriate to develop an assumption for that situation. The provision related to age 50 and 25 years of service that appears to be the source of confusion in the audit report is that a Tier 1/Tier 2 Police and Fire member is eligible for unreduced retirement once achieving <u>both</u> age 50 <u>and</u> 25+ years of service [ORS 238.280(4)(a)]. This statutory provision is already reflected in the structure and application of assumed retirement rates.	Complete	
38	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.	45	Milliman can consider this recommendation in the 2020 Experience Study. However, the percentage of benefits paid out as lump sums is quite low (the total lump sum assumption for retirements occurring in 2019 is 1%, declining to 0% for retirements from 2021 onwards, and the partial lump sum assumption is now 3.0%). Between that and the fact that a non-trivial fraction of members may reside outside of Oregon even when active, it is unlikely any revision to this assumption would materially impact calculated liabilities.	July 2021 as part of the 2020 Experience Study	

#	Statement/Recommendation	Page in GRS Report	Response	Expected Completion Date	Notes
<b>Section VII Actuarial Contract Review</b>					
39	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.	47	The PERS Board will consider extending the actuarial contract to the consulting actuary for a further two years at its December 2019 board meeting and the new contract will add in this statement.	December 2020	
40	We recommend OPERS consider adding a clause that sets out the orderly transition of records and services should the actuarial contract be terminated.	47	The PERS Board will consider extending the actuarial contract to the consulting actuary for a further two years at its December 2019 board meeting and the new contract will add in this clause.	December 2020	



# Oregon

Kate Brown, Governor

## Public Employees Retirement System

Headquarters:  
11410 S.W. 68<sup>th</sup> Parkway, Tigard, OR  
Mailing Address:  
P.O. Box 23700  
Tigard, OR 97281-3700  
888-320-7377  
TTY (503) 603-7766  
[www.oregon.gov/pers](http://www.oregon.gov/pers)

August 13, 2019

The Honorable Senator Betsy Johnson, Co-Chair  
The Honorable Senator Elizabeth Steiner-Hayward, Co-Chair  
The Honorable Representative Dan Rayfield, Co-Chair  
Joint Interim Committee on Ways and Means  
900 Court Street NE  
H-178 State Capitol  
Salem, OR 97301-4048

Dear Co-Chairpersons:

### **Nature of the Request**

The Public Employees Retirement System (PERS) requests acknowledgement of receipt of this report on the PERS Board's preliminary approval of changes to actuarial methods and assumptions. This report is provided in accordance with Section 57 of Senate Bill 1049(2019) (Chapter 355, 2019 Oregon Laws), which requires PERS to submit this report to the Joint Interim Committee on Ways and Means at least 30 days prior to the final adoption of actuarial methods and assumptions. Final adoption is scheduled for the October 4, 2019 PERS Board meeting.

### **Agency Action**

On July 26, 2019, the PERS Board preliminarily approved actuarial methods and assumptions that will be used for the December 31, 2018 and December 31, 2019 actuarial valuations of the system.

In this preliminary action, the Board retained or changed the following actuarial methods and assumptions:

#### ACTUARIAL METHODS

- Retain the Funding Policy based on the following objectives, while they might have competing interests: transparent; predictable and stable rates; protect funded status; equitable across generations; actuarially sound; and GASB compliant.
- Confirm continued use of the Entry Age Normal methodology.
- Continue use of the rate collaring policy which limits the change in base contribution rates to the larger of 20% of current rate or 3.00% of payroll. The collar widens incrementally when funded status is below 70%.
- As directed in Senate Bill 1049, on a one-time basis, set the amortization period for Tier One and Tier Two members to 22 years and reamortize the full liability of those two tiers. The amortization period for OPSRP liability remains at 16 years.

### NON-ECONOMIC ASSUMPTIONS

- Retain the inflation rate of 2.5%, which affects all other assumptions including system payroll growth, investment return and health care inflation.
- Retain the real wage growth rate of 1.0%, which represents the increase in wages in excess of inflation for the whole population.
- Retain the system payroll growth of 3.5%, which is assumed to equal the sum of inflation and real wage growth.

### ECONOMIC ASSUMPTIONS and ASSUMED RATE of RETURN

- Update the explicit assumptions regarding administrative expenses for Tier One/Tier Two and OPSRP.
- Update the assumed health cost trend (i.e., health cost inflation) rates for the RHIPA retiree healthcare program
- The Board recommended maintaining the assumed rate of return at 7.20%. They gave consideration to lowering the investment return assumption to 7.10% or 7.00%, based on an analysis of PERS's current target asset allocation using different sets of capital market outlook assumptions. The averages of the 50<sup>th</sup> percentiles for those outlooks across 10-year (one outlook) and 20-year (two outlooks) time horizons fell in the range between 6.64% and 7.32%. The median assumption for large public sector plans currently sits at 7.25%.

### DEMOGRAPHIC ASSUMPTIONS

- Adjust mortality assumptions to use Pub-2010 base tables and mortality improvement scale based on 60-year unisex average Social Security experience and updated to reflect most recent information available (January 2019).
- Adjust retirement rates for certain member categories and service bands to more closely align with recent and expected future experience; reduce percentage of future retirees assumed to elect a partial lump sum; increase percentage of members assumed to purchase credited service at retirement.
- Increase the merit component of the salary increase assumption for two member categories based on observations of the last eight years of experience.
- Update pre-retirement termination of employment assumptions for two member categories.
- Lower assumed rates of ordinary disability and general service duty disability to more closely match recent experience.
- Increase the Tier One unused vacation cash out assumption for most member categories
- Adjust the Tier One/Tier Two unused sick leave assumption for five member categories to reflect observed experience.
- Decrease the healthy participation assumption for the RHIA retiree healthcare program and decrease the RHIPA participation assumption for most service bands.

ALLOCATION PROCEDURES

- When allocating accrued liability for Tier One/Tier Two active members who have earned service with multiple PERS employers, base 90% of the allocation on service with each employer (100% for police & fire members) and base the rest on the member account balance associated with each employer. The assumption for general service has increased 5% since the prior experience study. This movement illustrates the continued migration of projected future Tier One/Tier Two retirement benefits away from the Money Match calculation, which is based on account balances, toward the ongoing Full Formula approach, which is based on final average salary.

**Action Requested**

PERS requests the Committee acknowledge receipt of the report.

**Legislation Affected**

No legislation is affected by this request.

Sincerely,



Kevin Olineck, Director

**Attachments**

July 31, 2019 Memo on Adoption of Actuarial Assumptions  
2018 Experience Study



# Oregon

Kate Brown, Governor

## Public Employees Retirement System

Headquarters:  
11410 S.W. 68<sup>th</sup> Parkway, Tigard, OR  
Mailing Address:  
P.O. Box 23700  
Tigard, OR 97281-3700  
(503) 598-7377  
TTY (503) 603-7766  
[www.oregon.gov/pers](http://www.oregon.gov/pers)

July 31, 2019

**TO:** Members of the Joint Committee on Ways and Means  
**FROM:** Kevin Olineck, Director  
**SUBJECT:** PERS Board Adoption of Actuarial Assumptions including Assumed Earnings Rate (Senate Bill 1049 Report)

### **BACKGROUND**

The PERS Board is directed, via ORS 238.605, to review actuarial methods and assumptions, including the assumed rate of return, every two years. This review reflects expectations for both investment earnings and benefit levels for some members, and the assumptions help establish an appropriate path for employer contribution rates.

Section 57 of SB 1049 (2019) states:

“At least 30 days before the Public Employees Retirement Board adopts changes to actuarial methods and assumptions used for purposes of the Public Employees Retirement System, the board shall submit a report to the Joint Committee on Ways and Means or the Joint Interim Committee on Ways and Means detailing the proposed changes and the associated, actuarially determined impact to the total liability of the system, the accrued liability of the system and employer contribution rates.”

At their July 26 meeting, the PERS Board reviewed and preliminarily approved a new set of actuarial methods and assumptions. This was part of a three-meeting process that the board undertook to review all the relevant methods and assumptions. The Board will formally approve the actuarial methods and assumptions on October 4, 2019.

These methods and assumptions will be used for:

The December 31, 2018 actuarial valuation that will provide the 2021-23 advisory employer contribution rates at the October 4, 2019 Board meeting; and

The December 31, 2019 actuarial valuation whose results establish the 2021-23 actual employer contribution rates to be adopted by the Board in Fall, 2020.

To comply with SB 1049, the following is a report of the methods and assumptions preliminarily approved by the PERS Board for the above-noted actuarial valuations and the actuarial valuation results. I have also attached a copy of the 2018 Experience Study that provides more detailed explanations of the following elements.

## **ACTUARIAL METHODS**

### **Board Funding Policy**

The Board agreed that the Funding Policy encapsulated in the following policy objectives continue to be relevant while acknowledging the competing interests within these objectives:

- Transparent
- Predictable and Stable Rates
- Protect Funded Status
- Equitable Across Generations
- Actuarially Sound
- GASB Compliant

### **Cost Allocation Method**

The Board confirmed continued use of the Entry Age Normal Methodology.

### **Rate Collaring**

The Board agreed to continue to use the rate collaring policy that was originally implemented with the December 31, 2004 actuarial valuation. This limits the change in base contribution rate to larger of 20% of current rate or 3.00% of payroll. The Collar widens incrementally when funded status is below 70%.

### **Amortization Period**

In 2013, on a go-forward basis, the PERS Board set the amortization period to determine the liabilities of Tier One and Tier Two members, at 20 years with the amortization period for OPSRP members set at 16 years. The respective liabilities were re-amortized at that time and then, in subsequent valuations, new liabilities that arose were amortized on a rolling 20- or 16-year basis, respectively (known as the level percent of pay, layered fixed period methodology).

Section 27 of SB1049 directed the PERS Board, to set, on a one-time basis, the amortization period for Tier One and Tier Two members to 22 years and reamortize the full liability of those two tiers.

In subsequent valuations, the PERS Board is expected to revert to the 20- and 16-year amortization periods.

## **NON-INVESTMENT ECONOMIC ASSUMPTIONS**

There are four primary non-investment economic assumptions the Board reviews and approves.

*Inflation* – this assumption affects others assumptions, including system payroll growth, investment return and health care inflation.

*Real Wage Growth* – represents the increase in wages in excess of inflation for the entire group due to improvements in productivity and competitive market pressures.

*System Payroll Growth* – is assumed to equal the sum of inflation and real wage growth. This assumption determines the shape of payments to amortize the unfunded liability.

*Administrative Expenses* – reflect the costs incurred by PERS in administering the Tier One, Tier Two and OPSRP programs. Note: no assumption is made for investment-related expenses as they are accounted for in the long-term investment return assumption.

The following chart shows the December 31, 2017 assumptions previously adopted by the Board and the updated December 31, 2018 assumptions adopted by the Board at the July 26, 2019 meeting.

	12/31/2017 Valuation Assumptions	12/31/2018 Valuation Revised Assumptions
Inflation	2.5%	2.5%
Real Wage Growth	<u>1.0%</u>	<u>1.0%</u>
System Payroll Growth	3.5%	3.5%
<u>Administrative Expenses:</u>		
- OPSRP	\$6.5 million	\$8.0 million
- Tier 1/Tier 2	\$37.5 million	\$32.5 million

## **DEMOGRAPHIC ASSUMPTIONS**

Milliman has analyzed member census data provided by PERS. Four years of data were analyzed for most demographic assumptions and eight years of data for salary increase assumptions. Recommendations were developed based on the statistical analysis. The attached 2018 Experience Study provides further detail.

**Mortality Assumption** – ORS 238.608 requires that actuarial equivalency factors use the best actuarial information on mortality available at the time. The mortality assumption consists of two parts: 1) a base table that lists probability of death at a given age; and 2) a projection scale that modifies the base table entries to reflect mortality improvement over time. Milliman recommends updating tables to reflect the January 2019 study from the Society of Actuaries (Pub-2010 base tables). The combined effect of changes is a decrease in liability of less than \$150 million.

**Rate of Retirement Assumption** – This is the likelihood that an eligible member will retire in a given year. Data are grouped by School District; Other General Service; and Police & Fire. Data are divided into three service bands and then Tier One/Tier Two vs. OPSRP. Milliman recommends lowering assumptions at some earlier retirement ages.

**Individual Member Salary Increase Assumption** – This reflects the combined effects of merit/longevity, general wage growth, and inflation assumptions. Eight years of data were analyzed for School Districts, Other General Service, and Police & Fire. It was noted that assumptions and experience for Police & Fire matched well. School District and Other General Service had higher increases therefore it was recommended that assumptions be updated to reflect a blend of current assumptions and recent experience.

**Pre-Retirement Employment Termination Assumption** – This is the likelihood that a member will leave employment prior to retirement eligibility for reasons other than death or disability. Milliman reviewed experience data and recommended adjustments to two of five groups for minor differences between current assumptions and actual experience.

**Final Average Salary Adjustments** – Milliman applies assumptions regarding the increase in final average salary for Tier One and Tier Two members reflecting unused sick leave and lump sum vacation payouts. It was recommended that adjustments be made to more closely track recent experience.

**RHIA and RHIPA Assumptions** – Milliman recommended changes to assumptions based on lower participation in RHIA and lower RHIPA rates.

### **ASSUMED RATE**

The assumed rate is used as a “discount rate” for establishing: the actuarial accrued liability, which is a net present value of the Oregon Public Employees Retirement Fund (OPERF); and the associated unfunded actuarial liability (UAL), or actuarial shortfall of the fund. The rate is also the guaranteed annual crediting level for Tier One active member regular accounts, and is used as the annuitization rate to convert Tier One and Tier Two member account balances to lifetime monthly retirement benefits.

The history of recent assumed rate changes is shown below:

<b><u>Effective Dates</u></b>	<b><u>Assumed Earnings Rate</u></b>
1989 – 2013	8.0%
2013 – 2015	7.75%
2015 – 2017	7.50%
2017 – 2019	7.20%

### **Data to support changes to the Assumed Earnings Rate**

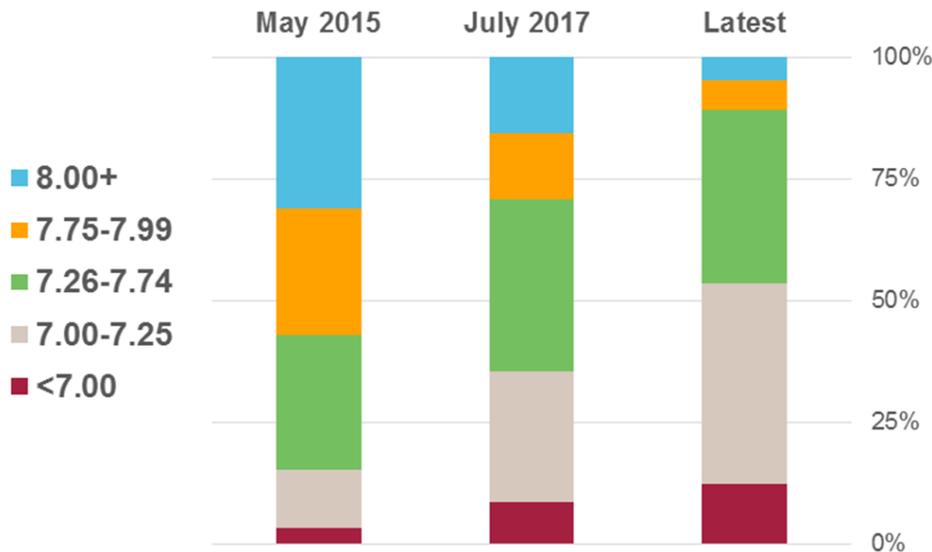
When considering changes to the assumed rate, the Board considers analysis presented to the Oregon Investment Council (OIC), charged with investing the OPERF, and from Milliman, PERS’ actuary.

The Oregon Investment Council consultants, Callan, and Milliman reported the following information at the June 5, 2019 joint OIC, PERS Board meeting with regard to projected returns:

	Milliman	Callan	Horizon
<b>Median Annualized Return</b>	<b>6.87%</b>	<b>7.32%</b>	<b>6.64%</b>
Assumed Inflation	2.50%	2.25%	2.24%
Timeframe Modeled	20 years	10 years	10 years

Milliman also reported a downward trend in return assumptions among public retirement plans, and over half of the 126 state-wide systems tracked by the National Association of State Retirement Administrators (NASRA) have reduced their return assumptions over the last several years. The current median assumption for large public systems is 7.25%.

The following Milliman chart shows distribution of pension plan return assumptions (Source NASRA April 2019).



Given the information noted above, the PERS Board **retained** and **re-adopted** an assumed rate of return for the above-noted valuation periods of **7.20%**.

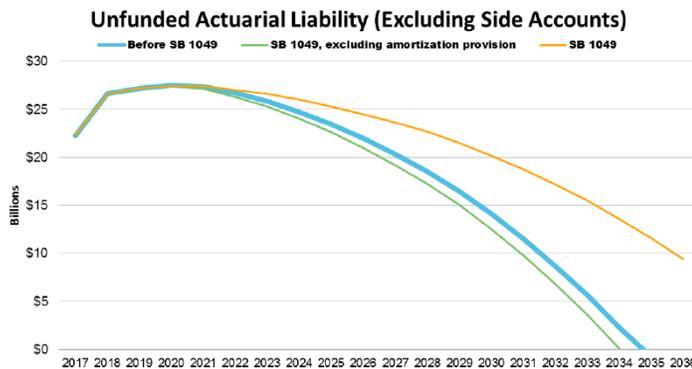
**ACTUARIALLY DETERMINED IMPACT TO THE ACCRUED LIABILITY OF THE SYSTEM**

On a preliminary basis, the estimated effect on combined Tier One, Tier Two and OPSRP liabilities based on Milliman’s valuation work for the period ending December 31, 2018 would be to not have a net impact to the Accrued Liability of \$86.6 billion. The different impacts to the Accrued Liability with the new assumptions are shown below.

12/31/2018 Accrued Liability	Assumed Return 7.2%
Current assumptions*	\$86.6 B
Mortality	(\$0.1 B)
Merit	\$0.0 B
Other demographic assumptions	<u>\$0.1 B</u>
Revised assumptions (before assumed return)	\$86.6 B
Assumed return	<u>\$0.0 B</u>
Revised assumptions	\$86.6 B

**Financial Modeling - Effect of SB 1049**

- Assumed rate of 7.2% and actual future returns of +7.20%



This work product was prepared for discussion purposes only and may not be appropriate to use for other purposes. Milliman does not intend to benefit and assumes no duty or liability to other parties who receive this work. Any recipient of this work product who desires professional guidance should engage qualified professionals for advice appropriate to its own specific needs.

**ACTUARIALLY DETERMINED IMPACT TO EMPLOYER CONTRIBUTION RATES**

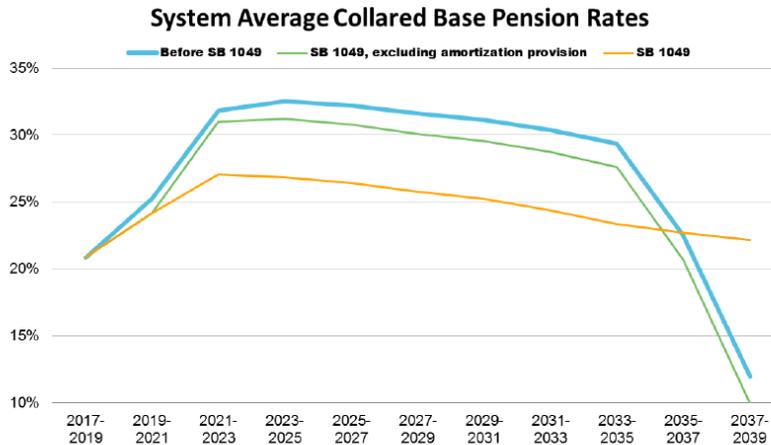
On a preliminary basis, the estimated effect on **uncollared** system-average advisory pension rates for 2021 based on Milliman’s valuation work would be to add 0.3% to the Normal Cost and no impact to the Unfunded Actuarial Liability for a combined total of **0.3%**. The different impacts to the Contribution Rate with the new assumptions are shown below.

	Assumed Return 7.2%	
	UAL	Normal Cost
Mortality	(0.1%)	0.0%
Merit	0.0%	0.2%
Other demographic assumptions	0.1%	0.1%
Assumed return	0.0%	0.0%
<b>Total</b>	<b>0.0%</b>	<b>0.3%</b>
<b>Combined Total</b>	<b>0.3%</b>	

Changes shown above are stated as a percent of payroll and exclude changes for the RHIA and RHIPA retiree healthcare programs.

**Financial Modeling - Effect of SB 1049**

- Assumed rate of 7.2% and actual future returns of +7.20%



This work product was prepared for discussion purposes only and may not be appropriate to use for other purposes. Milliman does not intend to benefit and assumes no duty or liability to other parties who receive this work. Any recipient of this work product who desires professional guidance should engage qualified professionals for advice appropriate to its own specific needs.



---

# OREGON PUBLIC EMPLOYEES RETIREMENT SYSTEM

## 2018 Experience Study

**Prepared by:**

Milliman, Inc.

**Matt Larrabee, FSA, EA, MAAA**

Principal and Consulting Actuary

**Scott Preppernau, FSA, EA, MAAA**

Principal and Consulting Actuary

1455 SW Broadway, Suite 1600

Portland OR 97201

Tel +1 503 227 0634

Fax +1 503 227 7956

milliman.com



This work product was prepared solely for Oregon Public Employees Retirement System for the purposes stated herein, and may not be appropriate to use for other purposes. Milliman does not intend to benefit and assumes no duty or liability to other parties who receive this work. Milliman recommends that third parties be aided by their own actuary or other qualified professional when reviewing the Milliman work product.



1455 SW Broadway  
Suite 1600  
Portland, OR 97201  
USA

Tel +1 503 227 0634  
Fax +1 503 227 7956

milliman.com

July 24, 2019

Board of Trustees  
Oregon Public Employees Retirement System

**Re: 2018 Experience Study – Oregon Public Employees Retirement System**

Dear Members of the Board:

The results of an actuarial valuation are based on the actuarial methods and assumptions used in the valuation. These methods and assumptions are used in developing employer contribution rates, disclosing employer liabilities pursuant to GASB requirements, and for analyzing the fiscal impact of proposed legislative amendments.

This experience study report has been prepared exclusively for the Oregon Public Employees Retirement System (PERS) and its governing PERS Board (Board). **The study recommends to the Board the actuarial methods and assumptions to be used in the December 31, 2018 and 2019 actuarial valuations of PERS.**

Except where otherwise noted, the analysis in this study was based on data for the experience period from January 1, 2015 to December 31, 2018 as provided by PERS. PERS is solely responsible for the validity, accuracy, and comprehensiveness of this information; the results of our analysis can be expected to differ and may need to be revised if the underlying data supplied is incomplete or inaccurate.

Milliman's work is prepared solely for the use and benefit of the Oregon Public Employees Retirement System.

Milliman does not intend to benefit or create a legal duty to any third party recipient of this report. No third party recipient of Milliman's work product should rely upon this report. Such recipients should engage qualified professionals for advice appropriate to their own specific needs.

The consultants who worked on this assignment are pension actuaries and, for the analysis of the RHIPA program, healthcare actuaries. Milliman's advice is not intended to be a substitute for qualified legal or accounting counsel.

The signing actuaries are independent of the plan sponsor. We are not aware of any relationship that would impair the objectivity of our work.



This work product was prepared solely for Oregon Public Employees Retirement System for the purposes stated herein, and may not be appropriate to use for other purposes. Milliman does not intend to benefit and assumes no duty or liability to other parties who receive this work. Milliman recommends that third parties be aided by their own actuary or other qualified professional when reviewing the Milliman work product.

On the basis of the foregoing, we hereby certify that, to the best of our knowledge and belief, this report is complete and accurate and has been prepared in accordance with generally recognized and accepted actuarial principles and practices. We are members of the American Academy of Actuaries and meet the Qualification Standards to render the actuarial opinion contained herein. Assumptions related to the healthcare cost inflation rates for the RHIPA retiree healthcare program discussed in this report were determined by Milliman actuaries qualified in such matters.

Sincerely,



Matt Larrabee, FSA, EA, MAAA  
Principal and Consulting Actuary



Scott Preppernau, FSA, EA, MAAA  
Principal and Consulting Actuary



This work product was prepared solely for Oregon Public Employees Retirement System for the purposes stated herein, and may not be appropriate to use for other purposes. Milliman does not intend to benefit and assumes no duty or liability to other parties who receive this work. Milliman recommends that third parties be aided by their own actuary or other qualified professional when reviewing the Milliman work product.

## Table of Contents

<b>1. Executive Summary .....</b>	<b>1</b>
<b>2. Actuarial Methods and Allocation Procedures .....</b>	<b>3</b>
<i>Overview.....</i>	3
<i>Actuarial Cost Method .....</i>	5
<i>Amortization Method.....</i>	5
<i>Asset Valuation Method.....</i>	6
<i>Excluded Reserves .....</i>	6
<i>Rate Collar Method .....</i>	7
<i>Liability Allocation for Actives with Multiple Employers .....</i>	7
<b>3. Economic Assumptions .....</b>	<b>9</b>
<i>Overview.....</i>	9
<i>Inflation .....</i>	10
<i>Real Wage Growth .....</i>	11
<i>Payroll Growth .....</i>	12
<i>Investment Return.....</i>	13
<i>Administrative Expenses.....</i>	16
<i>RHIPA Subsidy Cost Trend Rates.....</i>	17
<b>4. Demographic Assumptions .....</b>	<b>19</b>
<i>Overview.....</i>	19
<i>Mortality .....</i>	21
<i>Retirement Assumptions .....</i>	28
<i>Disability Incidence Assumptions .....</i>	41
<i>Termination Assumptions.....</i>	44
<i>Salary Increase Assumptions.....</i>	47
<i>Retiree Healthcare Assumptions .....</i>	51
<b>5. Appendix.....</b>	<b>53</b>
<i>Data.....</i>	53
<i>Assumption Tables .....</i>	53

## 1. Executive Summary

This experience study report has been prepared exclusively for the Oregon Public Employees Retirement System (PERS) and the PERS Board (Board) in order to analyze the system's experience from January 1, 2015 through December 31, 2018 and to recommend actuarial methods and assumptions to be used in the December 31, 2018 and 2019 actuarial valuations of PERS.

A brief summary of the recommended method and assumption changes contained in this report as well as items reviewed at the May 2019 and/or July 2019 Board meetings follows:

### Economic Assumptions

- In our professional opinion, the current investment return assumption of 7.20% per year is reasonable, based on an analysis of PERS's current target asset allocation with consideration of different sets of capital market outlook assumptions. However, the PERS Board should give consideration to reducing the assumption, with either 7.10% or 7.00% also being reasonable in our professional opinion. The median annualized return for the 10-year outlook from Callan (the outside investment advisor to the Oregon Investment Council) was 7.32%. The median annualized return for a 20-year time horizon based on Milliman's capital market outlook was 6.87%.
- Update the explicit assumptions regarding administrative expenses for Tier 1/Tier 2 and OPSRP.
- Update the assumed RHIPA cost subsidy trend rates.

### Demographic Assumptions

- Adjust mortality assumptions to use the new "Pub-2010" base tables and a standard update to the mortality improvement scale, which is based on 60-year unisex average Social Security experience.
- Adjust retirement rates for certain member categories and service bands to more closely align with recent and expected future experience; reduce percentage of future retirees assumed to elect a partial lump sum; increase percentage of members assumed to purchase credited service at retirement.
- Increase the merit component of the salary increase assumption for two member categories based on observations of the last eight years of experience.
- Update pre-retirement termination of employment assumptions for two member categories.
- Lower assumed rates of ordinary (non-duty) disability and general service duty disability to more closely match recent experience.
- Increase the Tier 1 unused vacation cash out assumption for most member categories, reflecting recent experience.
- Adjust the Tier 1/Tier 2 unused sick leave assumption for five member categories to more closely reflect recently observed experience.
- Decrease the healthy participation assumption for the RHIA retiree healthcare program, reflecting recent experience.
- Decrease the RHIPA participation assumption for most service bands, reflecting recent experience.

### Actuarial Methods

- Senate Bill 1049 was signed into law in June 2019 and requires a one-time re-amortization of Tier 1/Tier 2 UAL in the calculation of actuarially determined contribution rates for the 2021-2023 biennium. No additional changes are recommended for most actuarial methods, including the actuarial cost method, amortization method, and rate collar.

### Allocation Procedures

- When allocating accrued liability for Tier 1/Tier 2 active members who have earned service with multiple PERS employers, base 90% of the allocation on length of service with each employer (100% for police & fire members) and base the rest on the member account balance associated with each employer. The percentage allocation for general service has increased 5% since the prior experience study. This movement illustrates the continued migration of projected future Tier 1/Tier 2 retirement benefits away from the Money Match calculation, which is based on account balances, toward the ongoing Full Formula approach, which is based on final average salary.

## 2. Actuarial Methods and Allocation Procedures

### Overview

Actuarial methods and allocation procedures are used as part of the valuation to determine actuarial accrued liabilities, to determine normal costs, to allocate costs to individual employers and to amortize unfunded liabilities. The following Board objectives were considered in developing the actuarial methods and allocation procedures:

- Transparency of shortfall and funded status calculations
- Predictable and stable employer contribution rates
- Protection of the plan's funded status to enhance benefit security for members
- Equity across generations of taxpayers funding the program
- Actuarial soundness - crafting policy that will fully fund the system if assumptions are met
- Compliance with GASB (Governmental Accounting Standards Board) requirements

The actuarial methods used for the December 31, 2017 actuarial valuation and the changes recommended for the December 31, 2018 and 2019 actuarial valuations are shown in the table below.

Method	December 31, 2017 Valuation	December 31, 2018 and 2019 Valuations
Cost method	Entry Age Normal (EAN)	No change
UAL Amortization method	UAL amortized as a level percent of combined Tier 1/Tier 2 and OPSRP payroll	No change
UAL Amortization period	<ul style="list-style-type: none"> <li>▪ UAL bases – Closed amortization from the first rate-setting valuation in which experience is recognized               <ul style="list-style-type: none"> <li>– Tier 1/Tier 2 – re-amortized over 20 years effective December 31, 2013</li> <li>– OPSRP – 16 Years</li> <li>– RHIA/RHIPA – 10 years</li> </ul> </li> <li>▪ Newly established side accounts – Aligned with the new Tier 1/Tier 2 base from the most recent rate-setting valuation</li> <li>▪ Newly established transition liabilities or surpluses – 18 years from the date joining the SLGRP (State &amp; Local Government Rate Pool)</li> </ul>	<p>No change to OSRP and RHIA/RHIPA UAL, side accounts, and transition liabilities or surpluses.</p> <p>Current Tier 1/Tier 2 UAL will be re-amortized over 22 years per Senate Bill 1049.</p>
Asset valuation method	Market value	No change
Exclusion of reserves from valuation assets	Contingency Reserve, Capital Preservation Reserve, and Tier 1 Rate Guarantee Reserve (RGR) excluded from valuation assets. RGR is not excluded from valuation assets when RGR is negative (i.e., when the RGR is a deficit reserve).	No change

Method	December 31, 2017 Valuation	December 31, 2018 and 2019 Valuations
Allocation of Benefits in Force (BIF) Reserve	The BIF is allocated to each rate pool in proportion to the retiree liability attributable to the rate pool.	No change
Rate collar	Change in base contribution rate limited (i.e., collared) to greater of 20% of current base rate or 3% of payroll. Size of collar doubles if funded percentage excluding side accounts falls below 60% or increases above 140%. If the funded percentage excluding side accounts is between 60% and 70% or between 130% and 140%, the size of the rate collar is increased on a graded scale. Exclude RHIA and RHIPA (retiree medical) rates from the rate collar calculation.	No change
Liability allocation for actives with multiple employers	<ul style="list-style-type: none"> <li>▪ Allocate Actuarial Accrued Liability 15% (0% for police &amp; fire) based on account balance with each employer and 85% (100% for police &amp; fire) based on service with each employer</li> </ul>	Change allocation to 10% (0% for police & fire) based on account balance and 90% (100% for police & fire) based on service with each employer.
	<ul style="list-style-type: none"> <li>▪ Allocate Normal Cost to current employer</li> </ul>	No change

The methods or procedures are described in greater detail on the following pages.

## Actuarial Cost Method

The total cost of the program, over time, will be equal to the benefits paid less investment earnings and is not affected directly by the actuarial cost method. The actuarial cost method is simply a tool to allocate costs to past, current or future years and thus primarily affects the timing of cost recognition.

The December 31, 2017 valuation used the Entry Age Normal (EAN) method, which allocates costs as a level percentage of payroll across the full projected working career. EAN is the required method under the recently implemented GASB 67 and 68 financial reporting standards, though the Board could choose to use a different method for employer contribution rate calculations. Oregon PERS adopted EAN for all purposes with the December 31, 2012 valuation. Employing a consistent method for both financial reporting and contributions is more understandable to interested parties as only one set of liability and normal cost calculations will be made for each member, employer, and rate pool. The EAN approach is widely used in the actuarial and public plan sponsor community because it provides an actuarially sound estimate of the long-term employer contribution costs of a retirement program as a level percentage of payroll if all assumptions are met. The benefits of this method are unchanged from when the Board previously adopted it, and we recommend continuing to use the EAN cost method.

## Amortization Method

### Unfunded Actuarial Liability

The unfunded actuarial liability (UAL) is amortized as a level percentage of projected combined payroll (Tier 1/Tier 2 plus OPSRP) in order to maintain more level contribution rates as payroll for the closed group of Tier 1/Tier 2 members declines and payroll of OPSRP members increases. We recommend this methodology continue.

The UAL is currently amortized over the following closed periods as a level percent of projected payroll from the first rate-setting valuation in which the experience is recognized:

- Tier 1/Tier 2 – 20 years
- OPSRP – 16 years
- RHIA/RHIPA – 10 years

As part of a collection of method changes made with the 2012 Experience Study, the Board made a policy decision to re-amortize all existing Tier 1/Tier 2 unfunded actuarial liability (UAL) at the December 31, 2013 rate-setting actuarial valuation. Since then, gains and losses between subsequent rate-setting valuations have been amortized as a level percentage of payroll over a closed 20 year period from the rate-setting valuation in which they were first recognized.

Senate Bill 1049 was signed into law in June 2019 and requires a one-time re-amortization of Tier 1/Tier 2 UAL over a closed 22 year period at the December 31, 2019 rate-setting actuarial valuation which will set actuarially determined contribution rates for the 2021-2023 biennium.

### Side Accounts and Transition Liabilities/Surpluses

Prior to the 2010 Experience Study, side accounts and transition liabilities/surpluses were amortized over the period ending December 31, 2027. To better match the amortization periods for new side accounts and new transition liabilities with the amortization of the Tier 1/Tier 2 UAL and to avoid issues related to a shortening amortization period, as part of the 2010 Experience Study the PERS Board adopted the following amortization procedures which are not tied to a fixed date:

- In general, newly established side accounts have been amortized over a 20-year period aligned with the new Tier 1/Tier 2 UAL base from the most recent rate-setting valuation. For example, a side account created in July 2019 would have been amortized to December 31, 2037, aligned with the 20-year Tier 1 /Tier 2 UAL base created in the most recent rate-setting valuation as of December 31, 2017 valuation. Employers who make lump sum payments in accordance with the rules under OAR 459-009-0086(9) may select a shorter amortization period of either 6, 10, or 16 years since the most recent rate-setting valuation.
- New transition liabilities/surpluses are amortized over the 18 year period beginning when the employer joins the SLGRP. This amortization period aligns with the last Tier 1/Tier 2 amortization base established as an independent employer.

We recommend no additional changes to the amortization method or periods of side accounts and new transition liabilities/surpluses. Despite the 22-year re-amortization of Tier 1/Tier 2 UAL as of December 31, 2019 required by SB 1049, we recommend continuing to use a 20-year period as the default schedule for new side account amortizations, to align with both past practice and anticipated future amortization periods for Tier 1/Tier 2.

## Asset Valuation Method

Effective December 31, 2004, the Board adopted market value as the actuarial value of assets, replacing the four-year smoothing method previously used to determine the actuarial asset value, which is used for shortfall (UAL) calculations. Although asset smoothing is a common method for smoothing contribution rates in public sector plans, the smoothed asset value does not provide a transparent measure of the plan's funded status and UAL. Market value provides more transparency to members and other interested parties regarding the funded status of the plan. Instead of smoothing assets, a rate collar method (described below) is used to smooth contribution rates and systematically spread large rate increases across several biennia.

We recommend no change to the asset valuation method.

## Excluded Reserves

Statute provides that the Board may establish Contingency and Capital Preservation reserve accounts to mitigate gains and losses of invested capital and other contingencies, including certain legal expenses or judgments. In addition, statute requires the establishment and maintenance of a Rate Guarantee or Deficit reserve to fund earnings crediting to Tier 1 member regular accounts when actual earnings are below the investment return assumption selected by the Board.

The Contingency and Capital Preservation reserves are excluded from the valuation assets used for employer rate-setting calculations. We recommend no change to the treatment of the Contingency and Capital Preservation reserves.

The Rate Guarantee Reserve (RGR) was positive as of December 31, 2017, but can become negative (in deficit status) if, over time, the required crediting on Tier 1 member accounts exceeds the investment earnings on those accounts. The RGR was negative from the December 31, 2008 valuation to the December 31, 2012 valuation. All else being equal, excluding a negative reserve increases the level of valuation assets used in employer rate-setting calculations. This occurs because subtracting a negative amount is mathematically equivalent to adding a positive amount of the same magnitude. If the negative reserve was larger in absolute value than the sum of the other reserves, this approach would lead to the actuarial value of assets used in shortfall (UAL) calculations being larger than the market value of assets.

As part of the 2010 Experience Study, the Board decided to only exclude the RGR from assets when it is in positive surplus position, and not to subtract a negative RGR (which would increase the actuarial value of assets) when it is in deficit status. We recommend this treatment of the RGR continue.

## Rate Collar Method

Effective December 31, 2004, a rate collar method was adopted that limits biennium to biennium changes in contribution rates to be within a specified “collar” range. The existing rate collar method restricts the change in an employer’s “base” Tier 1/Tier 2 contribution rate (i.e., the rate before contemplation of side account rate offsets or rate adjustments for any pre-pooled obligations) to the greater of 20 percent of the current rate or 3% of payroll. If the funded status excluding side accounts is less than 60% or greater than 140%, the size of the rate collar is doubled. If the funded percentage excluding side accounts is between 60% and 70% or between 130% and 140%, the size of the rate collar is increased on a graded scale.

The rate collar is applied for each employer (or rate pool) prior to any adjustments to the employer contribution rate for side accounts, transition liabilities, or pre-SLGRP pooled liabilities. The rate collar only applies to employer contribution rates for pension benefits. Rates attributable to RHIA and RHIPA (retiree medical) programs are not subject to the collar.

## Liability Allocation for Actives with Multiple Employers

Over the course of a member’s working career, a member may work for more than one employer covered under the Tier 1/Tier 2 program. Since employer contribution rates are developed on an individual employer basis, the member’s liability should be allocated between such a member’s various Tier 1/Tier 2 employers. If all of the member’s employers participate in the same rate pool, the allocation has no effect on rates, but if the employers participate in different pools or are independent, the allocation can have an impact on the different employers’ rates.

When a member retires, PERS allocates the cost of the retirement benefit between the employers the member worked for based on the formula that produces the member’s retirement benefit. If the member’s benefit is calculated under the Money Match approach, the cost is allocated in proportion to the member’s account balance attributable to each employer. If the member’s benefit is calculated under the percent of final average pay Full Formula approach, the cost is allocated in proportion to the service attributable to each employer.

In the period prior to the 2003 system reforms and shortly thereafter, the vast majority of retirement benefits were calculated under the Money Match approach, so the member liability in valuations prior to December 31, 2006 had been allocated in proportion to the member’s account balance attributable to each employer. With no new member contributions to Tier 1/Tier 2, however, this procedure meant no liability was allocated to employers for service after December 31, 2003 in the valuation. As Money Match benefits became less dominant and retirements under the Full Formula approach become more prevalent, a change in the procedure to allocate liability among employers was warranted.

Effective with the December 31, 2006 valuation, a change was made to allocate a member’s actuarial accrued liability among employers based on a weighted average of the Money Match methodology, which utilizes account balance, and the Full Formula methodology, which utilizes service. The methodologies were weighted according to the percentage of the system-wide actuarial accrued liability for new retirements projected to be attributable to the Money Match and Full Formula approaches, respectively, as of the next rate-setting valuation. For the December 31, 2016 and December 31, 2017 valuations, the Money Match method was weighted 15 percent for general service members and 0 percent for police & fire members.

The total actuarial liability for Tier 1/Tier 2 active members estimated to be attributable to the Money Match approach as of December 31, 2018 is 11 percent for General Service members and one percent for Police & Fire members. This continues the decreasing trend of Money Match benefits seen in prior Experience Studies.

We recommend the Money Match approach be weighted 10 percent for general service members. This weighting will continue to be reviewed with each experience study and updated as necessary. For police & fire members we recommend the allocation continue to be based entirely on the Full Formula approach, an assumption first adopted in the 2014 Experience Study, once the Money Match portion of future police & fire retirements fell below 5%.

As in prior valuations, the member's normal cost will continue to be assigned to their current employer.

### 3. Economic Assumptions

#### Overview

Actuarial Standard of Practice (ASOP) No. 27, *Selection of Economic Assumptions for Measuring Pension Obligations*, provides guidance on selecting economic assumptions used in measuring obligations under defined benefit pension plans. ASOP No. 27 suggests that economic assumptions be developed using the actuary's professional judgment, taking into consideration past experience and the actuary's expectations regarding the future. The process for selecting economic assumptions involves:

- Identifying components of each assumption and evaluating relevant data
- Considering factors specific to the measurement along with other general factors
- Selecting a reasonable assumption

Under ASOP No. 27, an assumption is considered reasonable if:

- It is appropriate for the purpose of the measurement,
- It reflects the actuary's professional judgment,
- It takes into account relevant historical and current economic data,
- It reflects the actuary's estimate of future experience, the actuary's observation of estimates inherent in market data, or a combination thereof, and
- It has no significant bias, except when provisions for adverse deviation are included and disclosed.

A summary of the economic assumptions used for the December 31, 2017 actuarial valuation and those recommended for the December 31, 2018 and 2019 actuarial valuations is shown below:

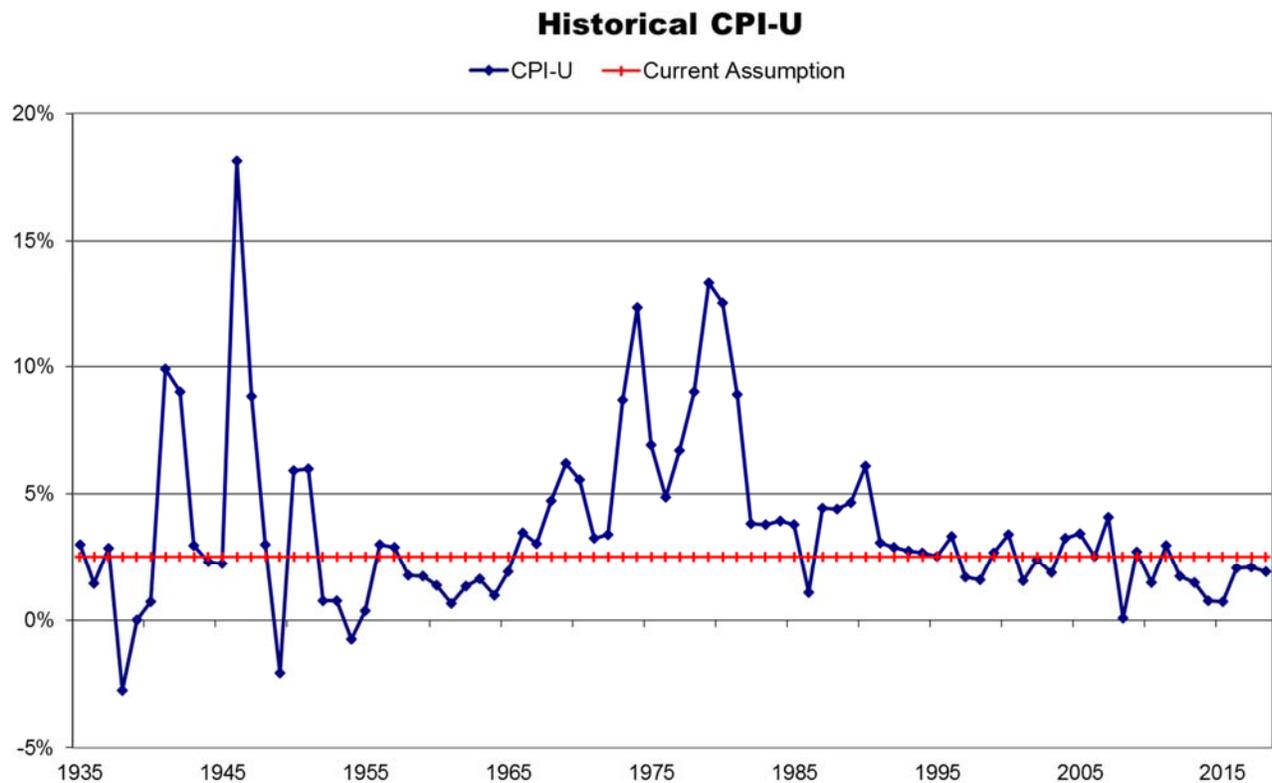
Assumption	December 31, 2017 Valuation	December 31, 2018 and 2019 Valuations
Inflation (other than healthcare)	2.50%	No Change
Real wage growth	1.00%	No Change
Payroll growth	3.50%	No Change
Regular investment return	7.20%	Current assumption is reasonable based on current data from capital market outlook models, but Board should give consideration to a lower rate, which would also be reasonable. Board will select the assumption at its July 26, 2019 meeting
Variable account investment return	Same as regular investment return	Same as regular investment return
Tier 1/Tier 2 administrative expenses	\$37.5 million/year	\$32.5 million/year
OPSRP administrative expenses	\$6.5 million/year	\$8.0 million/year

Assumption	December 31, 2017 Valuation	December 31, 2018 and 2019 Valuations
RHIPA subsidy cost trend rates		
▪ 2019 rate	5.90%	7.10%
▪ Ultimate inflation rate	4.20%	4.10%
▪ Year reaching ultimate rate	2093	2094

The recommended assumptions shown above, in our opinion, were selected in a manner consistent with the requirements of ASOP No. 27. Each of the above assumptions is described in detail below and on the following pages.

## Inflation

The assumed inflation rate is the basis for all of the other economic assumptions. It affects other assumptions including payroll growth, investment return, and healthcare inflation.



In selecting an appropriate inflation assumption, we consider both historical data and the breakeven inflation rates inherent in current long-term Treasury Inflation Protection Securities (TIPS). The chart above shows the annual inflation rate for the years ending December 31 from 1935 through 2018 as reported by the Bureau of Labor Statistics. The mean and median annual rates over this period are **3.60** percent and **2.90** percent respectively.

Historical inflation rates vary significantly from period to period and may not be an indication of future inflation rates. With the development of a TIPS market, we can calculate an estimated breakeven inflation rate by comparing yields on regular Treasury securities to the yields on TIPS. The table below shows yields as of December 31, 2018, for 10-year and 30-year Treasury bonds and TIPS.

As of 12/31/2018	10-Year	30-Year
Treasury Yield	2.69%	3.02%
TIPS Yield	0.98%	1.21%
<b>Breakeven Inflation</b>	1.71%	<b>1.81%</b>

We also considered three other inflation measures in our analysis: Social Security’s intermediate inflation projection average of 2.53 percent over the period 2019-2029 (with an ultimate rate of **2.60** percent), the Medicare Trustees’ intermediate assumption of 3.20 percent inflation for ten years and **2.60** percent thereafter, and the Congressional Budget Office’s projection of CPI of an average of 2.37 percent inflation over the period 2019-2029. These measures were taken from, respectively, the 2018 OASDI Trustees Report, the 2018 Annual Report of the Boards of Trustees of the Federal Hospital Insurance and Federal Supplementary Medical Insurance Trust Funds, and *The Budget and Economic Outlook: 2019 to 2029* published by the CBO in January 2019.

Based on the information shown above, we consider the current assumption of 2.50 percent to continue to be reasonable and appropriate. We recommend no change to the assumption at this time.

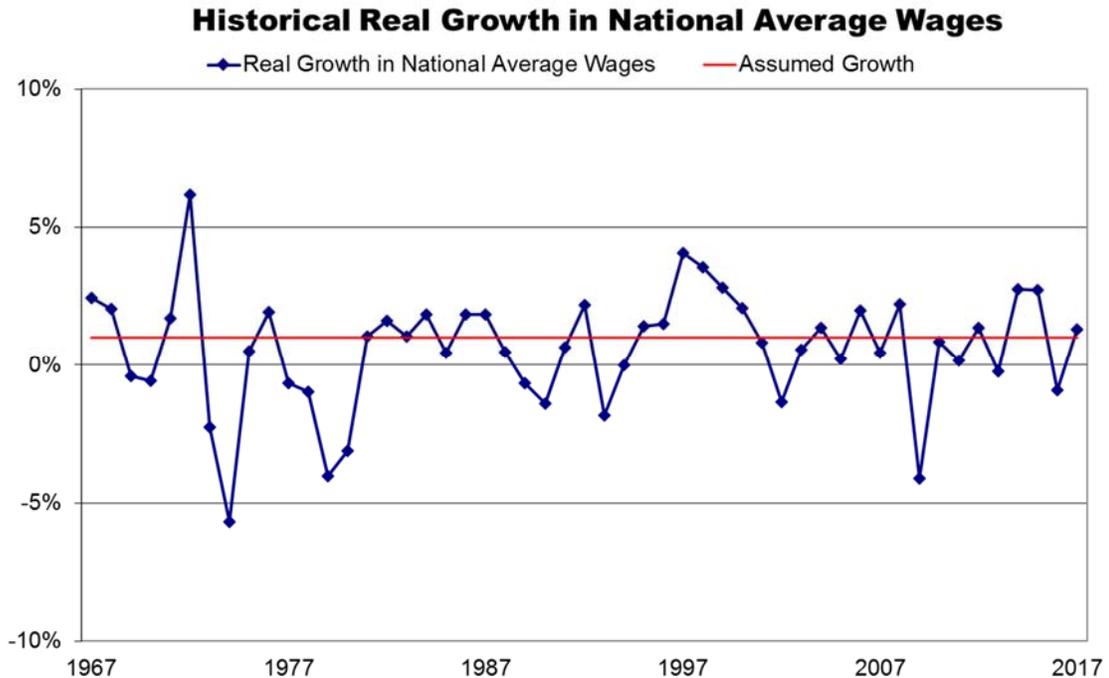
## Real Wage Growth

The expected salary growth assumption is the sum of three factors:

- Inflation,
- Real wage growth, and
- Merit and longevity wage growth.

Real wage growth represents the increase in wages above inflation for an entire population due to improvements in productivity and competitive pressures. Merit and longevity wage growth, in contrast, represent the increases in wages for an individual due to factors such as performance, promotion, or seniority.

The chart below shows the real growth in national average wages over the past fifty years based on data compiled by the Social Security Administration.



While the change in any one year has been volatile, the change over longer periods of time is more stable as shown in the table below. However, the significant outlier result of a 4.1 percent productivity decrease in 2009 (measuring change in national average wages from 2008 to 2009) has a strong downward impact on the trailing averages shown in the table below. For example, the 10 year trailing average ending on December 31, 2008, is 1.11 percent.

Length of Period Ending December 31, 2017	Average Real Growth in National Average Wages
10 years	0.59%
20 years	0.92%
30 years	0.82%
40 years	0.65%
50 years	0.57%

We also considered the Social Security Administration’s current long-term intermediate wage growth assumption of 1.21 percent in our analysis.

Based on the combination of historical data and forecasted future experience, we consider the current assumption of 1.00 percent to continue to be reasonable and appropriate. We recommend no change to the assumption at this time.

## Payroll Growth

Real wage growth combined with inflation represents the expected growth in total payroll for a stable population. Changes in payroll due to an increase or decline in the covered population are not captured by

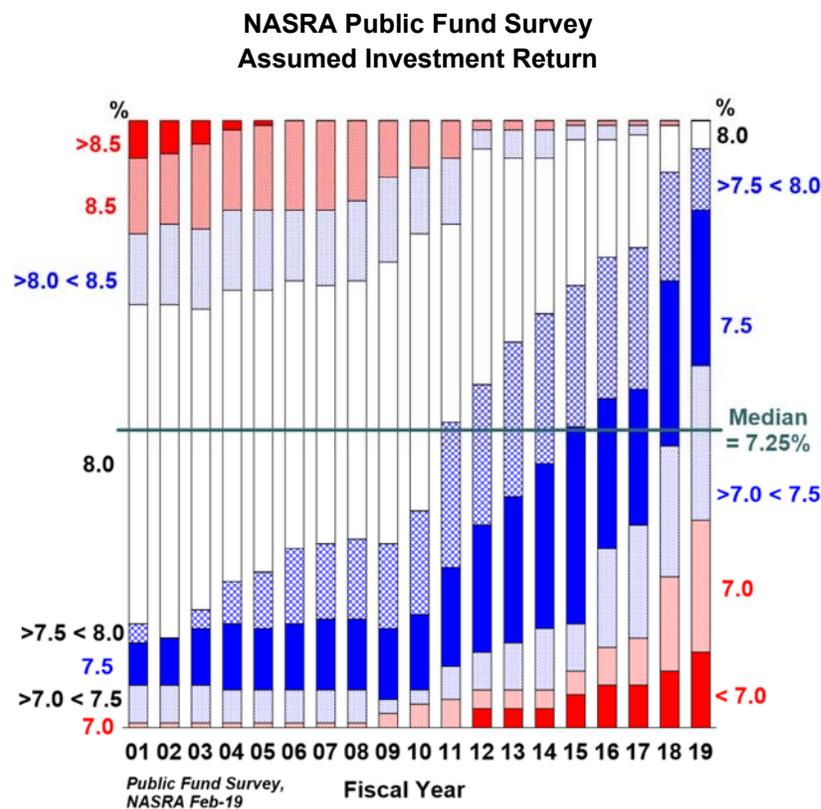
this assumption. The payroll growth assumption is used to develop the annual amount necessary to amortize the unfunded actuarial liability as a level percentage of projected future payroll.

Since we are recommending no changes to the inflation assumption or real wage growth assumption, we recommend that the payroll growth assumption should remain at 3.50 percent.

### Investment Return

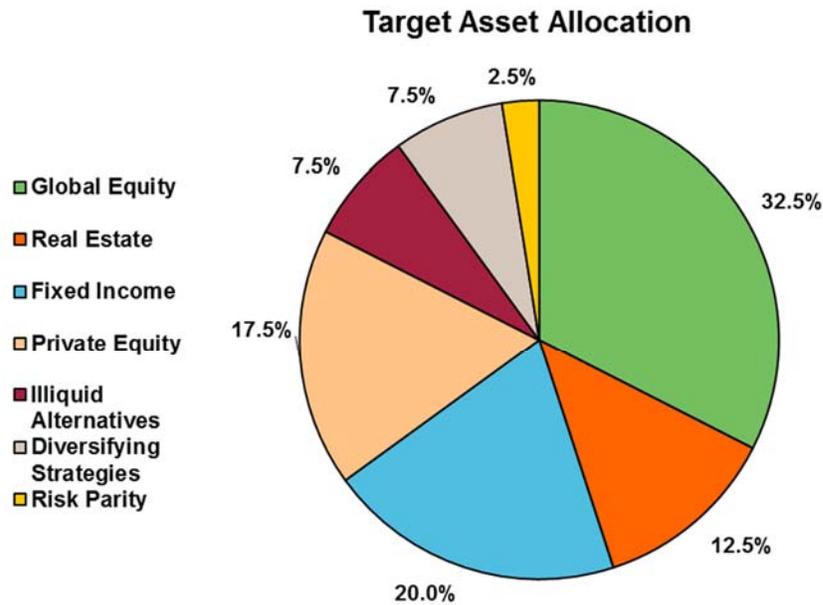
The assumed rate of investment return is used to calculate the present value as of the actuarial valuation date of future projected benefit payments from the retirement plan, to project interest credits applied to member accounts until retirement, to convert member accounts to a monthly retirement allowance under the Money Match formula, and to convert the retirement allowance to optional joint & survivor benefits. As such, it is one of the most important assumptions used in valuing the plan’s liabilities and developing contribution rates. The assumption is intended to reflect the long-term expected future return on the portfolio of assets that fund the benefits.

To provide some perspective on this assumption, the chart below shows the assumptions used by the 129 largest US public sector systems in a regularly updated survey published by the National Association of State Retirement Administrators (NASRA). As can be seen from the chart (updated in NASRA’s February 2019 Issue Brief), the Oregon PERS assumption of 7.20% used in the prior valuation is currently slightly lower than the median assumption for large US public sector systems. The arithmetic average (mean) of the return assumptions in the chart is 7.27%. Given the consensus view among investment professionals regarding low long-term expected returns for fixed income investments (relative to historical averages) and average future inflation , we believe that this downward trend in the survey will continue in the future as systems periodically revisit their investment return assumptions.



### Regular Accounts

Based on the Oregon Investment Council’s (OIC) Statement of Investment Objectives and Policy Framework for the Oregon Public Employees Retirement Fund as most recently revised on April 24, 2019, we understand the target asset allocation adopted by the OIC is as follows:



To develop an analytical basis for the Board’s selection of the investment return assumption, we use long-term assumptions developed by Milliman’s capital market assumptions team for each of the asset classes in which the plan is invested based on the OIC’s long-term target asset allocation. Since the OIC uses broader asset classes than those for which Milliman’s investment professionals develop long-term return assumptions, we used OIC’s description of each asset class to map it to the classes shown below. For example, the OIC’s allocation to “illiquid alternatives” was distributed among hedge funds, infrastructure, and commodities based on the detail available. Each asset class assumption is based on a consistent set of underlying assumptions, including the inflation assumption. These assumptions are not based on average historical returns, but instead are based on a forward-looking capital market economic model. Based on the target allocation and investment return assumptions for each of the asset classes, our model’s 50<sup>th</sup> percentile output is developed as follows:

Asset Class	Target Allocation	Annual Arithmetic Mean	20-Year Annualized Geometric Mean	Annual Standard Deviation
Core Fixed Income	9.60%	4.14%	4.07%	3.90%
Short-Term Bonds	9.60%	3.70%	3.68%	2.10%
Bank/Leveraged Loans	3.60%	5.40%	5.19%	6.85%
High Yield Bonds	1.20%	6.13%	5.74%	9.35%

Asset Class	Target Allocation	Annual Arithmetic Mean	20-Year Annualized Geometric Mean	Annual Standard Deviation
Large/Mid Cap US Equities	16.17%	7.35%	6.30%	15.50%
Small Cap US Equities	1.35%	8.35%	6.68%	19.75%
Micro Cap US Equities	1.35%	8.86%	6.79%	22.10%
Developed Foreign Equities	13.48%	8.30%	6.91%	17.95%
Emerging Market Equities	4.24%	10.35%	7.69%	25.35%
Non-US Small Cap Equities	1.93%	8.81%	7.25%	19.10%
Real Estate (REITS)	2.50%	8.29%	6.69%	19.30%
Real Estate (Property)	10.00%	6.19%	5.55%	12.00%
Timber	1.13%	6.36%	5.61%	13.00%
Farmland	1.13%	6.87%	6.12%	13.00%
Infrastructure	2.25%	7.51%	6.67%	13.85%
Private Equity	17.50%	11.95%	8.33%	30.00%
Commodities	1.13%	5.34%	3.79%	18.70%
Hedge Fund of Funds – Diversified	1.50%	4.28%	4.06%	6.90%
Hedge Fund – Event-driven	0.38%	5.89%	5.59%	8.10%
<b>Portfolio – Net of Investment Expenses</b>	100.00%	7.55%	<b>6.91%*</b>	<b>12.14%</b>

\*The Milliman model’s 20-year annualized geometric median is 6.87%.

Based on capital market expectations developed by credentialed investment professionals at Milliman.

We compared the expected return to the range of returns developed using a mean-variance model and the capital market assumptions of both Milliman and Callan, the OIC’s investment consultant. These capital market assumptions were developed based on year-end 2018 market conditions. In addition, we modeled the returns projected for the OIC’s asset allocation using the 10-year capital market assumptions from the 2018 Survey of Capital Market Assumptions published by Horizon Actuarial Services, LLC in August 2018. Returns shown below are net of passive investment expenses. In our modeling, we assumed that expenses incurred for active management are offset by additional returns gained from active management.

The table below compares the median of expected annualized returns calculated on a geometric basis for the Regular Account based on Milliman’s and Callan’s capital market assumptions, and based on the average assumptions from the Horizon survey.

	Callan	Horizon	Milliman
Median annualized geometric return	7.32%	6.64%	6.87%
Assumed inflation	2.25%	2.24%	2.50%
Timeframe modeled	10 years	10 years	20 years

It is common practice among public pension systems for the investment return assumption to be a multiple of either a tenth- or quarter-point (i.e., 0.10% or 0.25%). The lack of additional precision in selected assumptions can reasonably be attributed to the inability to have precise knowledge in advance regarding future investment returns. The median annualized return for the 10-year outlook from Callan (the investment advisor to the Oregon Investment Council) was 7.32%. The median annualized return for a 20-year time horizon based on Milliman's capital market outlook was 6.87%. Those model outputs are based on the forward-looking return expectations of the investment professionals from those firms, and before any potential active management adjustments. Actual future investment returns are not determined by the assumed rate of return. Selecting an assumed return materially above the 50<sup>th</sup> percentile implies a materially greater than 50% chance of actual long-term future experience falling short of the selected assumption.

Both the Callan and Milliman models use capital market assumptions developed shortly after the end of 2018 and reflect the significant market downturn in the fourth quarter of that year in the underlying starting point. Our understanding is the relatively lower asset prices and P/E ratios as of December 31, 2018 would work to increase the forward-looking expected returns in many asset classes, based upon the analytical framework of both models. Since equity markets subsequently increased significantly in the first half of 2019, an updated version of these models may produce lower expected future returns, all else equal.

Based on the capital market outlooks modeled, we believe the current investment return assumption is reasonable. However, the PERS Board should give consideration to reducing the assumption out of acknowledgement of the uncertainty of future outlooks and the variance of single point-in-time measurement models such as those discussed above.

## Variable Account

The variable account is invested entirely in Global Equities. As a result, the annual expected arithmetic return is significantly higher than for the regular account, but so is the standard deviation. The result is a long-term compounded geometric annual return similar to the regular account, based on Milliman's capital market assumptions. Prior to the December 31, 2012 valuation, the compound geometric variable account return was assumed to be higher than the regular account return. Beginning with that valuation, the variable account return assumption was set equal to the regular account return assumption, as the relationship between the various asset classes no longer warranted such a distinction in our opinion. We recommend continuing to set the variable account return assumption equal to the regular account return assumption.

## Administrative Expenses

In accordance with GASB Statements No. 67 and No. 68, the long-term investment return assumption is considered to be gross of administrative expenses. In order to account for expected administrative expenses, we develop explicit assumptions for both Tier 1/Tier 2 and OPSRP based on recent and expected future experience. The assumed expenses for each program are added to the normal cost in the calculation of contribution rates in order to fund expenses each year as they occur.

The Tier 1/Tier 2 assumed administrative expenses in the December 31, 2017 valuation were \$37.5 million per year and the OPSRP assumed administrative expenses were \$6.5 million. A summary of recent actual administrative expenses for both Tier 1/Tier 2 and OPSRP is shown below.

Year	Tier 1/Tier 2		OPSRP	
	Dollar Amount (\$ millions)	Percentage of Beginning of Year Assets	Dollar Amount (\$ millions)	Percentage of Beginning of Year Assets
2014	\$30.1	0.06%	\$5.0	0.30%
2015	\$31.5	0.06%	\$5.7	0.28%
2016	\$35.8	0.07%	\$5.9	0.25%
2017	\$35.1	0.07%	\$5.9	0.20%
2018	\$29.1	0.05%	\$7.6	0.18%

Based on PERS financial reporting information reviewed as part of this study, we recommend setting the assumed actual administrative expenses for 2018 and 2019 at \$32.5 million for Tier 1/Tier 2 and \$8.0 million for OPSRP. These amounts reflect recent historical experience with an expectation of inflation-related growth for the next two years.

### RHIPA Subsidy Cost Trend Rates

Trend rates are used to estimate increases in the employer cost of the RHIPA subsidy. Based on analysis performed by Milliman’s healthcare actuaries, we recommend the following change to the healthcare cost trend assumption. These rates include consideration of the excise tax scheduled to be introduced in 2022 by the Affordable Care Act.

Note that the following chart shows sample rates. A full chart can be found in the appendices.

Year	December 31, 2016 and 2017 Valuations	December 31, 2018 and 2019 Valuations
2017	7.5%	N/A
2018	6.5%	N/A
2019	5.9%	7.1%
2020	5.4%	5.8%
2021	5.3%	5.2%
2022	5.3%	5.0%
2023	5.3%	5.0%
2024	5.2%	5.0%
2025	5.2%	5.1%
2026	5.3%	5.0%
2027	5.3%	5.0%
2028	5.4%	5.0%
2029	6.2%	5.0%
2030	6.2%	5.4%

Year	December 31, 2016 and 2017 Valuations	December 31, 2018 and 2019 Valuations
2035	6.1%	5.9%
2040	6.0%	5.7%
2045	5.6%	5.6%
2050	5.4%	5.4%
2060	5.2%	5.1%
2070	4.6%	4.5%
2080	4.3%	4.2%
2090	4.3%	4.2%
2094+	4.2%	4.1%

## 4. Demographic Assumptions

### Overview

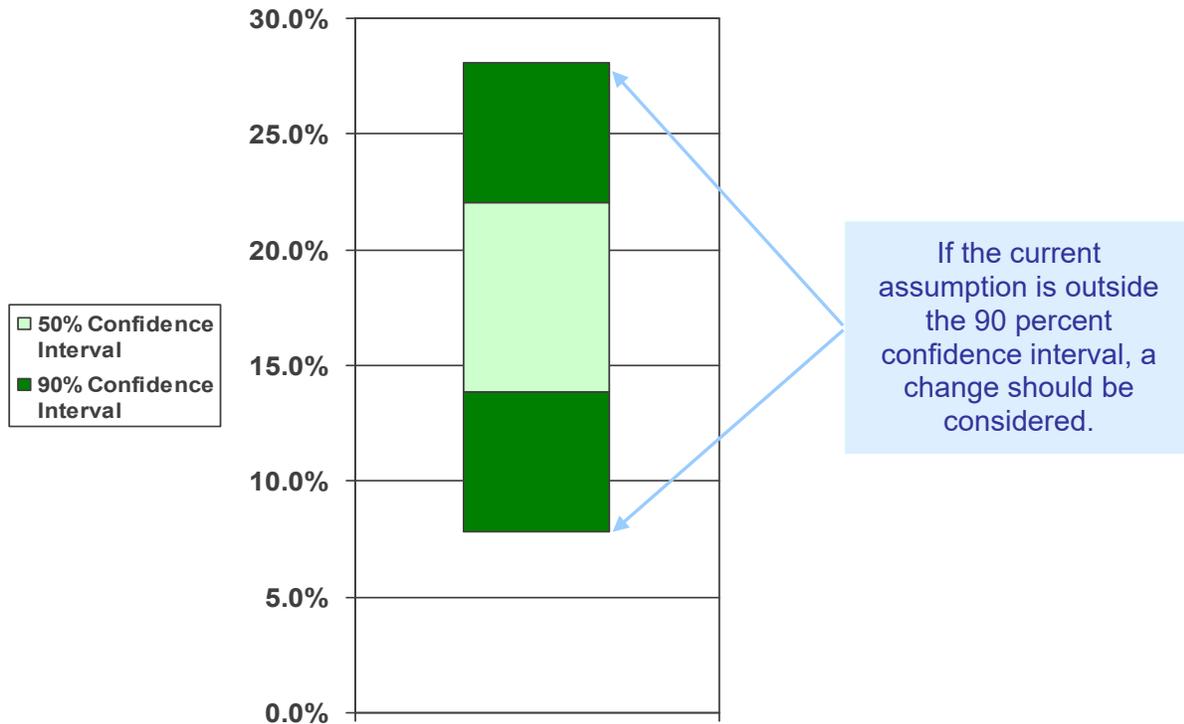
Actuarial Standard of Practice (ASOP) No. 35, *Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations*, provides guidance on selecting demographic assumptions used in measuring obligations under defined benefit pension plans. The general process for recommending demographic assumptions as defined in ASOP No. 35 is as follows:

- Identify the types of assumptions;
- Consider the relevant assumption universe;
- Consider the assumption format;
- Select the specific assumptions; and
- Evaluate the reasonableness of the selected assumption.

The purpose of the demographic experience study is to compare actual experience against expected experience based on the assumptions used in the most recent actuarial valuation. The observation period used in this study is January 1, 2015 through December 31, 2018, and the current assumptions are those adopted by the Board for the December 31, 2017 actuarial valuation. If the actual experience differs significantly from the overall expected experience, or if the pattern of actual experience by age, sex, or duration does not follow the expected pattern, new assumptions are considered.

Confidence intervals have been used to measure observed experience against current assumptions to determine the reasonableness of the assumption. The floating bars represent the 50 percent and 90 percent confidence intervals around the observed experience. The 90 percent confidence interval represents the range around the observed rate that could be expected to contain the true rate during the period of study with 90 percent probability. The size of the confidence interval depends on the number of observations and the likelihood of occurrence. If an assumption is outside the 90 percent confidence interval and there is no other information to explain the observed experience, a change in assumption should be considered. A sample graph with confidence intervals is shown below:

## Overview (continued)



The demographic assumptions used for the December 31, 2017 actuarial valuation and the recommended assumptions for the December 31, 2018 and December 31, 2019 actuarial valuations are shown in detail in the following sections.

A summary of the changes recommended to the Board are as follows:

- Adjust mortality assumptions to use the new “Pub-2010” base tables and a standard update to the mortality improvement scale, which is based on 60-year unisex average Social Security experience.
- Adjust retirement rates for certain member categories and service bands to more closely align with recent and expected future experience; reduce percentage of future retirees assumed to elect a partial lump sum; increase percentage of members assumed to purchase credited service at retirement.
- Increase the merit component of the salary increase assumption for two member categories based on observations of the last eight years of experience.
- Update pre-retirement termination of employment assumptions for two member categories.
- Lower assumed rates of ordinary (non-duty) disability and general service duty disability to more closely match recent experience.
- Increase the Tier 1 unused vacation cash out assumption for most member categories.
- Adjust the Tier 1/Tier 2 unused sick leave assumption for five member categories to more closely reflect recently observed experience.
- Decrease the healthy participation assumption for the RHIA retiree healthcare program.
- Decrease the RHIPA participation assumption for most service bands.

The recommended assumptions, in our opinion, were selected in a manner consistent with the requirements of ASOP No. 35.

## Mortality

Mortality rates are used to project the length of time benefits will be paid to current and future retirees and beneficiaries. The selection of a mortality assumption affects plan liabilities because the estimated present value of retiree benefits depends on how long the benefit payments are expected to continue. There are clear differences in the mortality rates among healthy retired members, disabled retired members, and non-retired members. As a result, each of these groups is reviewed independently.

A summary of the current assumed mortality rates and recommended changes is shown below:

Assumption	Recommended December 31, 2016 and 2017 Valuations	Recommended December 31, 2018 and 2019 Valuations
<b>Healthy Annuitant Mortality</b>	<b>RP-2014 Healthy Annuitant, Sex Distinct, Generational Projection with Unisex Social Security Data Scale</b>	<b>Pub-2010 Healthy Retiree, Sex Distinct, Generational Projection with Unisex Social Security Data Scale</b>
<ul style="list-style-type: none"> <li>▪ School District male</li> </ul>	White collar, set back 12 months	Teachers, no set back
<ul style="list-style-type: none"> <li>▪ Other General Service male (and male beneficiary)</li> </ul>	Blended 50% blue collar/50% white collar, set back 12 months	General Employees, set back 12 months
<ul style="list-style-type: none"> <li>▪ Police &amp; Fire male</li> </ul>	Blended 50% blue collar/50% white collar, set back 12 months	Public Safety, no set back
<ul style="list-style-type: none"> <li>▪ School District female</li> </ul>	White collar, set back 12 months	Teachers, no set back
<ul style="list-style-type: none"> <li>▪ Other General Service female (and female beneficiary)</li> </ul>	Blended 50% blue collar/50% white collar, no set back	General Employees, no set back
<ul style="list-style-type: none"> <li>▪ Police &amp; Fire female</li> </ul>	Blended 50% blue collar/50% white collar, no set back	Public Safety, set back 12 months
<b>Disabled Retiree Mortality</b>	<b>RP-2014 Disabled Retiree, Sex Distinct, Generational Projection with Unisex Social Security Data Scale</b>	<b>Pub-2010 Disabled Retiree, Sex Distinct, Generational Projection with Unisex Social Security Data Scale</b>
<ul style="list-style-type: none"> <li>▪ Police &amp; Fire male</li> </ul>	No collar adjustment, no set back	Blended 50% Public Safety, 50% Non-Safety, no set back
<ul style="list-style-type: none"> <li>▪ Other General Service male</li> </ul>	No collar adjustment, no set back	Non-Safety, set forward 24 months
<ul style="list-style-type: none"> <li>▪ Police &amp; Fire female</li> </ul>	No collar adjustment, no set back	Blended 50% Public Safety, 50% Non-Safety, no set back
<ul style="list-style-type: none"> <li>▪ Other General Service female</li> </ul>	No collar adjustment, no set back	Non-Safety, set forward 12 months
<b>Non-Annuitant Mortality</b>	<b>RP-2014 Employee, Sex Distinct, Generational Projection with Unisex Social Security Data Scale</b>	<b>Pub-2010 Employee, Sex Distinct, Generational Projection with Unisex Social Security Data Scale</b>
<ul style="list-style-type: none"> <li>▪ School District male</li> </ul>	Same collar and set back as Healthy Annuitant assumption	120% of same table and set back as Healthy Annuitant assumption
<ul style="list-style-type: none"> <li>▪ Other General Service male</li> </ul>	Same collar and set back as Healthy Annuitant assumption	115% of same table and set back as Healthy Annuitant assumption

### Mortality (*continued*)

Assumption	Recommended December 31, 2016 and 2017 Valuations	Recommended December 31, 2018 and 2019 Valuations
▪ Police & Fire male	Same collar and set back as Healthy Annuitant assumption	100% of same table and set back as Healthy Annuitant assumption
▪ School District female	Same collar and set back as Healthy Annuitant assumption	100% of same table and set back as Healthy Annuitant assumption
▪ Other General Service female	Same collar and set back as Healthy Annuitant assumption	125% of same table and set back as Healthy Annuitant assumption
▪ Police & Fire female	Same collar and set back as Healthy Annuitant assumption	100% of same table and set back as Healthy Annuitant assumption

### Mortality Improvement Scale

Mortality rates are expected to continue to decrease in the future, and the resulting increased longevity should be anticipated in the actuarial valuation. For Oregon PERS, this is done through the use of a generational mortality assumption, which incorporates a base table and a projection scale. The base table defines the mortality rates assumed at each age in a single specific calendar year, while the projection scale defines how quickly the mortality rates at each individual age are assumed to improve in future calendar years.

The current assumed mortality improvement scale is based on 60-year unisex average mortality improvement rates by age, calculated using Social Security data through 2013. Our recommendation is to update the mortality improvement scale based on Social Security data through 2015 (the most recent publically released data at the time we updated the improvement scale). We believe this meets the “*best actuarial information on mortality at the time*” standard mandated by ORS 238.607. A full listing of the recommended projection scale rates is included in the appendix.

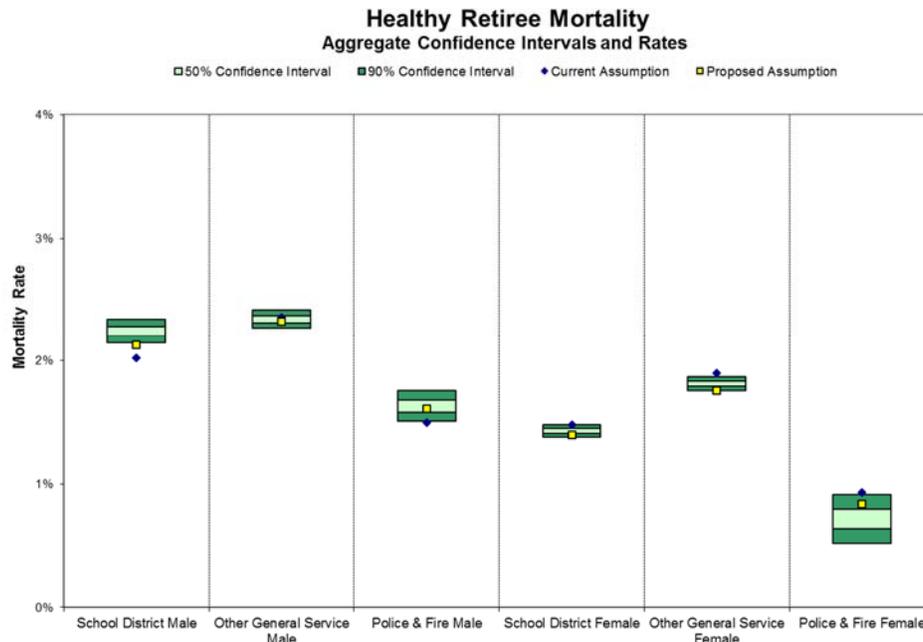
### Healthy Annuitant Mortality

Mortality assumptions for healthy retired members are separated into six groups based on employment category and gender (school district males, school district females, police & fire males, police & fire females, other general service males, other general service females). Beneficiaries were combined with non-school district general service members of the same gender. In prior experience studies, female police & fire members were not rated separately due to the relatively small size of the data set. However, the release of the Pub-2010 tables allowed us to make use of a larger, statistically credible data source specific to female police & fire retirees, so we now recommend a distinct assumption for this group.

To assist in review of the current mortality assumptions’ reasonability, we calculated the ratio of actual deaths to expected deaths (A/E ratio) during the experience study period for each of the six groups described above. In the prior study, mortality assumptions were targeted to achieve an A/E ratio of approximately 100 percent (from 98 to 103 percent) on a benefits-weighted basis. In the current study, A/E ratios for most groups remained near 100 percent, though both school district males and police & fire males showed an increase in the A/E ratio. Though the prior assumption basis continues to match experience reasonably well, we recommend updating the assumption to use the recently-published Pub-2010 mortality tables, as discussed below.

### Mortality (continued)

	Benefits-Weighted (\$1,000s of monthly benefits)		Current Assumption		Recommended Assumption	
	Exposures	Actual Deaths	Expected Deaths	A/E Ratio	Expected Deaths	A/E Ratio
School District male	209,554	4,699	4,229	111%	4,462	105%
Other General Service male (and male beneficiary)	348,098	8,149	8,208	99%	8,078	101%
Police & Fire male	108,651	1,771	1,628	109%	1,744	102%
School District female	320,325	4,576	4,740	97%	4,475	102%
Other General Service female (and female beneficiary)	314,936	5,702	5,967	96%	5,537	103%
Police & Fire female	12,871	92	120	76%	108	85%



We recommend moving from the RP-2014 mortality tables to the Pub-2010 mortality tables (released by the Society of Actuaries in January 2019) as the underlying base tables for generational mortality assumptions in the current study. The Pub-2010 mortality tables reflect experience that is both more recent and more relevant to the Oregon PERS member population. Despite the name, the RP-2014 family of mortality tables reflects experience from 2004 to 2008, while the Pub-2010 tables reflect observed experience from calendar years 2008-2013, with 2010 as the middle of the observation period. At least as importantly, the Pub-2010 tables are based exclusively upon data gathered from large public sector pension systems (including Oregon PERS) for the first modern study specific to the mortality experience of public pension plans, while the RP-2014 tables are based solely on private sector plan experience. As a result, the recommended assumptions are expected to better reflect the composition of Oregon PERS membership and the System’s anticipated future mortality experience.

## Mortality (*continued*)

In the Pub-2010 study, different gender-distinct mortality tables were published for three separate job categories: teachers, public safety, and general employees. When selecting a table to match the mortality rates of Oregon PERS, we started from the category table most applicable to the portion of the population under consideration, and then adjusted, if needed, to more closely align with recent Oregon PERS experience. At times we use a “set back” to adjust the mortality rates. A “set back” of 12 months, for example, treats all members as if they were 12 months younger than they really are when applying the mortality table, which results in lower assumed mortality rates for members.

A summary of the current and recommended healthy retiree mortality assumptions is shown below:

	Recommended December 31, 2016 and 2017 Valuations	Recommended December 31, 2018 and 2019 Valuations
<b>Basic Table</b>	<b>RP-2014 Healthy Annuitant, Sex Distinct, Generational Projection with Unisex Social Security Data Scale</b>	<b>Pub-2010 Healthy Retiree, Sex Distinct, Generational Projection with Unisex Social Security Data Scale</b>
School District male	White collar, set back 12 months	Teachers, no set back
Other General Service male (and male beneficiary)	Blended 50% blue collar/50% white collar, set back 12 months	General Employees, set back 12 months
Police & Fire male	Blended 50% blue collar/50% white collar, set back 12 months	Public Safety, no set back
School District female	White collar, set back 12 months	Teachers, no set back
Other General Service female (and female beneficiary)	Blended 50% blue collar/50% white collar, no set back	General Employees, no set back
Police & Fire female	Blended 50% blue collar/50% white collar, no set back	Public Safety, set back 12 months

## Disabled Retiree Mortality

Disabled members are expected to experience higher mortality rates at a given age than non-disabled retired members. As a result, disabled member mortality experience is analyzed separately from that of non-disabled annuitants and beneficiaries. We recommend using the Pub-2010 Disabled Retiree mortality tables and the 60-year average unisex Social Security projection scale as the starting point for setting disabled mortality assumptions in the current study. This will maintain a consistent basis for disabled and non-disabled retiree assumptions, as has been the case in prior studies.

In prior studies, we have recommended applying adjustments to the underlying disabled mortality tables published by the SOA where needed in order to more closely match assumptions to recent Oregon PERS experience. For this study, we compared recent Oregon PERS experience to the Pub-2010 Disabled Retiree mortality tables on a benefits-weighted approach to see whether similar adjustments would be advisable.

### Mortality (continued)

	Benefits-Weighted (\$1,000s of monthly benefits)		Current Assumption		Recommended Assumption	
	Exposures	Actual Deaths	Expected Deaths	A/E Ratio	Expected Deaths	A/E Ratio
Disabled Police & Fire male	7,930	177	256	69%	166	107%
Disabled General Service male	10,593	470	432	109%	445	106%
Disabled Police & Fire female	1,586	24	30	80%	23	106%
Disabled General Service female	14,781	439	396	111%	423	104%

In prior studies, disabled police & fire members were not rated separately due to the relatively small amount of experience for such members. However, the Pub-2010 report includes tables developed specifically for disabled police & fire members based on statistically credible data sets for these populations, so we were able to refine this assumption. Using a benefits-weighted approach, the selected variations of the Pub-2010 Disabled Retiree mortality tables fell within a 90 percent confidence interval around observed experience for all groups.



## Mortality (*continued*)

A summary of current and recommended disabled retiree mortality assumptions is shown below:

	Recommended December 31, 2016 and 2017 Valuations	Recommended December 31, 2018 and 2018 Valuations
<b>Basic Table</b>	<b>RP-2014 Disabled Retiree, Sex Distinct, Generational Projection with Unisex Social Security Data Scale</b>	<b>Pub-2010 Disabled Retiree, Sex Distinct, Generational Projection with Unisex Social Security Data Scale</b>
Disabled Police & Fire male	No collar adjustment, no set back	Blended 50% Public Safety, 50% Non-Safety, no set back
Disabled General Service male	No collar adjustment, no set back	Non-Safety, set forward 24 months
Disabled Police & Fire female	No collar adjustment, no set back	Blended 50% Public Safety, 50% Non-Safety, no set back
Disabled General Service female	No collar adjustment, no set back	Non-Safety, set forward 12 months

### ***Non-Annuitant Mortality***

The non-annuitant mortality assumption applies to active members and dormant members (those members who have terminated employment but have a vested right to a future benefit). As with the other mortality assumptions, we recommend using the Pub-2010 mortality tables and the 60-year average unisex Social Security projection scale as the starting point for setting mortality assumptions for this group. This will maintain a consistent basis for mortality assumptions, as has been the case in prior studies.

For a given age and gender, an employed person is on average less likely to die in a given year than a retired person of the same age and gender. For the current study we recommend using separate Pub-2010 Healthy Retiree and Pub-2010 Employee mortality tables for healthy annuitants and non-annuitants, respectively. Each Healthy Retiree table published by the SOA has a corresponding Employee table, which reflects differences in the anticipated mortality rates for the retiree and employee populations.

For each population subgroup, we recommend using the Pub-2010 Employee table (including adjustments) that corresponds to the Healthy Retiree table selected for that subgroup, and then adjusting the mortality rates with a scaling factor if needed to better match recent Oregon PERS experience. For example, mortality for non-annuitant School District males will be assumed to follow the Pub-2010 Employee table for the teacher job category, with no set back, and will be projected generationally using the Social Security Unisex Scale (all of which parallels treatment for the corresponding retiree group), and will be scaled by a factor of 120% to better match the aggregate Oregon PERS-specific experience of the relevant employee group.

The relative values of corresponding Pub-2010 Employee and Healthy Retiree mortality tables were developed by the SOA based on a much larger population than that of Oregon PERS. As a result, we believe it is preferable to reflect that relationship as the starting point when developing non-annuitant versions of the recommended healthy annuitant mortality tables for Oregon PERS. The analysis below compares recent experience in aggregate for the non-annuitant population under this approach. This comparison was done on a headcount-weighted basis only, since the final level of retirement benefits cannot be predicted with certainty for current active members.

**Mortality (continued)**

	Headcount-Weighted		Current Assumption		Recommended Assumption	
	Exposures	Actual Deaths	Expected Deaths	A/E Ratio	Expected Deaths	A/E Ratio
Total Non-Annuitant Experience	826,764	1,091	1,102	99%	968	113%

In aggregate, using the Pub-2010 Employee mortality tables corresponding to the relevant recommended Healthy Retiree mortality tables for each subgroup and adjusted as noted below produces an A/E ratio of 113 percent. For a headcount-weighted analysis, we would prefer an A/E ratio between 110 percent and 120 percent to approximate an outcome similar to targeting 100 percent on a benefits-weighted basis. The actual A/E ratio of 113 percent shown above fits well within this range.

A summary of the current and recommended non-annuitant mortality assumptions is shown below:

	Recommended December 31, 2016 and 2017 Valuations	Recommended December 31, 2018 and 2019 Valuations
Basic Assumption	<b>RP-2014 Employee, Sex Distinct, Generational Projection with Unisex Social Security Data Scale</b>	<b>Pub-2010 Employee, Sex Distinct, Generational Projection with Unisex Social Security Data Scale</b>
School District male	White collar, set back 12 months	120% of Teachers, no set back
Other General Service male	Blended 50% blue collar/50% white collar, set back 12 months	115% of General Employees, set back 12 months
Police & Fire male	Blended 50% blue collar/50% white collar, set back 12 months	100% of Public Safety, no set back
School District female	White collar, set back 12 months	100% of Teachers, no set back
Other General Service female	Blended 50% blue collar/50% white collar, no set back	125% of General Employees, no set back
Police & Fire female	Blended 50% blue collar/50% white collar, no set back	Public Safety, set back 12 months

## Retirement Assumptions

The retirement assumptions used in the actuarial valuation include the following assumptions:

- Retirement from active status
- Probability a member will elect a lump sum option at retirement
- Percentage of members who elect to purchase credited service at retirement.
- Probability a member will remain an Oregon resident during retirement.

### ***Retirement from Active Status***

Members are eligible to retire as early as age 55 (50 for police & fire members), or earlier if the member has 30 years of service. In our analysis, we have found significant differences in the retirement patterns based on length of service, employment category (general service or police & fire), and eligibility for unreduced benefits.

A summary of the early, normal, and unreduced retirement dates under the plan are as follows:

Employment Category	Tier	Normal Retirement Age	Early Retirement Age	Unreduced Retirement
General Service	1	58	55	30 years of service
General Service	2	60	55	30 years of service
General Service	OPSRP	65	55	Age 58 with 30 years
Police & Fire	1 and 2	55	50	30 years of service, or age 50 with 25 years of service
Police & Fire	OPSRP	60	50	Age 53 with 25 years
State Judiciary	N/A	65	60	60 if Plan B; N/A if Plan A

### ***Structure for Retirement Rates***

The structure of the PERS retirement rate assumption separates rates by job classification and by service level. General service rates differ across three service bands: less than 15 years, 15 to 29 years, and 30 or more years of service. Each service band has different assumptions for school districts versus all other general service members. Police & fire rates employ the following three service bands: less than 13 years, 13 to 24 years, and 25 or more years of service.

The service band structure anticipates that member retirement decisions will contemplate the amount of the retirement benefit and the affordability of retirement.

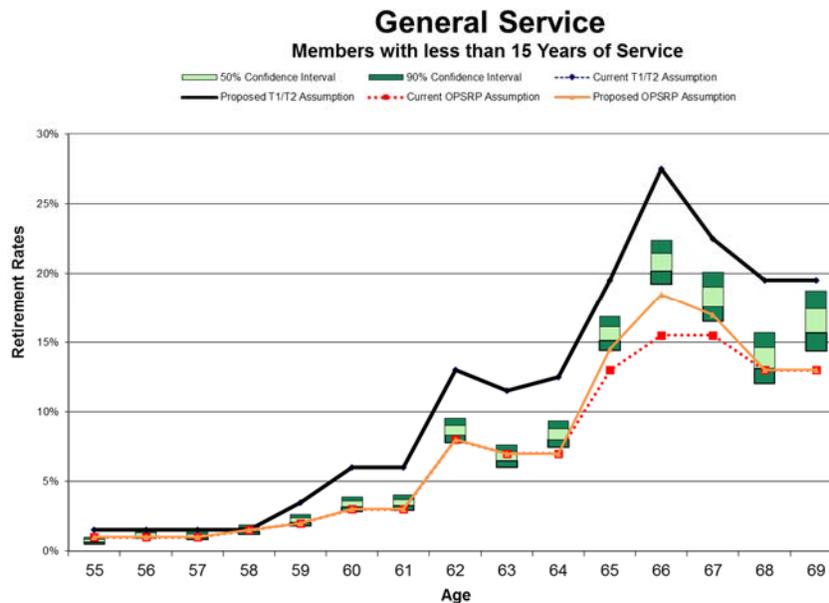
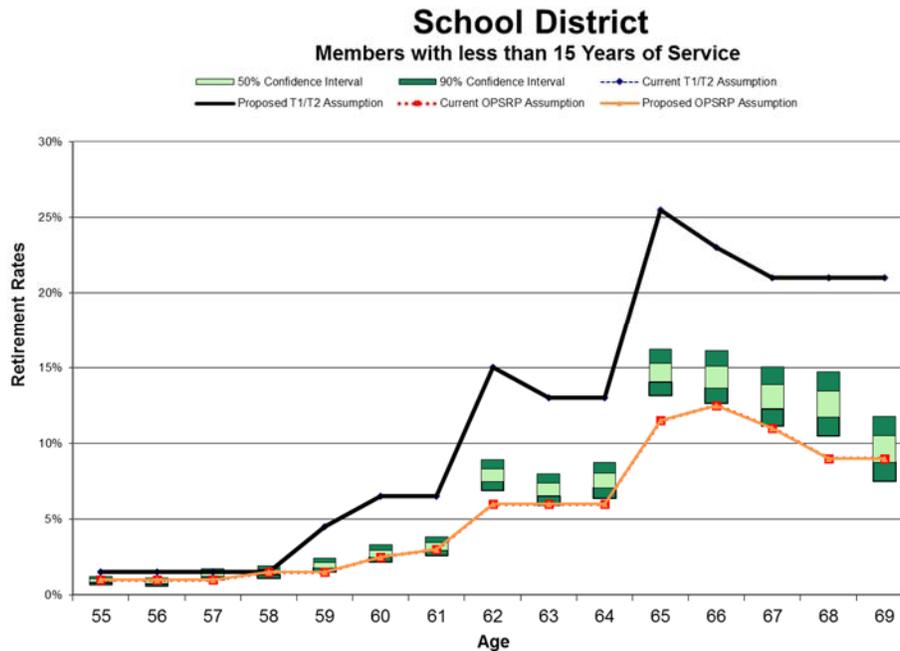
### ***School District and General Service Retirement Rates***

#### **Members with Less Than 15 Years of Service**

Retirement decisions by members with less than 15 years of service are likely to be heavily influenced by the availability of resources other than PERS benefits, including Social Security, prior employment, spousal benefits, and savings.

## Retirement Assumptions (continued)

The following charts show the current assumed rates of retirement, the confidence interval around observed experience, and the recommended retirement rate assumption for school district and general service members retiring with less than 15 years of service.

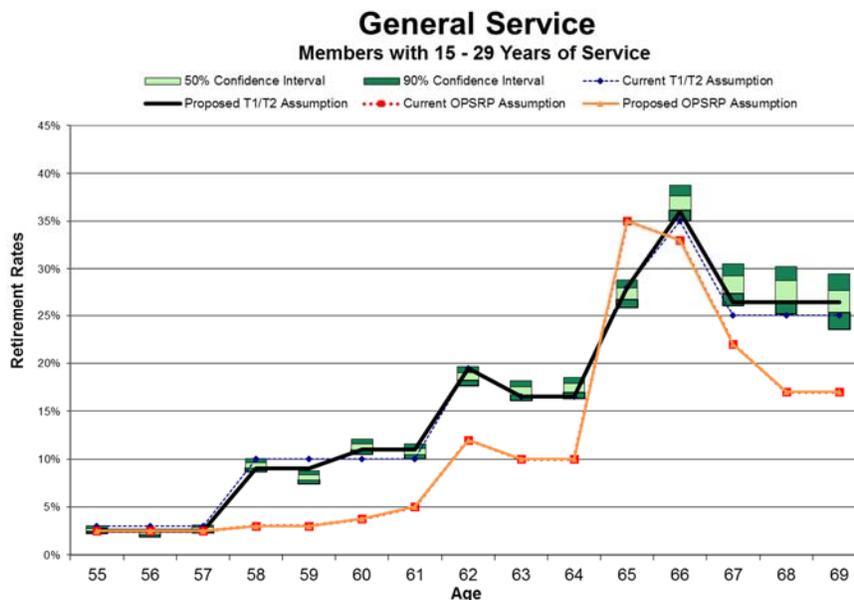
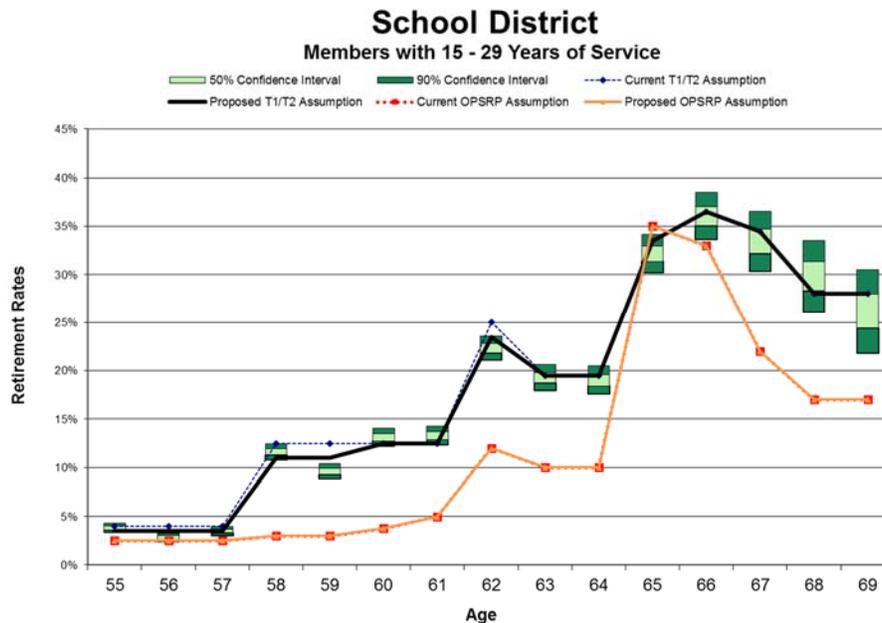


## Retirement Assumptions (continued)

### Members with 15 to 30 Years of Service

Retirement decisions by members with 15 to 29 years of service are likely to be influenced by the structure of PERS benefits as well as the availability of other resources, including Social Security, prior employment, spousal benefits, and savings.

The following charts show the current assumed rates of retirement, the confidence interval around observed experience, and the recommended retirement rate assumption for school district and general service members retiring with more than 15 years of service and less than 30 years of service.

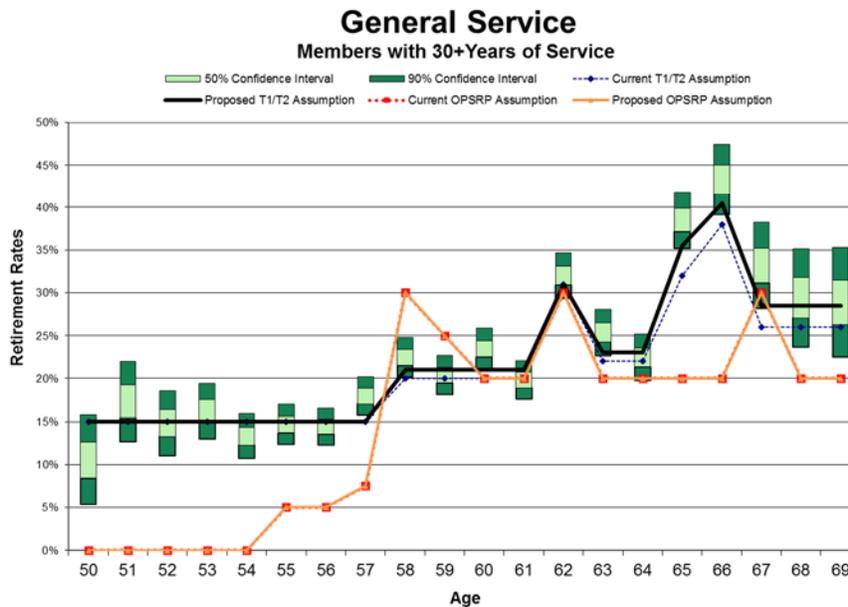
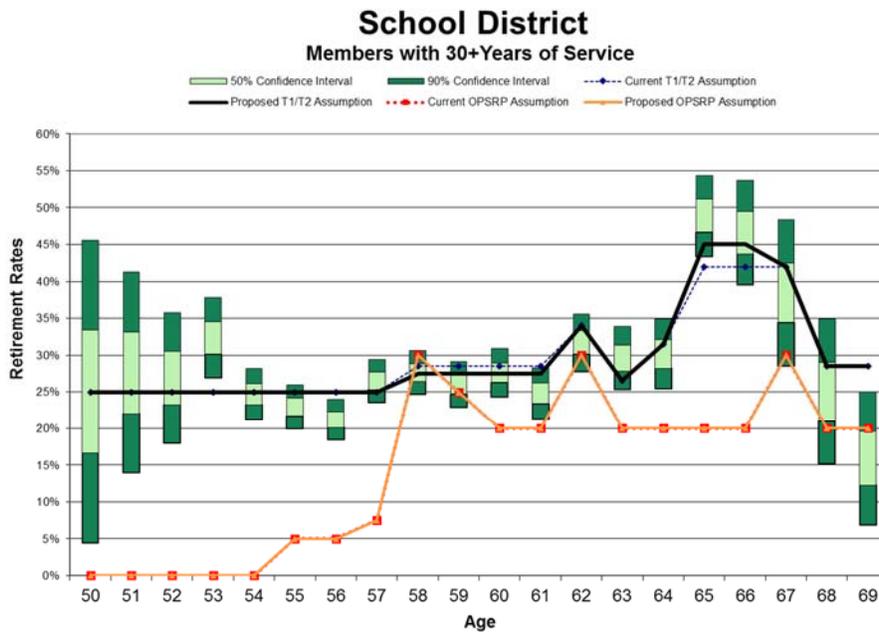


## Retirement Assumptions (continued)

### Members with 30 or More Years of Service

Members with 30 or more years of service are eligible for unreduced PERS benefits at any age (age 58 for OPSRP). As a result, retirement rates at all ages are relatively high, with a spike when Social Security benefits become available.

The following charts show the current assumed rates of retirement, the confidence interval around observed experience and the recommended retirement rate assumption for school district and other general service members retiring with more than 30 years of service.



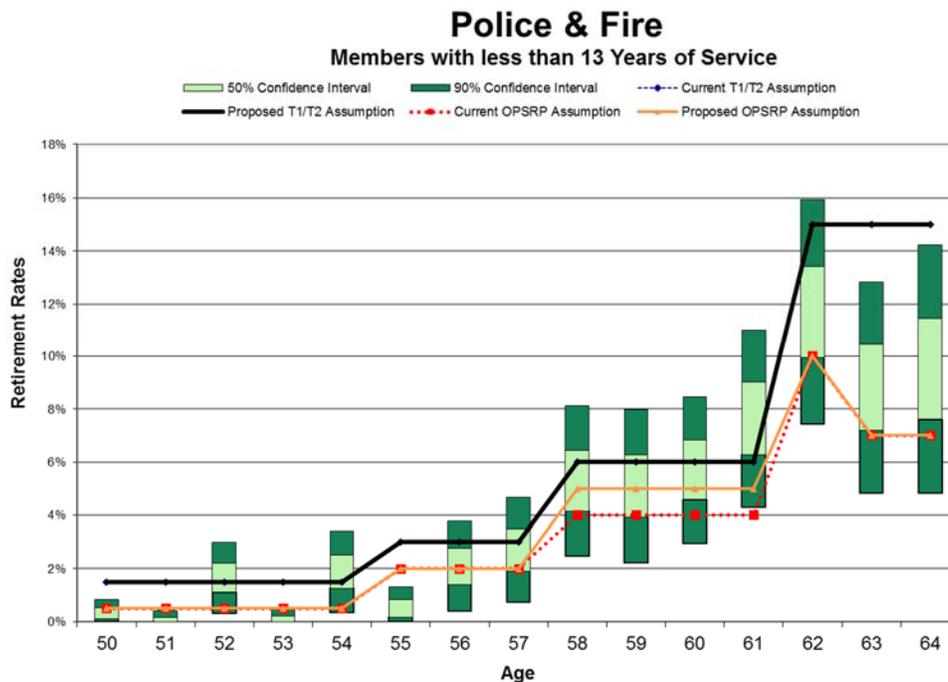
## Retirement Assumptions (continued)

### Police & Fire

#### Members with Less Than 13 Years of Service

The retirement assumption for police & fire members differs for members retiring with less than 13 years of service, those retiring with between 13 and 24 years of service, and those retiring with more than 25 years of service. Retirement decisions by members with less than 13 years of service are likely to be heavily influenced by the availability of resources other than PERS benefits, including Social Security, prior employment, spousal benefits, and savings.

The following graph shows the current assumed rates of retirement, the confidence interval around observed experience and the recommended retirement rate assumption for police & fire members retiring with less than 13 years of service.

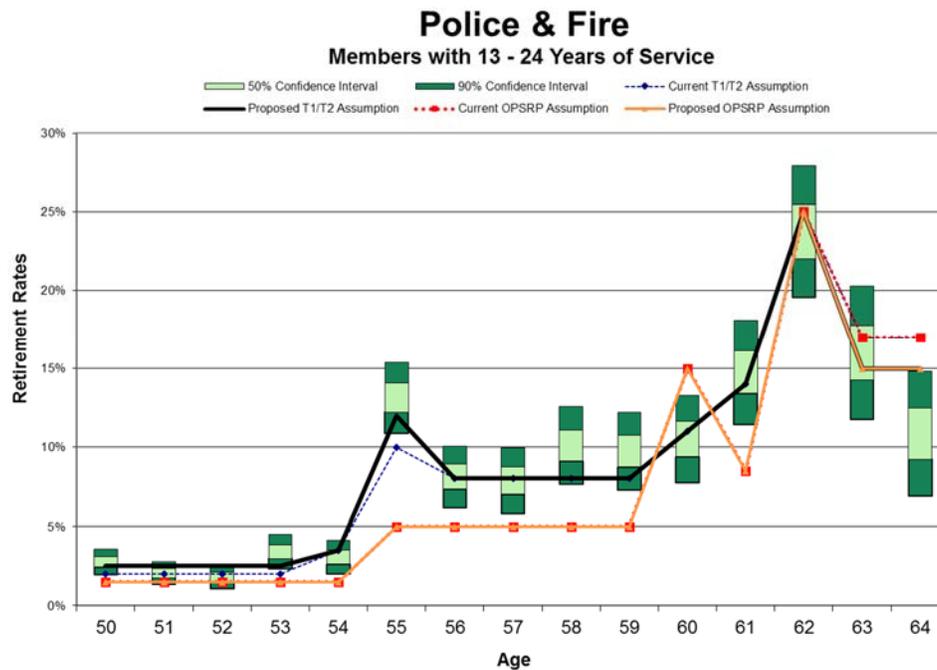


## Retirement Assumptions (continued)

### Members with 13 to 24 Years of Service

Retirement rates for members with 13 to 24 years of service are likely to be influenced by the structure of PERS benefits as well as the availability of other resources, including Social Security, prior employment, spousal benefits, and savings.

The following chart shows the current assumed rates of retirement, the confidence interval around observed experience, and the recommended retirement rate assumption for police & fire members retiring with between 13 and 24 years of service.

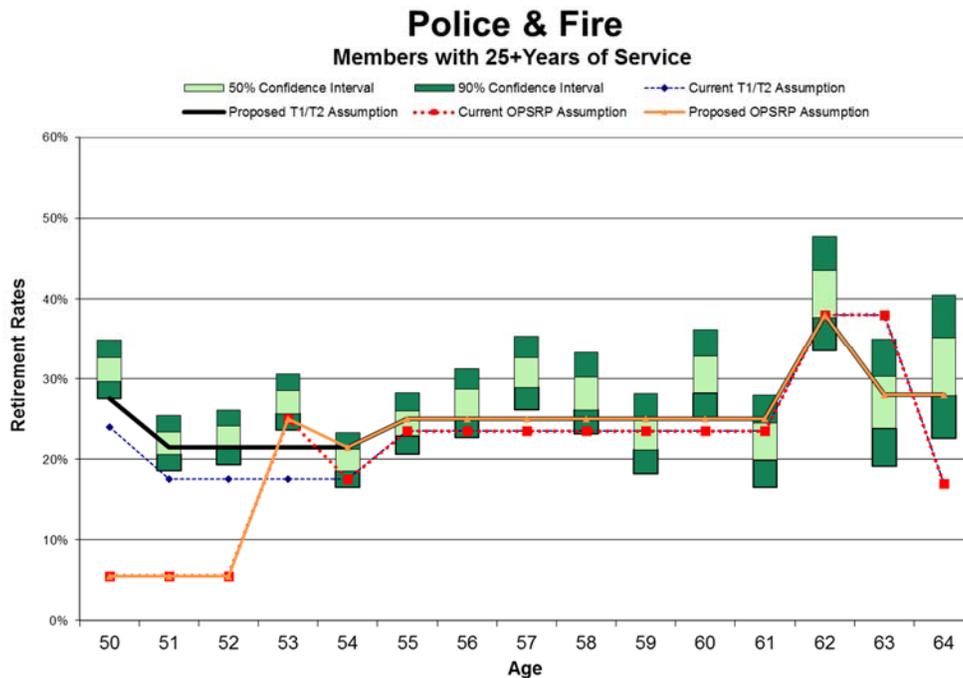


## Retirement Assumptions (continued)

### Members with 25 or More Years of Service

Police & fire members with 25 or more years of service can retire immediately at age 50 (53 for OPSRP) with unreduced retirement benefits. As a result, retirement rates at all ages are relatively high, with a spike at first eligibility for unreduced benefits, and another increase when Social Security benefits become available.

The following chart shows the current assumed rates of retirement, the confidence interval around observed experience, and the recommended retirement rate assumption for police & fire members retiring with more than 25 years of service.

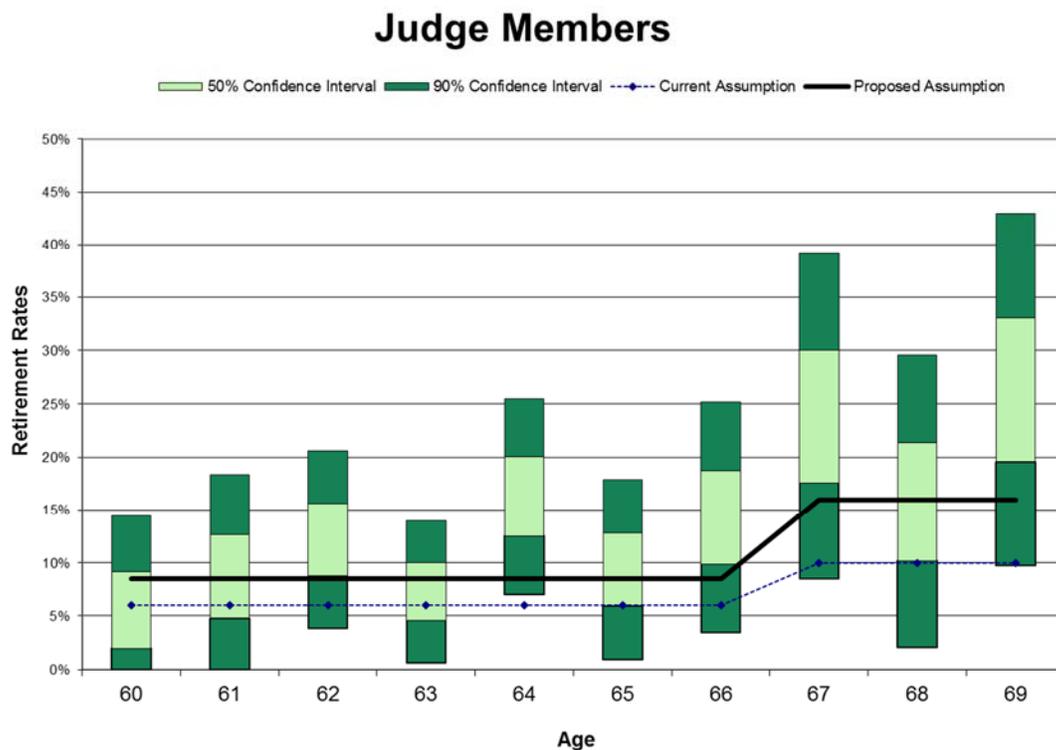


## Retirement Assumptions (continued)

### Judges

The vast majority of members of the State Judiciary elect to receive PERS benefits under Plan B. These benefits are available on an unreduced basis immediately upon retirement eligibility at age 60. As a result, there is relatively little variation in retirement rates by age for these members.

The following chart shows the current assumed rates of retirement, the confidence interval around observed experience, and the recommended retirement rate assumption for members of the State Judiciary.



## Retirement Assumptions (continued)

### Summary of Recommended Retirement Rates

The following table summarizes our recommended Tier 1/Tier 2 retirement rates:

Tier 1/Tier 2 Recommended December 31, 2018 and 2019 Valuations										
	Police & Fire			General Service			School Districts			Judges
Age	< 13 yrs	13-24 yrs	25+ yrs	<15 yrs	15-29 yrs	30+ yrs	<15 yrs	15-29 yrs	30+ yrs	
Less than 50						15.00%			25.00%	
50	1.50%	2.50%	27.50%			15.00%			25.00%	
51	1.50%	2.50%	21.50%			15.00%			25.00%	
52	1.50%	2.50%	21.50%			15.00%			25.00%	
53	1.50%	2.50%	21.50%			15.00%			25.00%	
54	1.50%	3.50%	21.50%			15.00%			25.00%	
55	3.00%	12.00%	25.00%	1.50%	2.50%	15.00%	1.50%	3.50%	25.00%	
56	3.00%	8.00%	25.00%	1.50%	2.50%	15.00%	1.50%	3.50%	25.00%	
57	3.00%	8.00%	25.00%	1.50%	2.50%	15.00%	1.50%	3.50%	25.00%	
58	6.00%	8.00%	25.00%	1.50%	9.00%	21.00%	1.50%	11.00%	27.50%	
59	6.00%	8.00%	25.00%	3.50%	9.00%	21.00%	4.50%	11.00%	27.50%	
60	6.00%	11.00%	25.00%	6.00%	11.00%	21.00%	6.50%	12.50%	27.50%	8.50%
61	6.00%	14.00%	25.00%	6.00%	11.00%	21.00%	6.50%	12.50%	27.50%	8.50%
62	15.00%	25.00%	38.00%	13.00%	19.50%	31.00%	15.00%	23.50%	34.00%	8.50%
63	15.00%	15.00%	28.00%	11.50%	16.50%	23.00%	13.00%	19.50%	26.50%	8.50%
64	15.00%	15.00%	28.00%	12.50%	16.50%	23.00%	13.00%	19.50%	31.50%	8.50%
65	100.00%	100.00%	100.00%	19.50%	28.00%	35.50%	25.50%	33.50%	45.00%	8.50%
66				27.50%	36.00%	40.50%	23.00%	36.50%	45.00%	8.50%
67				22.50%	26.50%	28.50%	21.00%	34.50%	42.00%	16.00%
68				19.50%	26.50%	28.50%	21.00%	28.00%	28.50%	16.00%
69				19.50%	26.50%	28.50%	21.00%	28.00%	28.50%	16.00%
70				100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

## Retirement Assumptions (continued)

The following table summarizes our recommended OPSRP retirement rates:

OPSRP Recommended December 31, 2018 and 2019 Valuations									
	Police & Fire			General Service			School Districts		
Age	< 13 yrs	13-24 yrs	25+ yrs	<15 yrs	15-29 yrs	30+ yrs	<15 yrs	15-29 yrs	30+ yrs
50	0.50%	1.50%	5.50%						
51	0.50%	1.50%	5.50%						
52	0.50%	1.50%	5.50%						
53	0.50%	1.50%	25.00%						
54	0.50%	1.50%	21.50%						
55	2.00%	5.00%	25.00%	1.00%	2.50%	5.00%	1.00%	2.50%	5.00%
56	2.00%	5.00%	25.00%	1.00%	2.50%	5.00%	1.00%	2.50%	5.00%
57	2.00%	5.00%	25.00%	1.00%	2.50%	7.50%	1.00%	2.50%	7.50%
58	5.00%	5.00%	25.00%	1.50%	3.00%	30.00%	1.50%	3.00%	30.00%
59	5.00%	5.00%	25.00%	2.00%	3.00%	25.00%	1.50%	3.00%	25.00%
60	5.00%	15.00%	25.00%	3.00%	3.75%	20.00%	2.50%	3.75%	20.00%
61	5.00%	8.50%	25.00%	3.00%	5.00%	20.00%	3.00%	5.00%	20.00%
62	10.00%	25.00%	38.00%	8.00%	12.00%	30.00%	6.00%	12.00%	30.00%
63	7.00%	15.00%	28.00%	7.00%	10.00%	20.00%	6.00%	10.00%	20.00%
64	7.00%	15.00%	28.00%	7.00%	10.00%	20.00%	6.00%	10.00%	20.00%
65	100.00%	100.00%	100.00%	14.50%	35.00%	20.00%	11.50%	35.00%	20.00%
66				18.50%	33.00%	20.00%	12.50%	33.00%	20.00%
67				17.00%	22.00%	30.00%	11.00%	22.00%	30.00%
68				13.00%	17.00%	20.00%	9.00%	17.00%	20.00%
69				13.00%	17.00%	20.00%	9.00%	17.00%	20.00%
70				100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

## Retirement Assumptions (*continued*)

### ***Lump Sum Option at Retirement***

At retirement, a member has the option of electing a total lump sum distribution equal to two times the member's account balance, a partial lump sum distribution equal to the member's account balance with a reduced monthly allowance, or a monthly allowance with no lump sum distribution. The percentage of active members electing a lump sum distribution at retirement has declined slightly from the prior experience study. The results of our analysis are as follows:

<b>Election at Retirement</b>	<b>Number of Retired Members</b>	<b>Percentage of Retirements</b>	<b>December 31, 2017 Valuation Assumption</b>	<b>Recommended December 31, 2018 and 2019 Valuations</b>
Partial Lump Sum	561	2.6%	3.5%	3.0%
Total Lump Sum				
• 2015	110	2.0%	3.0%	N/A
• 2016	98	1.9%	2.5%	N/A
• 2017	103	1.6%	2.0%	N/A
• 2018	69	1.4%	1.5%	N/A
• 2019	TBD	TBD	1.0%	No change
• 2020	TBD	TBD	0.5%	No change

When a member elects a total or partial lump sum under Money Match or a partial lump sum under Full Formula, they give up the value of future COLAs (cost of living allowances) on the lump sum amount. A total lump sum election under Full Formula may cause the member to give up significantly more. Because there are no new contributions to member accounts and the system is projected to become dominated by Full Formula over time, we expect the total lump sum rate to decline over time.

Based on the data shown above, we recommend lowering the partial lump sum assumption of 3.5 percent to 3.0 percent. We recommend no change to the total lump sum assumption of 1.0 percent in 2019 decreasing by 0.5 percent per year until reaching 0.0 percent.

## Retirement Assumptions (*continued*)

### **Purchase of Credited Service**

A member has the option of purchasing service at retirement to enhance their retirement benefits. Service may be purchased under one or more of the following categories:

- Purchase of forfeited service
- Credit for waiting time
- Credit for educational service
- Credit for military service
- Credit for seasonal positions
- Credit for police officers and firefighters
- Purchase of retirement credit for disability time

Most purchases are full cost purchases, meaning the member pays both the member and employer cost to obtain the service. Since the member pays the full cost of the service purchased, the purchase produces no impact or only a small impact on projected Tier 1/Tier 2 employer costs. The most common, and predictable, non-full cost service purchase made by members is purchasing credit for the six-month waiting period. Thus, for valuation purposes, we have included an adjustment to account for those members who are expected to make the waiting period service purchase.

For Money Match retirements, the purchase of credited service is generally cost-neutral to the system, because the member is depositing both the member and employer contributions. Therefore, in reviewing actual experience, we examined non-Money Match retirements. The following table shows the number of members who retired in the experience period and elected to purchase credit for the six-month waiting period:

	Count	Number Electing to Purchase Waiting Time Service	Percentage of Retirements	December 31, 2017 Valuation Assumption	Recommended December 31, 2018 and 2019 Valuations
Non-Money Match Retirements	12,620	8,928	71%	65%	70%

We recommend increasing the assumption of non-Money Match retirements purchasing credited service for the six month waiting period from 65 percent to 70 percent.

## Retirement Assumptions (*continued*)

### ***Oregon Residency Status***

Members who are eligible for a tax remedy benefit adjustment under Senate Bill 656 or House Bill 3349 may only receive the adjustment as long as they remain residents of Oregon for tax purposes following retirement. Since a member's residency status may change multiple times during retirement, the residency status of a newly retired member may not be representative of that member's probability of remaining resident later in retirement. As such, we analyzed the entire current population of retired members and beneficiaries who are eligible for a tax remedy and compared to the number who are currently receiving a tax remedy. The results of that analysis are as follows:

<b>Number Eligible for Tax Remedy</b>	<b>Number Receiving Tax Remedy</b>	<b>Percentage Receiving Tax Remedy</b>	<b>December 31, 2017 Valuation Assumption</b>	<b>Recommended December 31, 2018 and 2019 Valuations</b>
117,492	99,792	85%	85%	85%

## Disability Incidence Assumptions

The Plan provides duty and non-duty disability benefits to members. Members are eligible to receive duty disability benefits if they become disabled as a direct result of a job-related injury or illness, regardless of length of service. Members are eligible for non-duty disability benefits (also referred to as ordinary disability) if they become disabled after ten years of service (six years if a judge), but prior to normal retirement eligibility.

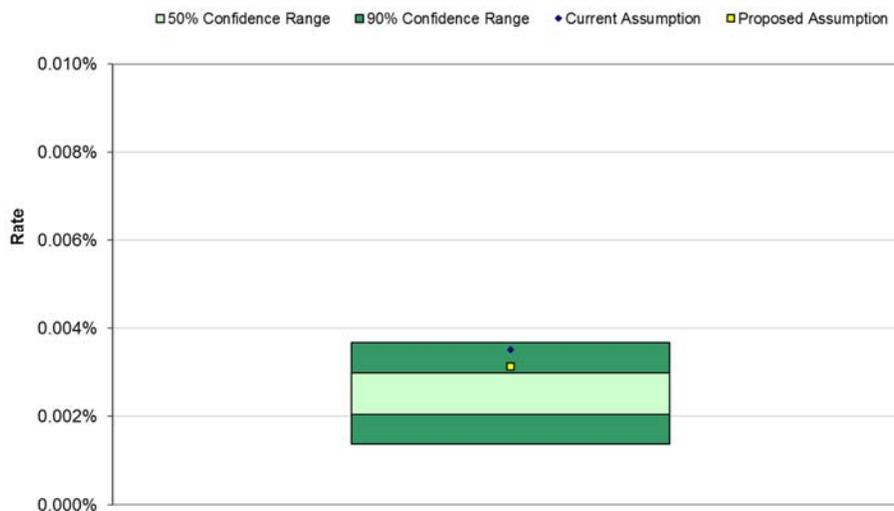
Duty disability incidence rates are developed separately for police & fire and general service members. Ordinary (non-duty) disability rates are developed for the system as a whole.

### Duty Disability

Due to the limited amount of experience data available at some ages, this assumption employs a standard table adjusted to fit within the aggregate confidence interval.

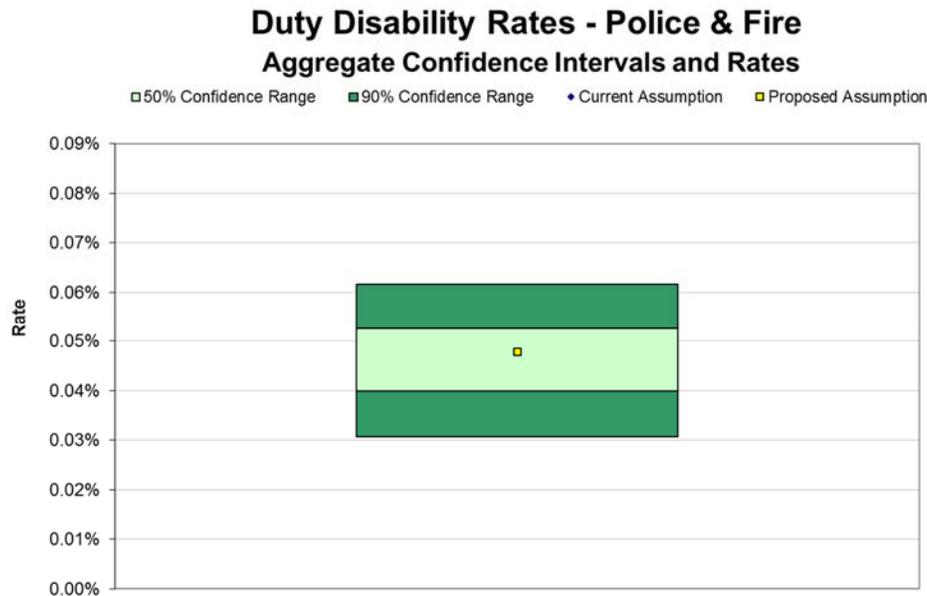
While the current assumed aggregate rate for the general service assumption is within the 90 percent confidence interval of the disability rates experienced, it sits near the top of the confidence interval for the second consecutive study. As such, we recommend updating the assumption.

**Duty Disability Rates - General Service**  
**Aggregate Confidence Intervals and Rates**



The current assumed aggregate rate for police & fire members is within the 50 percent confidence interval. As such, we recommend maintaining the current assumption and continuing to monitor experience in the next study.

## Disability Incidence Assumptions (*continued*)

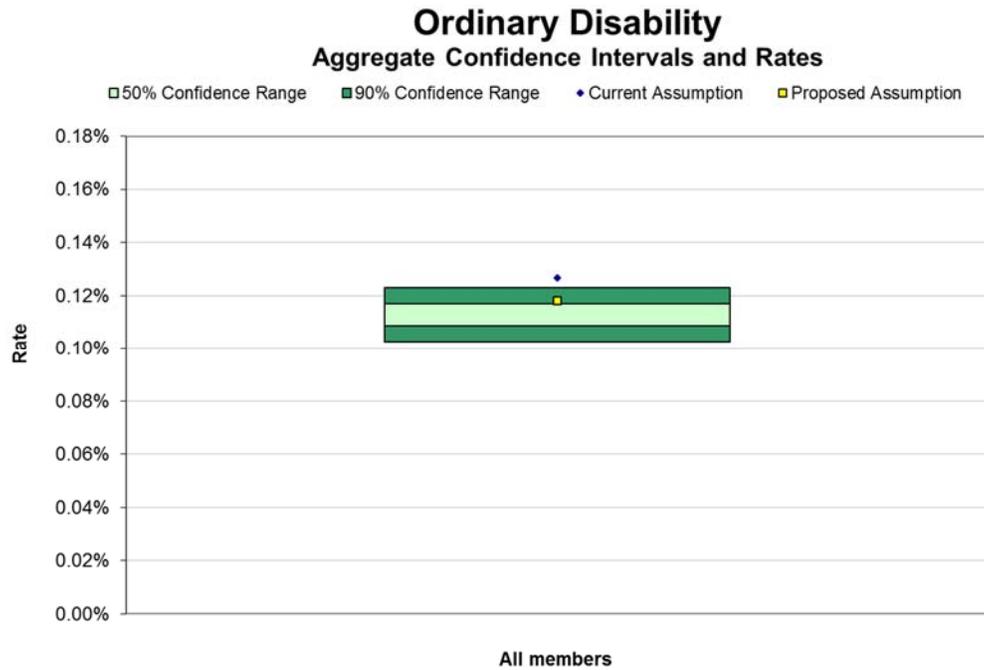


### **Ordinary (Non-Duty) Disability**

As with duty disability, the experience data for ordinary disability was very limited at specific ages. Therefore, this assumption also uses a standard table adjusted to fit within the aggregate confidence interval. Based on the disability rates experienced in the observation period, we recommend lowering the ordinary disability incidence assumption at this time.

The data underlying the ordinary disability study showed a pattern wherein a member’s record would only be recognized as a disability retirement (rather than a service retirement or other separation from service) after a lag period that could span over a year. Because such lagged experience is not yet available for 2018, the final year of our study, we included in our analysis an assumption as to additional disabilities occurring in 2018 that will not be apparent until the subsequent reporting period. This assumption was based on an average of such records observed in the first three years of the study.

## Disability Incidence Assumptions (continued)



The following table summarizes our recommended disability incidence rate assumptions:

Percentage of the 1985 Disability Class 1 Rates (sample rates shown for ages 20–55)		
	December 31, 2017 Valuation	Recommended December 31, 2018 and 2019 Valuations
Duty Disability		
• Police & Fire	20% (0.0060%–0.1690%)	No change
• General Service	0.9% (0.0003%–0.0076%)	0.8% (0.0002%–0.0068%)
Ordinary Disability	35% with 0.18% cap (0.0150%–0.1800%)	30% with 0.18% cap (0.0090%–0.1800%)

## Termination Assumptions

Not all active members are expected to continue working for covered employers until retirement. Termination rates represent the probabilities that a member will leave covered employment for causes other than retirement, disability or death at any given point during their working career.

Termination rates have been developed as service-based assumptions. The service-based assumptions reflect the experience of Tier 1, Tier 2, and OPSRP members, with each group affecting the period of the table relating to the relevant service amount.

Assumptions are developed for the following groups:

- School District males
- School District females
- Other General Service males
- Other General Service females
- Police & Fire (single table for both males and females)

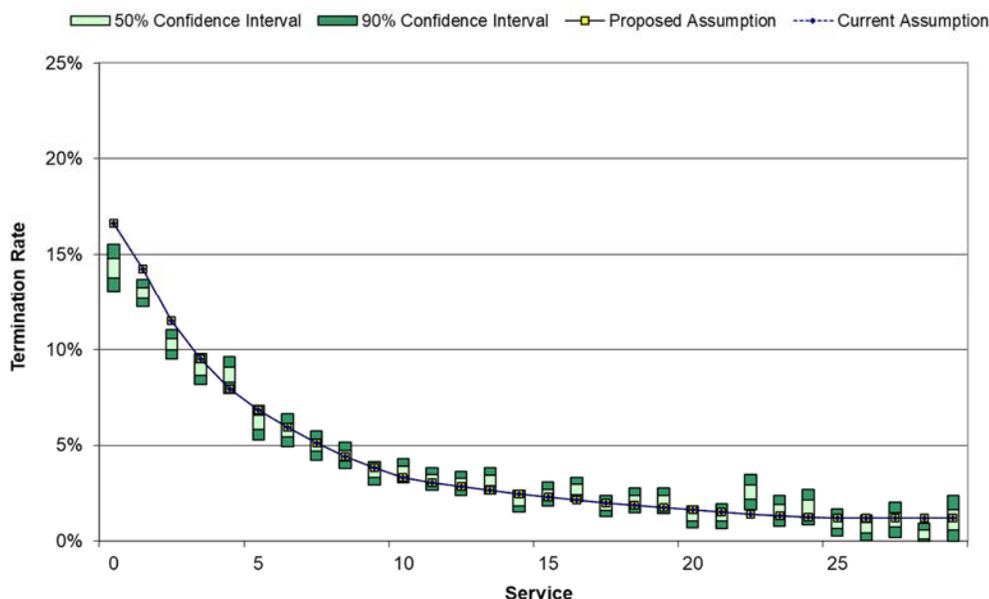
### Termination Rates

The following charts show the confidence interval around observed experience and the recommended rates of termination by year of service. These charts are based on the observed experience of members in the relevant group during the study period. We recommend changes to the assumptions for school district males, school district females, and non-school district general service males. For the other two groups, we recommend maintaining the current assumption and evaluating again with the next study.

Full listings of recommended termination assumptions are included in the appendix.

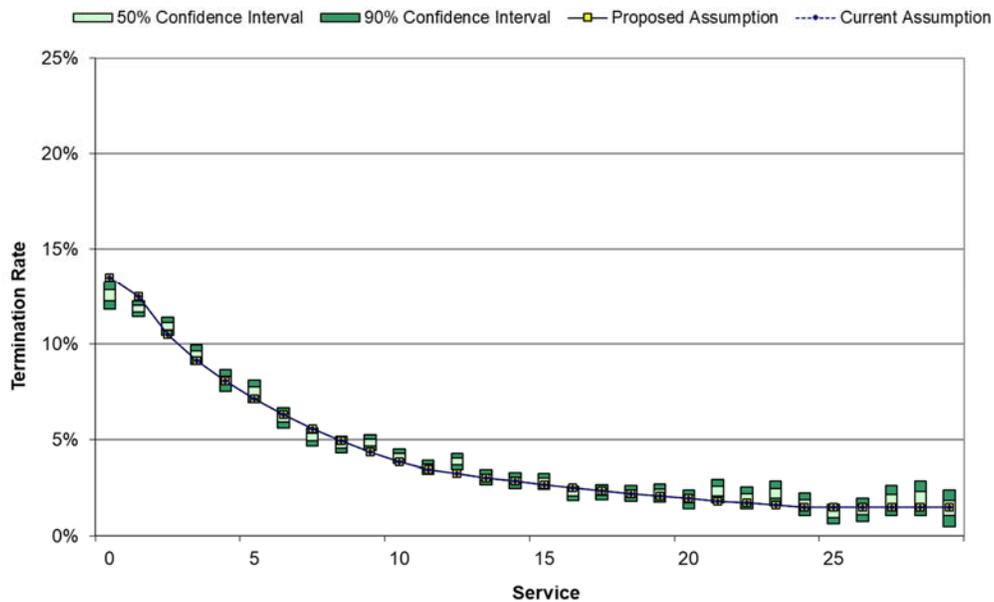
## School Districts

### School District Male



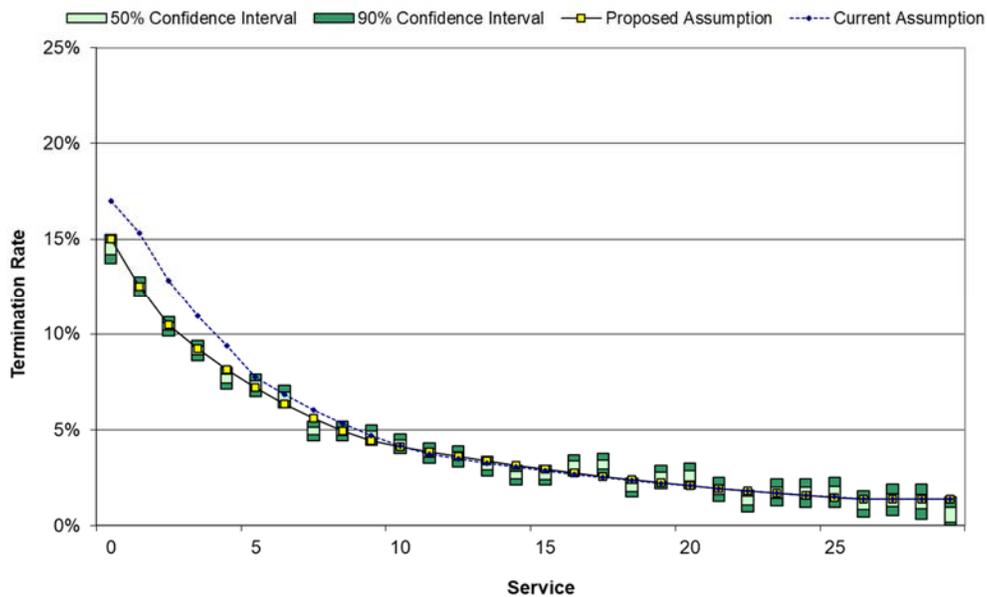
## Termination Assumptions (continued)

### School District Female

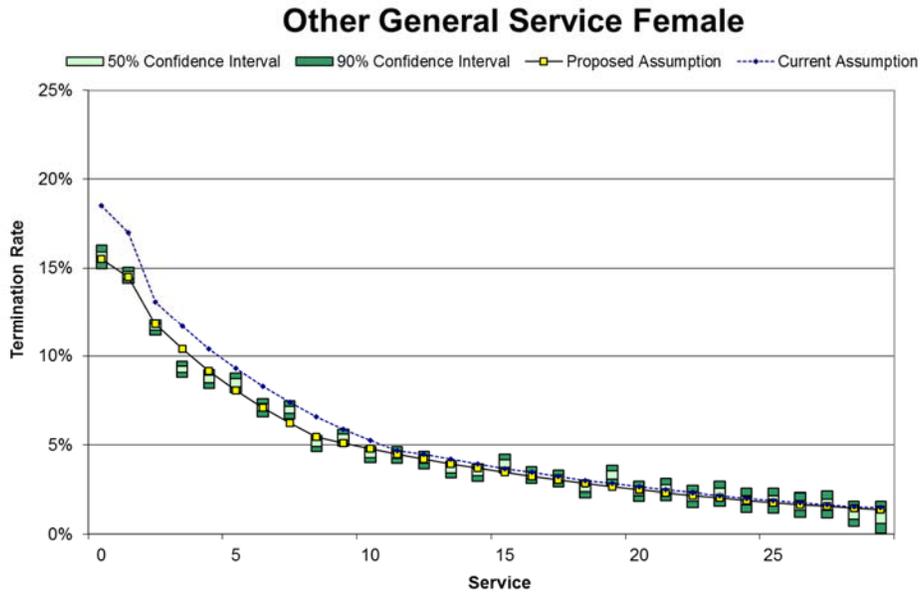


### General Service

### Other General Service Male

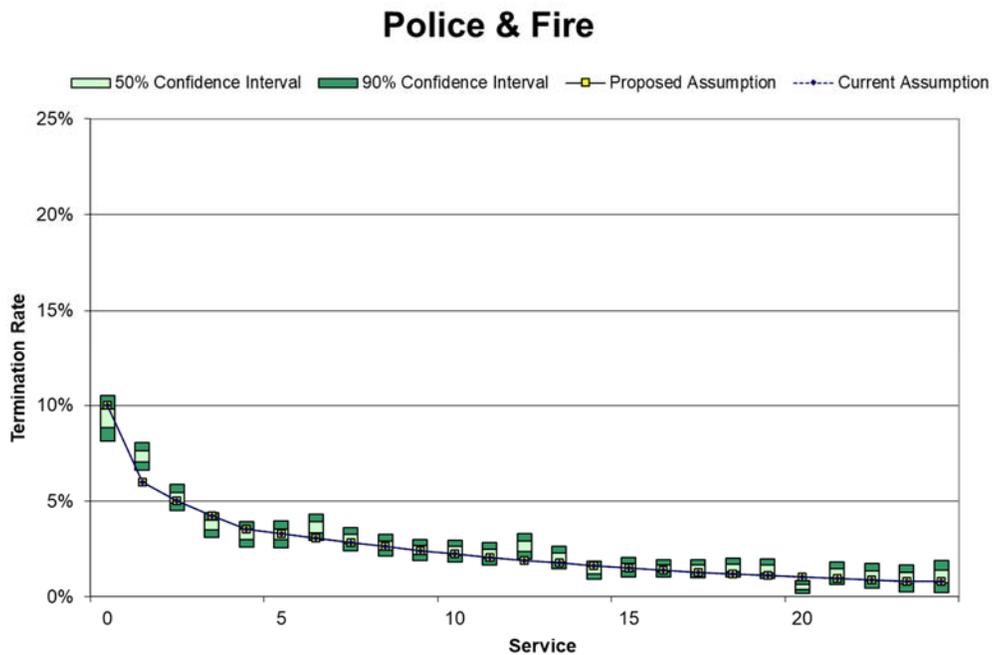


## Termination Assumptions (*continued*)



## Police & Fire

All police & fire members were rated together, with no variation by group or gender.



## Salary Increase Assumptions

The salary increase assumptions analyzed with demographic experience were:

- Merit scale increases
- Unused sick leave adjustments
- Unused vacation cash out adjustments

### Merit Scale

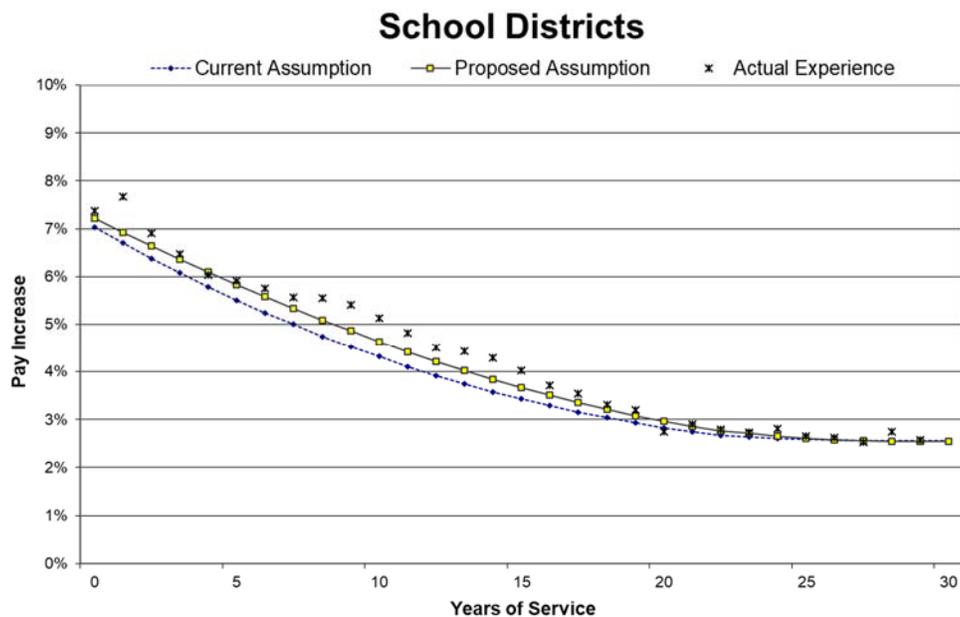
The merit scale assumption is used in conjunction with the inflation and real wage growth assumptions to project individual member salaries to retirement. In developing this assumption, our analysis first focused on the gross salary increases received by members during the observation period. The assumed merit (or longevity) component was then determined by backing out assumed inflation and real wage growth.

In order to capture experience across a broader range of budget, collective bargaining, and economic cycles, the analysis covered observed salary experience from 2010 through 2018.

Assumptions are developed for the following groups:

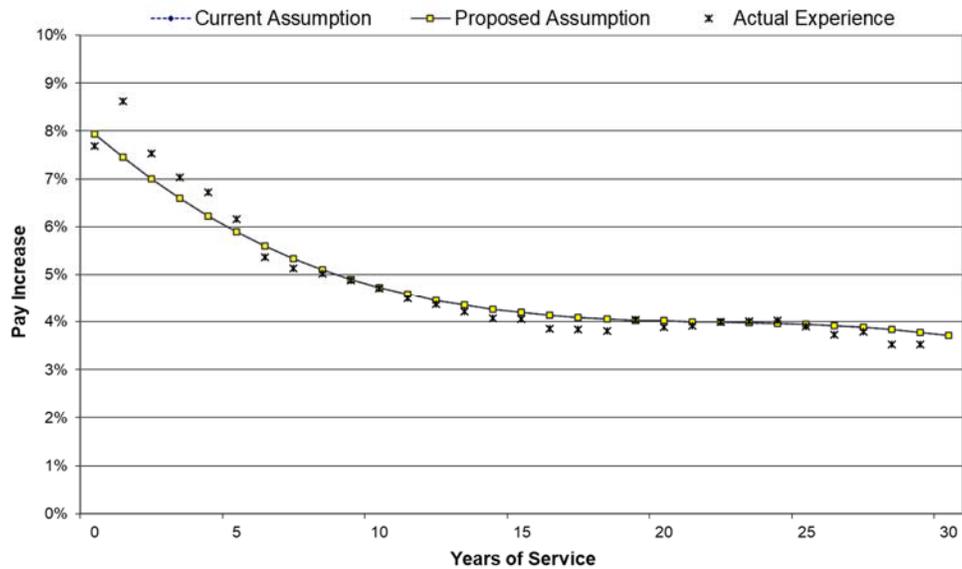
- School Districts
- Other General Service
- Police & Fire

The following charts show the current assumed rates of gross salary increases, the eight-year average of salary increases based on observed experience, and the recommended rates of gross salary increases. We recommend maintaining the current salary increase assumption for police & fire members, and increasing the assumptions for the other two groups. Where we have proposed new assumptions, the proposed rates strike a balance between the previous assumptions and the experience observed in the study period.

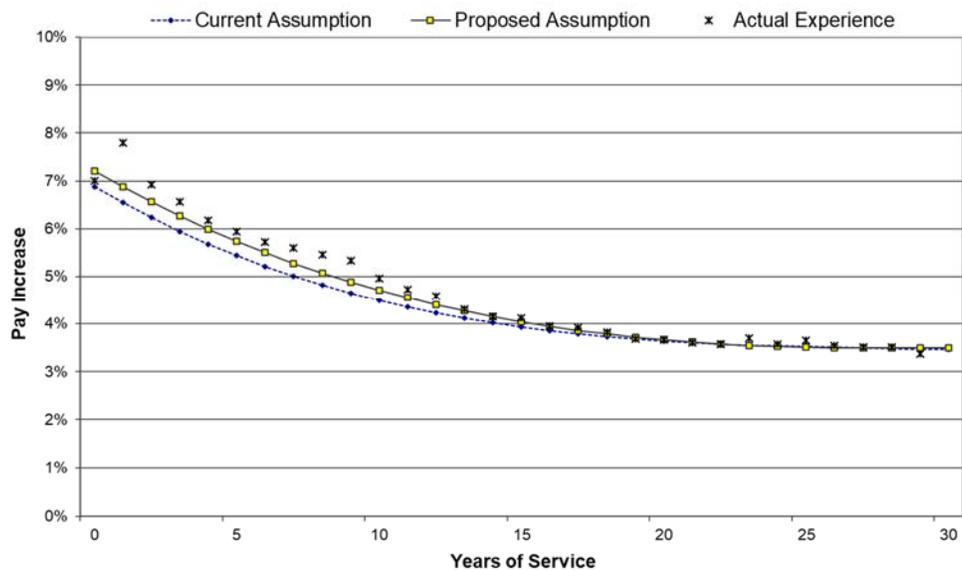


## Salary Increase Assumptions (*continued*)

### Police & Fire



### Other General Service

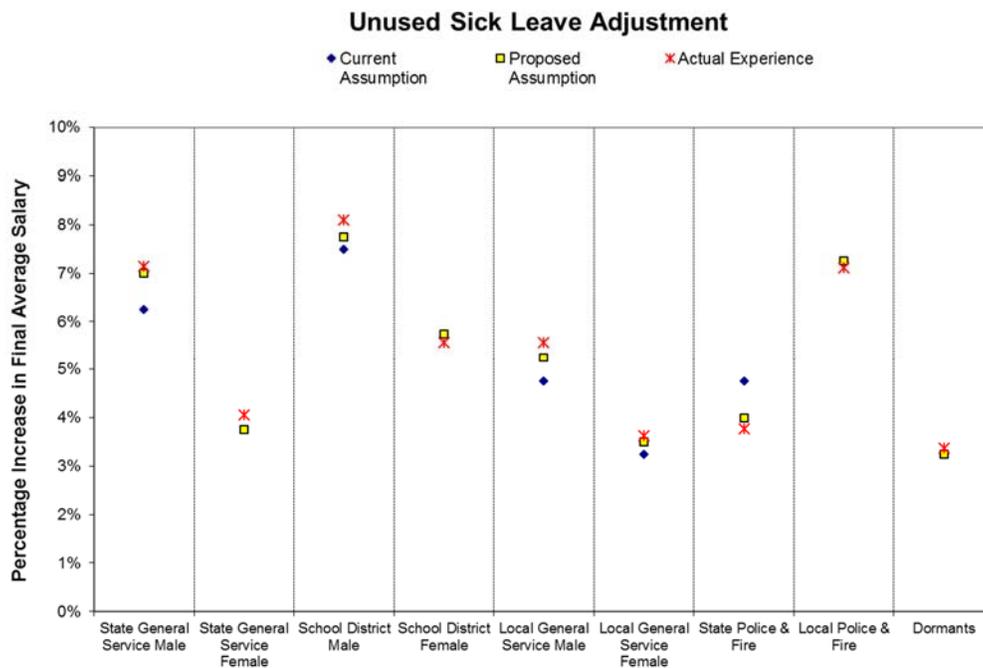


## Salary Increase Assumptions (*continued*)

### Unused Sick Leave Adjustment

Employers may elect to participate in the Unused Sick Leave Program. This program allows Tier 1/Tier 2 members to convert the value of one-half of their accumulated sick leave into additional retirement benefits. The assumption represents the percentage increase in a member’s final average pay due to the inclusion of the value of 50 percent of the member’s accumulated sick leave, and is only applied to employers who participate in the program.

For active members, there are currently eight sets of rates developed by employer group, employment category (general service or police & fire), and gender. In addition, a single rate is developed for eligible dormant members. The chart below shows the current assumption, the four-year average of the observed experience, and the recommended assumption for each of the groups studied. If the current assumption is not visible on the chart, it is the same as the proposed assumption.

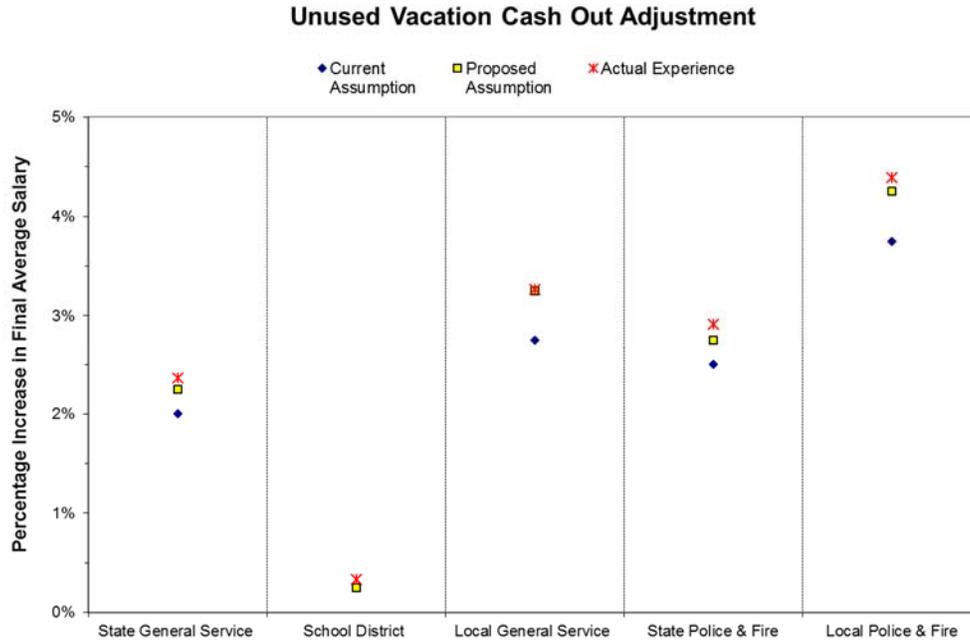


Due to the volatility in experience from one study to the next, for the groups where we recommended changes the recommended change is between the prior assumption and the actual observed experience. How closely the recommended assumption is set to the recently observed experience is influenced by the sample size of the particular group.

## Salary Increase Assumptions (*continued*)

### Unused Vacation Cash Out Adjustment

Tier 1 members are eligible to include the value of any lump sum payment of unused vacation pay in the calculation of their final average salary. The assumption shown below represents the percentage increase in a member's final average salary expected to result from this provision.



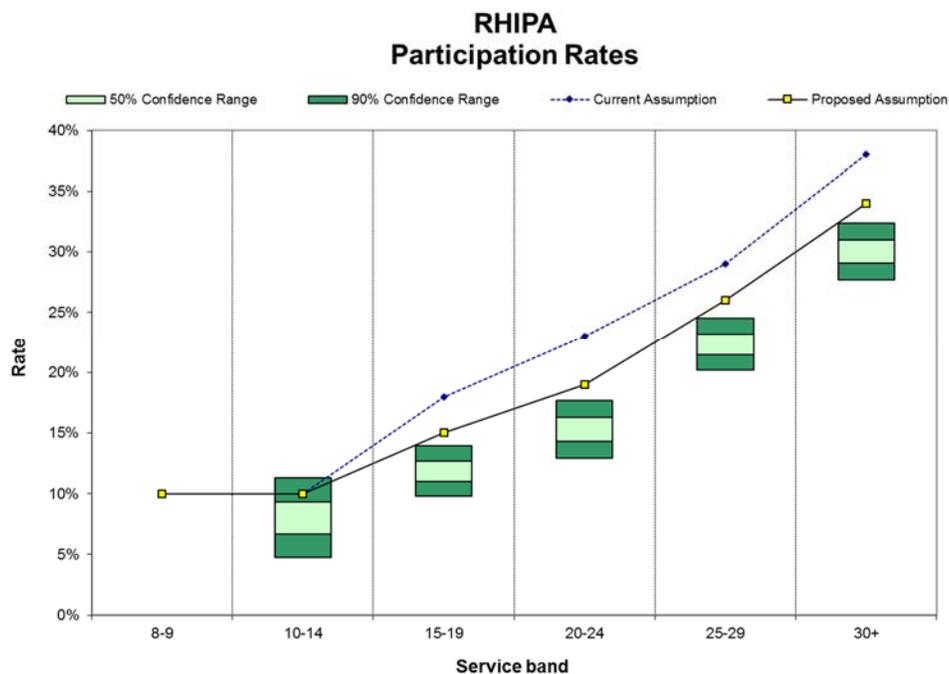
## Retiree Healthcare Assumptions

There are two retiree healthcare programs offered to eligible members, the Retiree Health Insurance Premium Account (RHIPA) and the Retiree Health Insurance Account (RHIA).

### RHIPA

RHIPA is a program for eligible retirees from State of Oregon employment that provides a subsidized pre-Medicare insurance plan. In the previous valuation, the participation rate assumption for future eligible retirees varied based on service at the time of retirement, as the level of employer-paid benefits in the RHIPA program varies by service level. We recommend continuing this structure for the assumption.

The current assumptions are consistently higher than recent observed experience. We recommend decreasing the assumed participation level at most age ranges, as shown below. The level of participation in RHIPA may be affected, at least in part, by economic conditions, cost of coverage, competition from alternative programs available to retirees, and the impact of healthcare reform legislation becoming effective. Since changes in these factors could change participation rates in RHIPA quickly and because the program's funded status is below 50% at the most recent valuation, we recommend that PERS closely monitor participation on a regular basis.



## Retiree Healthcare Assumptions (*continued*)

### RHIA

RHIA is a subsidized Medicare supplemental insurance program offered to all eligible retirees. Participation rates during the period of study decreased to approximately 31 percent for healthy retirees compared to the current assumption of 35 percent. For disabled retirees, the participation followed the current assumption of 20 percent fairly closely. As shown in the table below, we recommend decreasing the healthy assumption to 32 percent and maintaining the disabled assumption of 20 percent.

The data underlying this study showed a pattern wherein members would sometimes not appear until one or two years following retirement (or reaching age 65 if already retired). This may be due to a combination of participant behavior and administrative delay. Because such lagged experience is not yet available for the final two years of our study, we included in our analysis an assumption as to the number of additional enrollments not yet reported for members who retired (or reached age 65 if already retired) during 2017 or 2018. This assumption was based on the number of such records observed in the first two years of the study



## 5. Appendix

### Data

Except where noted, the analysis in this study was based on data for the experience period from January 1, 2015 to December 31, 2018 as provided by the Oregon Public Employees Retirement System (PERS). PERS is solely responsible for the validity, accuracy and comprehensiveness of this information; the results of our analysis can be expected to differ and may need to be revised if the underlying data supplied is incomplete or inaccurate.

The member data was summarized according to the actual and potential member decrements for each year in the study. Actual and potential decrements were grouped according to age or service depending on the demographic assumption.

### Assumption Tables

A complete listing of all the assumptions, methods and procedures presented to the Board for review on July 26, 2019 that are to be used in the December 31, 2018 and December 31, 2019 actuarial valuations are summarized on the following pages.

### Methods and Procedures

**Actuarial cost method:** Entry Age Normal

**UAL amortization method:** Level percent of combined Tier 1, Tier 2, and OPSRP payroll

**UAL amortization period:**

- Closed amortization from the first rate setting valuation in which the experience is recognized
  - Tier 1/Tier 2 – 20 years
  - OPSRP – 16 years
  - RHIA/RHIPA – 10 years
  - Senate Bill 1049 was signed into law in June 2019 and requires a one-time re-amortization of Tier 1 /Tier 2 UAL over a closed 22 year period at the December 31, 2019 rate-setting actuarial valuation.
- In general side accounts are aligned with a 20-year period from the most recent rate-setting valuation. Employers who make lump sum payments in accordance with the rules under OAR 459-009-0086(9) may select a shorter amortization period of either 6, 10, or 16 years since the most recent rate-setting valuation.
- New transition liabilities are amortized over the 18-year period beginning when the employer joins the SLGRP.

**Asset valuation method:** Market value

**Excluded reserves:** Contingency Reserve, Capital Preservation Reserve. Rate Guarantee Reserve is excluded only when it is positive.

**Contribution Rate Stabilization Method:** Contribution rates for a rate pool (e.g. Tier 1/Tier 2 SLGRP, Tier 1/Tier 2 School Districts, OPSRP) are confined to a collar based on the prior contribution rate (prior to application of side accounts, pre-SLGRP liabilities, and 6 percent Independent Employer minimum). The new contribution rate will generally not increase or decrease from the prior contribution rate by more than the greater of 3 percentage points or 20 percent of the prior contribution rate. If the funded percentage excluding

side accounts drops below 60% or increases above 140%, the size of the collar doubles. If the funded percentage excluding side accounts is between 60% and 70% or between 130% and 140%, the size of the rate collar is increased on a graded scale.

**Liability Allocation for Actives with Several Employers:** Allocate Actuarial Accrued Liability 10% (0% for police & fire) based on account balance with each employer and 90% (100% for police & fire) based on service with each employer.

Allocate Normal Cost to current employer.

**Allocation of Benefits-In-Force (BIF) Reserve:** The BIF is allocated to each rate pool in proportion to the retiree liability attributable to the rate pool.

### Recommended Economic Assumptions

Inflation	2.50%
Real wage growth	1.00%
Payroll growth	3.50%
Investment return	Current assumption is reasonable based on current data from capital market outlook models, but the Board should give consideration to a lower assumption, which would also be reasonable. Board will select the assumption at its July 26, 2019 meeting
Interest crediting	
▪ Regular account	Equal to investment return assumption
▪ Variable account	Equal to investment return assumption
RHIPA subsidy cost trend rates	
▪ 2019 trend rate	7.10%
▪ Ultimate trend rate	4.10%
▪ Year reaching ultimate trend	2094

# Demographic Assumptions

## Mortality

Healthy Annuitant Mortality - Sample Values												
Age	Other General Service Male				Police & Fire Male		School District Female		Other General Service Female		Police & Fire Female	
	School District Male	Pub2010 Retiree, Teachers, Generational w/Social Security Data Scale, 0 year setback	Pub2010 Retiree, General Employees, Generational w/Social Security Data Scale, 1 year setback	Male	Pub2010 Retiree, Public Safety, Generational w/Social Security Data Scale, 0 year setback	Pub2010 Retiree, Teachers, Generational w/Social Security Data Scale, 0 year setback	Pub2010 Retiree, General Employees, Generational w/Social Security Data Scale, 0 year setback	Pub2010 Retiree, Public Safety, Generational w/Social Security Data Scale, 1 year setback	Female	Female	Female	Female
Year of Birth	1950	1960	1950	1960	1950	1960	1950	1960	1950	1960	1950	1960
50	0.001235	0.001110	0.001535	0.001380	0.002136	0.001920	0.000812	0.000730	0.002470	0.002220	0.001491	0.001340
51	0.001343	0.001207	0.003280	0.002948	0.002322	0.002088	0.000870	0.000782	0.002565	0.002305	0.001640	0.001474
52	0.001448	0.001302	0.003496	0.003142	0.002516	0.002261	0.000937	0.000842	0.002679	0.002408	0.001819	0.001635
53	0.001572	0.001414	0.003728	0.003351	0.002724	0.002451	0.000991	0.000891	0.002789	0.002509	0.002004	0.001801
54	0.001693	0.001525	0.003963	0.003566	0.002960	0.002666	0.001054	0.000949	0.002896	0.002609	0.002205	0.001984
55	0.002348	0.002117	0.004225	0.003806	0.003223	0.002906	0.001203	0.001183	0.003012	0.002716	0.002434	0.002192
56	0.002554	0.002302	0.004492	0.004050	0.003512	0.003167	0.001278	0.001194	0.003137	0.002829	0.002689	0.002425
57	0.002775	0.002502	0.004776	0.004306	0.003837	0.003460	0.001331	0.001210	0.003280	0.002958	0.002971	0.002679
58	0.003023	0.002720	0.005074	0.004575	0.004208	0.003786	0.001400	0.001252	0.003432	0.003088	0.003277	0.002955
59	0.003285	0.002950	0.005387	0.004847	0.004619	0.004148	0.001478	0.001305	0.003519	0.003250	0.003618	0.003256
60	0.003570	0.003203	0.005730	0.005146	0.005080	0.004557	0.001560	0.001350	0.003640	0.003445	0.003990	0.003583
61	0.003887	0.003480	0.006084	0.005458	0.005598	0.005012	0.001646	0.001406	0.003763	0.004114	0.003683	0.003958
62	0.004243	0.003791	0.006465	0.005788	0.006169	0.005512	0.001740	0.001461	0.003891	0.004439	0.003966	0.004352
63	0.004627	0.004121	0.006893	0.006159	0.006800	0.006057	0.001843	0.001528	0.004029	0.004302	0.003556	0.004785
64	0.005073	0.004505	0.007352	0.006549	0.007505	0.006665	0.001946	0.001624	0.004164	0.004475	0.003901	0.005256
65	0.005573	0.004939	0.007878	0.006996	0.008294	0.007351	0.002051	0.001721	0.004312	0.004771	0.004115	0.005775
66	0.006150	0.005440	0.008492	0.007526	0.009169	0.008110	0.002164	0.001814	0.004463	0.005004	0.004604	0.006347
67	0.006813	0.006020	0.009204	0.008141	0.010151	0.008970	0.002277	0.001914	0.004624	0.005257	0.006158	0.006964
68	0.007593	0.006723	0.010036	0.008867	0.011267	0.009976	0.002392	0.002014	0.004792	0.005525	0.006819	0.007659
69	0.008485	0.007527	0.011015	0.009752	0.012525	0.011112	0.002512	0.002140	0.004960	0.005850	0.007567	0.008475
70	0.009522	0.008473	0.012137	0.010767	0.013953	0.012417	0.002642	0.002231	0.005131	0.006097	0.008418	0.009374
71	0.010702	0.009542	0.013422	0.011944	0.015550	0.013865	0.002778	0.002364	0.005300	0.006484	0.010499	0.010402
72	0.012032	0.010739	0.014841	0.013233	0.017311	0.015451	0.002920	0.002514	0.005472	0.006794	0.011648	0.011516
73	0.013535	0.012081	0.016425	0.014661	0.019255	0.017186	0.003066	0.002665	0.005614	0.007014	0.012620	0.012728
74	0.015203	0.013556	0.018158	0.016208	0.021395	0.019077	0.003220	0.002814	0.005778	0.007228	0.013728	0.014038
75	0.017127	0.015287	0.020073	0.017899	0.023831	0.021271	0.003380	0.002969	0.005931	0.007479	0.014773	0.015444
76	0.019307	0.017251	0.022269	0.019877	0.026556	0.023727	0.003529	0.003124	0.006092	0.007702	0.015751	0.017079
77	0.021783	0.019503	0.024731	0.022097	0.029647	0.026542	0.003680	0.003274	0.006251	0.007921	0.016666	0.018887
78	0.024514	0.021969	0.027542	0.024658	0.033060	0.029628	0.003840	0.003426	0.006400	0.008181	0.017666	0.020946
79	0.027633	0.024815	0.030654	0.027472	0.036950	0.033182	0.004000	0.003570	0.006550	0.008310	0.018558	0.023178
80	0.031140	0.028021	0.034216	0.030727	0.041318	0.037179	0.004160	0.003700	0.006690	0.008460	0.019464	0.025723
81	0.035254	0.031851	0.038248	0.034417	0.046404	0.041925	0.004320	0.003840	0.006840	0.008610	0.020344	0.028563
82	0.040043	0.036361	0.042984	0.038835	0.052248	0.047443	0.004480	0.003980	0.006990	0.008760	0.021214	0.031941
83	0.045543	0.041564	0.048478	0.044020	0.058825	0.053686	0.004640	0.004120	0.007140	0.008910	0.022074	0.035859
84	0.052099	0.047884	0.054692	0.049914	0.066555	0.061171	0.004800	0.004260	0.007290	0.009060	0.022924	0.040299
85	0.059645	0.055208	0.062003	0.056988	0.075298	0.069697	0.004960	0.004390	0.007440	0.009210	0.023774	0.045659
86	0.068116	0.063432	0.070269	0.065042	0.084975	0.079131	0.005120	0.004530	0.007590	0.009360	0.024624	0.051800
87	0.077759	0.072850	0.079323	0.073867	0.095881	0.089828	0.005280	0.004680	0.007740	0.009510	0.025474	0.058633
88	0.088705	0.083608	0.089417	0.083772	0.108176	0.101960	0.005440	0.004840	0.007890	0.009660	0.026324	0.066445
89	0.100810	0.095497	0.100631	0.094849	0.121690	0.115276	0.005600	0.004990	0.008040	0.009810	0.027174	0.075390
90	0.114087	0.108509	0.112719	0.106778	0.136457	0.129786	0.005760	0.005150	0.008190	0.009960	0.028024	0.085294
91	0.129202	0.123504	0.125604	0.119464	0.152348	0.145630	0.005920	0.005290	0.008340	0.010110	0.028874	0.096201
92	0.145374	0.139523	0.139969	0.133796	0.167987	0.161225	0.006080	0.005440	0.008490	0.010260	0.029724	0.108584
93	0.162894	0.156966	0.154951	0.148714	0.183626	0.176944	0.006240	0.005590	0.008640	0.010410	0.030624	0.121469
94	0.181662	0.175756	0.170957	0.164736	0.199349	0.192867	0.006400	0.005740	0.008790	0.010560	0.031524	0.135233
95	0.200867	0.194921	0.188011	0.181898	0.214676	0.208321	0.006560	0.005890	0.008940	0.010710	0.032424	0.149977
96	0.220917	0.215024	0.205416	0.199336	0.230597	0.224446	0.006720	0.006040	0.009090	0.010860	0.033324	0.165100
97	0.239884	0.233719	0.223767	0.217799	0.245687	0.239373	0.006880	0.006190	0.009240	0.011010	0.034224	0.181374
98	0.260020	0.253846	0.241253	0.235053	0.262786	0.256546	0.007040	0.006340	0.009390	0.011160	0.035124	0.197078
99	0.278235	0.271629	0.260316	0.254135	0.279036	0.272411	0.007200	0.006490	0.009540	0.011310	0.036024	0.214871
100	0.297397	0.290627	0.277831	0.271234	0.297397	0.290627	0.007360	0.006640	0.009690	0.011460	0.036924	0.231630
101	0.316454	0.309651	0.296713	0.289959	0.316454	0.309651	0.007520	0.006790	0.009840	0.011610	0.037824	0.250398
102	0.335437	0.328459	0.315758	0.308880	0.335437	0.328459	0.007680	0.006940	0.009990	0.011760	0.038724	0.269900
103	0.354198	0.347177	0.334732	0.327769	0.354198	0.347177	0.007840	0.007090	0.010140	0.011910	0.039624	0.289678
104	0.370960	0.363608	0.353489	0.346483	0.370960	0.363608	0.008000	0.007240	0.010290	0.012060	0.040524	0.309594
105	0.388782	0.381458	0.370218	0.362880	0.388782	0.381458	0.008160	0.007390	0.010440	0.012210	0.041424	0.327669
106	0.406045	0.398796	0.388044	0.380733	0.406045	0.398796	0.008320	0.007540	0.010590	0.012360	0.042324	0.347229
107	0.422672	0.415541	0.405315	0.398078	0.422672	0.415541	0.008480	0.007690	0.010740	0.012510	0.043224	0.366457
108	0.436496	0.429132	0.421953	0.414834	0.436496	0.429132	0.008640	0.007840	0.010890	0.012660	0.044124	0.385234
109	0.451571	0.444398	0.435753	0.428402	0.451571	0.444398	0.008800	0.007990	0.011040	0.012810	0.045024	0.401059
110	0.463846	0.456935	0.450849	0.443687	0.463846	0.456935	0.008960	0.008140	0.011190	0.012960	0.045924	0.418470
111	0.465521	0.459045	0.463150	0.456249	0.465521	0.459045	0.009120	0.008290	0.011340	0.013110	0.046824	0.435171
112	0.467297	0.461257	0.464870	0.458402	0.467297	0.461257	0.009280	0.008440	0.011490	0.013260	0.047724	0.451114
113	0.466689	0.460658	0.466689	0.460658	0.466689	0.460658	0.009440	0.008590	0.011640	0.013410	0.048624	0.466658
114	0.468609	0.463016	0.468609	0.463016	0.468609	0.463016	0.009600	0.008740	0.011790	0.013560	0.049524	0.481659
115	0.470631	0.465480	0.468047	0.462461	0.470631	0.465480	0.009760	0.008890	0.011940	0.013710	0.050424	0.496669
116	0.470114	0.464968	0.470114	0.464968	0.470114	0.464968	0.009920	0.009040	0.012090	0.013860	0.051324	0.511674
117	0.469596	0.464456	0.469596	0.464456	0.469596	0.464456	0.010080	0.009200	0.012240	0.014010	0.052224	0.526689
118	0.469080	0.463945	0.469080	0.463945	0.469080	0.463945	0.010240	0.009350	0.012390	0.014160	0.053124	0.541694
119	0.468564	0.463435	0.468564	0.463435	0.468564							

### Demographic Assumptions (continued)

Age	Beneficiary Mortality - Sample Values				Disabled Retired Mortality			
	Male		Female		Police & Fire Male	Police & Fire Female	Other General Service Male	Other General Service Female
	Pub2010 Retiree, General Employees, Generational w/Social Security Data Scale, 1 year setback	Pub2010 Retiree, General Employees, Generational w/Social Security Data Scale, 0 year setback	Blended 50% Pub2010 Retiree/50% Non-Safety Disabled Retiree, Generational w/Social Security Data Scale, 0 year setback	Blended 50% Pub2010 Public Safety Disabled Retiree, Generational w/Social Security Data Scale, 0 year setback	Pub2010 Non-Safety Disabled Retiree, Generational w/Social Security Data Scale, 2 year setforw ard	Pub2010 Non-Safety Disabled Retiree, Generational w/Social Security Data Scale, 1 year setforw ard		
Year of Birth	1950	1960	1950	1960	1950	1950	1950	1950
50	0.001535	0.001380	0.002470	0.002220	0.010891	0.009940	0.020224	0.017076
51	0.003280	0.002948	0.002565	0.002305	0.011474	0.010264	0.021124	0.017467
52	0.003496	0.003142	0.002679	0.002408	0.012050	0.010596	0.021962	0.017845
53	0.003728	0.003351	0.002789	0.002509	0.012603	0.010928	0.022729	0.018205
54	0.003963	0.003566	0.002896	0.002609	0.013139	0.011265	0.023421	0.018536
55	0.004225	0.003806	0.003012	0.002716	0.013659	0.011600	0.024011	0.018841
56	0.004492	0.004050	0.003137	0.002829	0.014165	0.011934	0.024566	0.019105
57	0.004776	0.004306	0.003280	0.002958	0.014653	0.012260	0.025076	0.019343
58	0.005074	0.004575	0.003432	0.003088	0.015152	0.012593	0.025580	0.019556
59	0.005387	0.004847	0.003619	0.003250	0.015658	0.012923	0.026127	0.019774
60	0.005730	0.005146	0.003840	0.003445	0.016190	0.013275	0.026770	0.020000
61	0.006084	0.005458	0.004114	0.003683	0.016778	0.013648	0.027530	0.020280
62	0.006465	0.005788	0.004439	0.003966	0.017438	0.014065	0.028398	0.020617
63	0.006893	0.006159	0.004829	0.004302	0.018183	0.014527	0.029357	0.021018
64	0.007352	0.006549	0.005264	0.004675	0.019006	0.015039	0.030400	0.021496
65	0.007878	0.006996	0.005771	0.005115	0.019911	0.015613	0.031518	0.022063
66	0.008492	0.007526	0.006336	0.005604	0.020888	0.016253	0.032758	0.022747
67	0.009204	0.008141	0.006969	0.006158	0.021949	0.016983	0.034081	0.023591
68	0.010036	0.008867	0.007702	0.006819	0.023134	0.017836	0.035533	0.024589
69	0.011015	0.009752	0.008530	0.007567	0.024413	0.018797	0.037097	0.025767
70	0.012137	0.010767	0.009459	0.008418	0.025842	0.019898	0.038774	0.027098
71	0.013422	0.011944	0.010499	0.009361	0.027397	0.021108	0.040586	0.028584
72	0.014841	0.013233	0.011648	0.010397	0.029112	0.022428	0.042527	0.030224
73	0.016425	0.014661	0.012914	0.011527	0.031008	0.023861	0.044789	0.032031
74	0.018158	0.016208	0.014300	0.012751	0.033101	0.025406	0.047293	0.034142
75	0.020073	0.017899	0.015879	0.014173	0.035557	0.027179	0.050158	0.036502
76	0.022269	0.019877	0.017629	0.015751	0.038293	0.029145	0.053261	0.039192
77	0.024731	0.022097	0.019621	0.017566	0.041400	0.031379	0.056818	0.042123
78	0.027542	0.024658	0.021821	0.019556	0.044722	0.033906	0.060765	0.045458
79	0.030654	0.027472	0.024340	0.021858	0.048415	0.036963	0.065381	0.049154
80	0.034216	0.030727	0.027205	0.024480	0.052411	0.040359	0.070622	0.053465
81	0.038248	0.034417	0.030599	0.027646	0.056997	0.044319	0.076417	0.058389
82	0.042984	0.038835	0.034584	0.031403	0.062188	0.048851	0.083145	0.063880
83	0.048478	0.044020	0.039174	0.035751	0.067970	0.053930	0.090535	0.070306
84	0.054692	0.049914	0.044708	0.041091	0.074804	0.059907	0.098424	0.077510
85	0.062003	0.056988	0.051147	0.047342	0.082543	0.066655	0.107088	0.085047
86	0.070269	0.065042	0.058503	0.054479	0.091003	0.073928	0.116632	0.092963
87	0.079323	0.073867	0.066976	0.062747	0.100790	0.081873	0.128397	0.101241
88	0.089417	0.083772	0.076648	0.072244	0.111718	0.090552	0.141247	0.109624
89	0.100631	0.094849	0.087314	0.082712	0.124352	0.099780	0.155133	0.118162
90	0.112719	0.106778	0.098832	0.094000	0.138148	0.109613	0.169082	0.127672
91	0.125604	0.119464	0.111585	0.106665	0.153044	0.120602	0.183530	0.137653
92	0.139969	0.133796	0.124848	0.119823	0.167987	0.132086	0.198620	0.148676
93	0.154951	0.148714	0.138941	0.133885	0.183626	0.144493	0.213877	0.160995
94	0.170957	0.164736	0.153967	0.148960	0.199349	0.157997	0.230105	0.174240
95	0.188011	0.181898	0.169459	0.164444	0.214676	0.172182	0.245792	0.189074
96	0.205416	0.199336	0.186033	0.181070	0.230597	0.187707	0.263428	0.204361
97	0.223767	0.217799	0.202322	0.197123	0.245687	0.203316	0.280188	0.221651
98	0.241253	0.235053	0.220398	0.215165	0.262786	0.220873	0.298770	0.238543
99	0.260316	0.254135	0.237770	0.232125	0.279036	0.237903	0.317851	0.257414
100	0.277831	0.271234	0.256822	0.250975	0.297397	0.256822	0.336850	0.277128
101	0.296713	0.289959	0.276518	0.270495	0.316454	0.276518	0.355619	0.297079
102	0.315758	0.308880	0.296455	0.290288	0.335437	0.296455	0.372449	0.317122
103	0.334732	0.327769	0.316488	0.310215	0.354198	0.316488	0.390264	0.335636
104	0.353489	0.346483	0.334965	0.328326	0.370960	0.334965	0.407511	0.355244
105	0.370218	0.362880	0.354569	0.347890	0.388782	0.354569	0.424112	0.374466
106	0.388044	0.380733	0.373792	0.367118	0.406045	0.373792	0.437983	0.393181
107	0.405315	0.398078	0.392512	0.385891	0.422672	0.392512	0.453020	0.409332
108	0.421953	0.414834	0.408636	0.401742	0.436496	0.408636	0.465240	0.426589
109	0.435753	0.428402	0.425906	0.419141	0.451571	0.425906	0.466828	0.443081
110	0.450849	0.443687	0.442416	0.435824	0.463846	0.442416	0.468514	0.458762
111	0.463150	0.456249	0.458120	0.451746	0.465521	0.458120	0.467905	0.467905
112	0.464870	0.458402	0.467297	0.461257	0.467297	0.467297	0.469736	0.467297
113	0.466689	0.460658	0.466689	0.460658	0.466689	0.466689	0.471668	0.469172
114	0.466082	0.460059	0.468609	0.463016	0.468609	0.468609	0.471149	0.471149
115	0.468047	0.462461	0.470631	0.465480	0.470631	0.470631	0.470631	0.470631
116	0.470114	0.464968	0.470114	0.464968	0.470114	0.470114	0.470114	0.470114
117	0.469596	0.464456	0.469596	0.464456	0.469596	0.469596	0.469596	0.469596
118	0.469080	0.463945	0.469080	0.463945	0.469080	0.469080	1.000000	0.469080
119	0.468564	0.463435	0.468564	0.463435	0.468564	0.468564	1.000000	1.000000
120	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000

This work product was prepared solely for Oregon Public Employees Retirement System for the purposes stated herein, and may not be appropriate to use for other purposes. Milliman does not intend to benefit and assumes no duty or liability to other parties who receive this work. Milliman recommends that third parties be aided by their own actuary or other qualified professional when reviewing the Milliman work product.



### Demographic Assumptions (continued)

Non-Annuitant Mortality												
Age	School District Male		Other General Service Male		Police & Fire Male		School District Female		Female		Police & Fire Female	
	120% of Pub2010 Employee, Teachers, Generational w/Social Security Data Scale, 0 year setback		115% of Pub2010 Employee, General Employees, Generational w/Social Security Data Scale, 1 year setback		100% of Pub2010 Employee, Public Safety, Generational w/Social Security Data Scale, 0 year setback		100% Pub2010 Employee, Teachers, Generational w/Social Security Data Scale, 0 year setback		125% of Pub2010 Employee, General Employees, Generational w/Social Security Data Scale, 0 year setback		100% of Pub2010 Employee, Public Safety, Generational w/Social Security Data Scale, 1 year setback	
Year of Birth	1950	1960	1950	1960	1950	1960	1950	1960	1950	1960	1950	1960
30	0.000300	0.000287	0.000445	0.000426	0.000465	0.000446	0.000159	0.000152	0.000213	0.000204	0.000285	0.000273
31	0.000326	0.000313	0.000468	0.000448	0.000476	0.000456	0.000170	0.000163	0.000227	0.000217	0.000305	0.000292
32	0.000340	0.000325	0.000493	0.000472	0.000488	0.000466	0.000182	0.000174	0.000255	0.000244	0.000316	0.000303
33	0.000371	0.000353	0.000520	0.000497	0.000504	0.000479	0.000195	0.000185	0.000272	0.000259	0.000339	0.000324
34	0.000389	0.000368	0.000550	0.000523	0.000521	0.000492	0.000220	0.000208	0.000304	0.000287	0.000365	0.000347
35	0.000421	0.000395	0.000582	0.000550	0.000549	0.000516	0.000234	0.000220	0.000336	0.000316	0.000391	0.000370
36	0.000452	0.000422	0.000628	0.000590	0.000577	0.000539	0.000259	0.000242	0.000368	0.000344	0.000418	0.000393
37	0.000485	0.000450	0.000673	0.000628	0.000595	0.000551	0.000285	0.000265	0.000416	0.000386	0.000445	0.000415
38	0.000532	0.000490	0.000719	0.000667	0.000635	0.000585	0.000312	0.000287	0.000449	0.000414	0.000484	0.000449
39	0.000563	0.000516	0.000779	0.000718	0.000674	0.000617	0.000349	0.000320	0.000497	0.000455	0.000511	0.000471
40	0.000610	0.000554	0.000837	0.000766	0.000714	0.000649	0.000375	0.000341	0.000545	0.000495	0.000549	0.000503
41	0.000668	0.000604	0.000910	0.000827	0.000750	0.000679	0.000412	0.000372	0.000605	0.000547	0.000587	0.000534
42	0.000723	0.000652	0.000978	0.000885	0.000807	0.000728	0.000446	0.000408	0.000648	0.000584	0.000623	0.000564
43	0.000790	0.000711	0.001056	0.000952	0.000850	0.000764	0.000491	0.000441	0.000703	0.000633	0.000668	0.000602
44	0.000852	0.000767	0.001130	0.001017	0.000900	0.000810	0.000521	0.000469	0.000755	0.000679	0.000699	0.000629
45	0.000942	0.000848	0.001213	0.001091	0.000961	0.000864	0.000562	0.000506	0.000820	0.000738	0.000738	0.000664
46	0.001031	0.000927	0.001306	0.001176	0.001022	0.000918	0.000615	0.000553	0.000885	0.000796	0.000777	0.000699
47	0.001130	0.001016	0.001413	0.001270	0.001091	0.000981	0.000666	0.000599	0.000948	0.000852	0.000815	0.000733
48	0.001241	0.001116	0.001516	0.001363	0.001159	0.001042	0.000716	0.000644	0.001009	0.000907	0.000864	0.000776
49	0.001349	0.001213	0.001642	0.001476	0.001248	0.001122	0.000765	0.000687	0.001082	0.000973	0.000899	0.000809
50	0.001482	0.001332	0.001765	0.001587	0.001335	0.001200	0.000812	0.000730	0.001154	0.001038	0.000946	0.000850
51	0.001611	0.001448	0.001886	0.001695	0.001420	0.001276	0.000870	0.000782	0.001238	0.001113	0.001002	0.000900
52	0.001738	0.001562	0.002029	0.001824	0.001525	0.001370	0.000937	0.000842	0.001320	0.001187	0.001056	0.000950
53	0.001886	0.001697	0.002168	0.001949	0.001626	0.001463	0.000991	0.000891	0.001413	0.001272	0.001110	0.000998
54	0.002032	0.001830	0.002316	0.002084	0.001725	0.001554	0.001054	0.000949	0.001504	0.001355	0.001161	0.001045
55	0.002174	0.001960	0.002460	0.002216	0.001843	0.001662	0.001127	0.001016	0.001619	0.001460	0.001222	0.001101
56	0.002339	0.002109	0.002625	0.002367	0.001980	0.001786	0.001199	0.001081	0.001733	0.001562	0.001282	0.001156
57	0.002513	0.002266	0.002800	0.002524	0.002115	0.001907	0.001279	0.001153	0.001857	0.001674	0.001351	0.001218
58	0.002709	0.002437	0.002994	0.002699	0.002278	0.002049	0.001379	0.001241	0.001992	0.001792	0.001429	0.001289
59	0.002923	0.002625	0.003196	0.002876	0.002456	0.002206	0.001486	0.001334	0.002148	0.001929	0.001496	0.001346
60	0.003168	0.002842	0.003404	0.003057	0.002640	0.002368	0.001610	0.001444	0.002325	0.002086	0.001580	0.001419
61	0.003454	0.003092	0.003629	0.003255	0.002848	0.002550	0.001751	0.001567	0.002510	0.002247	0.001662	0.001491
62	0.003766	0.003365	0.003869	0.003464	0.003080	0.002752	0.001916	0.001712	0.002713	0.002424	0.001741	0.001559
63	0.004103	0.003655	0.004125	0.003685	0.003323	0.002960	0.002096	0.001867	0.002946	0.002624	0.001837	0.001641
64	0.004486	0.003984	0.004403	0.003922	0.003576	0.003176	0.002308	0.002049	0.003207	0.002848	0.001929	0.001718
65	0.004914	0.004355	0.004693	0.004167	0.003860	0.003421	0.002542	0.002253	0.003483	0.003087	0.002026	0.001799
66	0.005362	0.004743	0.005006	0.004437	0.004320	0.003821	0.002806	0.002481	0.003797	0.003359	0.002121	0.001880
67	0.005854	0.005173	0.005340	0.004723	0.004823	0.004262	0.003100	0.002739	0.004149	0.003666	0.002404	0.002127
68	0.006390	0.005658	0.005708	0.005043	0.005416	0.004795	0.003447	0.003052	0.004536	0.004016	0.002717	0.002401
69	0.006971	0.006184	0.006122	0.005420	0.006070	0.005385	0.003852	0.003417	0.004961	0.004401	0.003092	0.002738
70	0.007571	0.006737	0.006591	0.005847	0.006816	0.006066	0.004316	0.003841	0.005439	0.004840	0.003513	0.003117
71	0.008187	0.007301	0.007111	0.006328	0.007651	0.006823	0.004848	0.004323	0.005961	0.005315	0.003993	0.003553
72	0.008826	0.007878	0.007687	0.006854	0.008586	0.007663	0.005453	0.004867	0.006522	0.005821	0.004540	0.004048
73	0.009482	0.008464	0.008304	0.007412	0.009619	0.008585	0.006125	0.005467	0.007128	0.006362	0.005159	0.004605
74	0.010149	0.009050	0.008975	0.008011	0.010757	0.009592	0.006890	0.006144	0.007782	0.006939	0.005851	0.005222
75	0.010898	0.009728	0.009693	0.008643	0.012076	0.010778	0.007767	0.006932	0.008517	0.007602	0.006626	0.005909
76	0.012366	0.011049	0.010509	0.009380	0.013545	0.012102	0.008819	0.007879	0.009322	0.008329	0.007529	0.006720
77	0.014059	0.012587	0.011395	0.010181	0.015229	0.013635	0.010034	0.008983	0.010212	0.009143	0.008555	0.007643
78	0.015969	0.014312	0.012392	0.011095	0.017101	0.015326	0.011403	0.010219	0.011186	0.010024	0.009744	0.008723
79	0.018174	0.016321	0.013447	0.012051	0.019245	0.017283	0.012977	0.011653	0.012268	0.011017	0.011084	0.009933
80	0.020696	0.018622	0.014634	0.013142	0.021659	0.019489	0.014785	0.013304	0.013461	0.012113	0.012629	0.011340

## Demographic Assumptions *(continued)*

### Mortality Improvement Scale

Unisex Social Security Data Mortality Projection Scale					
Based on 60-year average of experience through 2015					
Age	Improvement Rate	Age	Improvement Rate	Age	Improvement Rate
15	1.41%	50	1.06%	85	0.77%
16	1.32%	51	1.06%	86	0.71%
17	1.22%	52	1.06%	87	0.65%
18	1.12%	53	1.05%	88	0.59%
19	1.01%	54	1.04%	89	0.54%
20	0.92%	55	1.03%	90	0.50%
21	0.84%	56	1.03%	91	0.45%
22	0.78%	57	1.03%	92	0.41%
23	0.71%	58	1.05%	93	0.37%
24	0.65%	59	1.07%	94	0.33%
25	0.58%	60	1.08%	95	0.30%
26	0.53%	61	1.10%	96	0.27%
27	0.48%	62	1.12%	97	0.26%
28	0.45%	63	1.15%	98	0.24%
29	0.43%	64	1.18%	99	0.24%
30	0.42%	65	1.20%	100	0.23%
31	0.43%	66	1.22%	101	0.22%
32	0.45%	67	1.23%	102	0.21%
33	0.50%	68	1.21%	103	0.20%
34	0.56%	69	1.19%	104	0.20%
35	0.62%	70	1.16%	105	0.19%
36	0.68%	71	1.14%	106	0.18%
37	0.75%	72	1.13%	107	0.17%
38	0.82%	73	1.13%	108	0.17%
39	0.88%	74	1.14%	109	0.16%
40	0.95%	75	1.13%	110	0.15%
41	1.00%	76	1.12%	111	0.14%
42	1.03%	77	1.10%	112	0.13%
43	1.05%	78	1.09%	113	0.13%
44	1.05%	79	1.07%	114	0.12%
45	1.05%	80	1.05%	115	0.11%
46	1.06%	81	1.01%	116	0.11%
47	1.06%	82	0.96%	117	0.11%
48	1.06%	83	0.91%	118	0.11%
49	1.06%	84	0.84%	119	0.11%

## Demographic Assumptions (continued)

### Retirement Assumptions

#### Retirement from Active Status (Tier 1/Tier 2)

Age	Police & Fire			General Service / School Districts						Judges	
	<13 Years	13 - 24	25+ Years	General Service			School Districts				
				< 15 years	15-29 Years	30+ Years	< 15 years	15-29 Years	30+ Years		
< 50						15.0%				25.0%	
50	1.5%	2.5%	27.5%			15.0%				25.0%	
51	1.5%	2.5%	21.5%			15.0%				25.0%	
52	1.5%	2.5%	21.5%			15.0%				25.0%	
53	1.5%	2.5%	21.5%			15.0%				25.0%	
54	1.5%	3.5%	21.5%			15.0%				25.0%	
55	3.0%	12.0%	25.0%	1.5%	2.5%	15.0%	1.5%	3.5%		25.0%	
56	3.0%	8.0%	25.0%	1.5%	2.5%	15.0%	1.5%	3.5%		25.0%	
57	3.0%	8.0%	25.0%	1.5%	2.5%	15.0%	1.5%	3.5%		25.0%	
58	6.0%	8.0%	25.0%	1.5%	9.0%	21.0%	1.5%	11.0%		27.5%	
59	6.0%	8.0%	25.0%	3.5%	9.0%	21.0%	4.5%	11.0%		27.5%	
60	6.0%	11.0%	25.0%	6.0%	11.0%	21.0%	6.5%	12.5%		27.5%	8.5%
61	6.0%	14.0%	25.0%	6.0%	11.0%	21.0%	6.5%	12.5%		27.5%	8.5%
62	15.0%	25.0%	38.0%	13.0%	19.5%	31.0%	15.0%	23.5%		34.0%	8.5%
63	15.0%	15.0%	28.0%	11.5%	16.5%	23.0%	13.0%	19.5%		26.5%	8.5%
64	15.0%	15.0%	28.0%	12.5%	16.5%	23.0%	13.0%	19.5%		31.5%	8.5%
65	100.0%	100.0%	100.0%	19.5%	28.0%	35.5%	25.5%	33.5%		45.0%	8.5%
66				27.5%	36.0%	40.5%	23.0%	36.5%		45.0%	8.5%
67				22.5%	26.5%	28.5%	21.0%	34.5%		42.0%	16.0%
68				19.5%	26.5%	28.5%	21.0%	28.0%		28.5%	16.0%
69				19.5%	26.5%	28.5%	21.0%	28.0%		28.5%	16.0%
70				100.0%	100.0%	100.0%	100.0%	100.0%		100.0%	100.0%

#### Retirement from Active Status (OPSRP)

Age	Police & Fire			General Service / School Districts							
	<13 Years	13 - 24	25+ Years	General Service			School Districts				
				< 15 years	15-29 Years	30+ Years	< 15 years	15-29 Years	30+ Years		
50	0.5%	1.5%	5.5%								
51	0.5%	1.5%	5.5%								
52	0.5%	1.5%	5.5%								
53	0.5%	1.5%	25.0%								
54	0.5%	1.5%	21.5%								
55	2.0%	5.0%	25.0%	1.0%	2.5%	5.0%	1.0%	2.5%		5.0%	
56	2.0%	5.0%	25.0%	1.0%	2.5%	5.0%	1.0%	2.5%		5.0%	
57	2.0%	5.0%	25.0%	1.0%	2.5%	7.5%	1.0%	2.5%		7.5%	
58	5.0%	5.0%	25.0%	1.5%	3.0%	30.0%	1.5%	3.0%		30.0%	
59	5.0%	5.0%	25.0%	2.0%	3.0%	25.0%	1.5%	3.0%		25.0%	
60	5.0%	15.0%	25.0%	3.0%	3.8%	20.0%	2.5%	3.8%		20.0%	
61	5.0%	8.5%	25.0%	3.0%	5.0%	20.0%	3.0%	5.0%		20.0%	
62	10.0%	25.0%	38.0%	8.0%	12.0%	30.0%	6.0%	12.0%		30.0%	
63	7.0%	15.0%	28.0%	7.0%	10.0%	20.0%	6.0%	10.0%		20.0%	
64	7.0%	15.0%	28.0%	7.0%	10.0%	20.0%	6.0%	10.0%		20.0%	
65	100.0%	100.0%	100.0%	14.5%	35.0%	20.0%	11.5%	35.0%		20.0%	
66				18.5%	33.0%	20.0%	12.5%	33.0%		20.0%	
67				17.0%	22.0%	30.0%	11.0%	22.0%		30.0%	
68				13.0%	17.0%	20.0%	9.0%	17.0%		20.0%	
69				13.0%	17.0%	20.0%	9.0%	17.0%		20.0%	
70				100.0%	100.0%	100.0%	100.0%	100.0%		100.0%	100.0%

## Demographic Assumptions *(continued)*

### *Lump Sum Option at Retirement*

Partial Lump Sum	3.0% for all years
Total Lump Sum	1.0% for 2019, declining by 0.5% per year until reaching 0.0%

### *Purchase of Credited Service at Retirement*

Money Match Retirements	0%
Non-Money Match Retirements	70%

### *Oregon Residency Status*

For purposes of determining eligibility for SB 656/HB 3349 benefit adjustments, 85% of retirees are assumed to remain Oregon residents after retirement.

## **Disability Assumptions**

Age	Duty Disability		
	Police & Fire	General Service	Ordinary Disability
20	0.0060%	0.0002%	0.0090%
25	0.0086%	0.0003%	0.0129%
30	0.0128%	0.0005%	0.0192%
35	0.0196%	0.0008%	0.0294%
40	0.0316%	0.0013%	0.0474%
45	0.0518%	0.0021%	0.0777%
50	0.0896%	0.0036%	0.1344%
55	0.1690%	0.0068%	0.1800%
60	0.2408%	0.0096%	0.1800%
65	0.3080%	0.0123%	0.1800%

## Demographic Assumptions *(continued)*

### Termination Assumptions

Duration	School District	School District	General	General	Police & Fire
	Male	Female	Service Male	Service Female	
0	16.63%	13.50%	15.00%	15.50%	10.00%
1	14.25%	12.50%	12.50%	14.50%	5.97%
2	11.50%	10.50%	10.46%	11.81%	5.02%
3	9.50%	9.13%	9.23%	10.39%	4.22%
4	7.93%	8.07%	8.15%	9.14%	3.54%
5	6.86%	7.13%	7.19%	8.04%	3.31%
6	5.93%	6.31%	6.35%	7.07%	3.06%
7	5.12%	5.58%	5.60%	6.22%	2.83%
8	4.43%	4.93%	4.94%	5.44%	2.61%
9	3.82%	4.36%	4.42%	5.09%	2.41%
10	3.31%	3.85%	4.13%	4.77%	2.23%
11	3.04%	3.45%	3.85%	4.47%	2.06%
12	2.84%	3.24%	3.60%	4.18%	1.90%
13	2.65%	3.04%	3.36%	3.92%	1.76%
14	2.47%	2.85%	3.13%	3.67%	1.63%
15	2.30%	2.68%	2.93%	3.43%	1.50%
16	2.15%	2.51%	2.73%	3.22%	1.39%
17	2.00%	2.36%	2.55%	3.01%	1.28%
18	1.87%	2.21%	2.38%	2.82%	1.19%
19	1.74%	2.08%	2.22%	2.64%	1.10%
20	1.62%	1.95%	2.08%	2.47%	1.01%
21	1.52%	1.83%	1.94%	2.32%	0.94%
22	1.41%	1.72%	1.81%	2.17%	0.87%
23	1.32%	1.61%	1.69%	2.03%	0.80%
24	1.23%	1.50%	1.58%	1.90%	0.80%
25	1.20%	1.50%	1.47%	1.78%	0.80%
26	1.20%	1.50%	1.40%	1.67%	0.80%
27	1.20%	1.50%	1.40%	1.56%	0.80%
28	1.20%	1.50%	1.40%	1.46%	0.80%
29	1.20%	1.50%	1.40%	1.40%	0.80%
30 +	1.20%	1.50%	1.40%	1.40%	0.80%

**Demographic Assumptions (continued)**

**Merit Salary Increase Assumptions**

Duration	School	Other General	
	District	Service	Police & Fire
0	3.72%	3.70%	4.44%
1	3.43%	3.37%	3.95%
2	3.15%	3.06%	3.50%
3	2.87%	2.77%	3.09%
4	2.60%	2.49%	2.72%
5	2.34%	2.24%	2.39%
6	2.08%	2.00%	2.10%
7	1.83%	1.78%	1.83%
8	1.59%	1.57%	1.60%
9	1.36%	1.39%	1.40%
10	1.14%	1.21%	1.23%
11	0.92%	1.05%	1.08%
12	0.72%	0.90%	0.95%
13	0.53%	0.77%	0.85%
14	0.34%	0.65%	0.76%
15	0.17%	0.54%	0.69%
16	0.01%	0.45%	0.64%
17	-0.14%	0.36%	0.59%
18	-0.28%	0.29%	0.56%
19	-0.42%	0.22%	0.53%
20	-0.53%	0.16%	0.52%
21	-0.64%	0.12%	0.50%
22	-0.73%	0.08%	0.49%
23	-0.79%	0.05%	0.48%
24	-0.85%	0.03%	0.46%
25	-0.89%	0.01%	0.44%
26	-0.92%	0.00%	0.42%
27	-0.94%	0.00%	0.38%
28	-0.95%	0.00%	0.34%
29	-0.95%	0.00%	0.28%
30 +	-0.95%	0.00%	0.21%

## Demographic Assumptions *(continued)*

### *Unused Sick Leave Adjustment*

<b>Actives</b>	
• State General Service Male	7.0%
• State General Service Female	3.75%
• School District Male	7.75%
• School District Female	5.75%
• Local General Service Male	5.25%
• Local General Service Female	3.50%
• State Police & Fire	4.00%
• Local Police & Fire	7.25%
<b>Dormants</b>	3.25%

### *Unused Vacation Cash Out Adjustment*

Tier 1	
• State General Service	2.25%
• School District	0.25%
• Local General Service	3.25%
• State Police & Fire	2.75%
• Local Police & Fire	4.25%
Tier 2	0.00%

## **Retiree Healthcare Assumptions**

### *Retiree Healthcare Participation*

RHIPA	
• 8 – 9 years of service	10.0%
• 10 – 14 years of service	10.0%
• 15 – 19 years of service	15.0%
• 20 – 24 years of service	19.0%
• 25 – 29 years of service	26.0%
• 30+ years of service	34.0%
RHIA	
• Healthy Retired	32.0%
• Disabled Retired	20.0%

*RHIPA Subsidy Cost Trend Rates*

Year	Rate
2019	7.10%
2020	5.80%
2021	5.20%
2022-2024	5.00%
2025	5.10%
2026-2029	5.00%
2030	5.40%
2031-2033	5.90%
2034	5.80%
2035	5.90%
2036-2039	5.80%
2040	5.70%
2041	5.80%
2042	5.70%
2043	5.80%
2044	5.70%
2045	5.60%
2046-2047	5.50%
2048-2050	5.40%
2051-2053	5.30%
2054-2058	5.20%
2059-2063	5.10%
2064	5.00%
2065	4.90%
2066-2067	4.80%
2068	4.70%
2069	4.60%
2070	4.50%
2071-2072	4.40%
2073	4.30%
2074-2093	4.20%
2094+	4.10%