

***Indiana Public Retirement System
Public Employees' Retirement Fund***

***Replication of the Actuarial Valuation
June 30, 2016***

March 7, 2017

***The Board of Trustees
Indiana Public Retirement System
Indianapolis, IN***

Dear Board Members:

An actuarial valuation is prepared annually by PricewaterhouseCoopers LLP (Fund Actuary) for the Public Employees' Retirement Fund of the Indiana Public Retirement System. Submitted in this report are the results of the replication and review of the June 30, 2016 actuarial valuation. This report has been prepared for use by the Indiana Public Retirement System (INPRS).

Census Data and Asset Information

The member census data and the asset information for this replication were furnished by the Fund Actuary. The Fund Actuary received the asset information and member data from INPRS. The Fund Actuary performed certain checks for reasonableness, but did not audit the data. Nyhart did not audit the information provided, and did not review it thoroughly for reasonableness or compare it with the prior year's submission for consistency. The accuracy of the results presented in this report is dependent on the accuracy and completeness of the information provided.

Benefit Provisions

The benefit provisions reflected in the replication of results are those in effect as of June 30, 2016 and summarized in the Fund Actuary's valuation report. Nyhart did not audit the benefit provisions compared to Indiana Code, but did review them for reasonableness and consistency with Nyhart's understanding of the Fund. An audit of the benefit provisions summarized in the valuation report has been performed by INPRS legal staff and they have concluded that all benefit provisions that appear in the report are consistent with Indiana Code.

Assumptions and Methods

The selection of actuarial assumptions and methods are the responsibility of the Board and the Fund Actuary. The assumptions and methods used in this replication are those described in the Actuarial Assumptions and Methods section of the Fund Actuary's valuation report. Nyhart relied on the description found in the valuation report and did not review the assumptions for reasonableness. Nyhart performed a cursory review of the actuarial assumptions and methods as they pertained to the relevant replication computations.

The majority of the actuarial assumptions used in the June 30, 2016 valuation were adopted by the Board pursuant to the Experience Study completed in April 2015, which reflects the experience period from July 1, 2010 to June 30, 2014. These assumptions and methods have been used to develop the Actuarially Determined Contribution and are consistent with the accounting requirements detailed in GASB Statements No. 67 and No. 68.

Benefit obligations in the June 30, 2016 valuation are determined using June 30, 2015 census data and rolled-forward to the June 30, 2016 measurement date at the valuation interest rate, using actual distributions and ASA account returns during that period, and for any other material events that would require additional adjustments to the benefit obligations.

Certification

To the best of our knowledge, this report is complete and accurate and has been prepared in accordance with generally accepted actuarial principles and the Actuarial Standards of Practice as described by the American Academy of Actuaries. In addition, information has been prepared in accordance with applicable government standards of financial reporting for defined benefit pension funds.

Future actuarial measurements may differ significantly from the current measurements presented in this report due to such factors as the following:

- Fund experience differing from that anticipated by the economic or demographic assumptions;
- changes in economic or demographic assumptions;
- increases or decreases expected as part of the natural operation of the methodology used for these measurements (such as the end of an amortization period or additional cost or contribution requirements based on the Fund's Funded status); and
- changes in Fund provisions or applicable law.

We did not perform an analysis of the potential range of future measurements due to the limited scope of our engagement.

In the Fund Actuary's opinion, the actuarial assumptions and methods are individually reasonable and in combination represent their best estimate of anticipated experience of the Fund. Nyhart did not review the actuarial assumptions and methods.

Neither Nyhart nor any of its employees have any relationship with the Fund or its sponsor which could impair or appear to impair the objectivity of this report. While Nyhart has collaborated on INPRS projects with PricewaterhouseCoopers LLP (Fund Actuary), Nyhart does not have any relationship with the Fund Actuary that would impair the objectivity of this report.

The undersigned are compliant with the continuing education requirements of the Qualification Standards for Actuaries Issuing Statements of Actuarial Opinion in the United States.

Respectfully submitted,



Michael Zurek, EA, MAAA



Danielle Winegardner, ASA, EA, MAAA



Tayt V. Odom, FSA, EA, MAAA

Executive Summary

Purpose and Scope of the Actuarial Peer Review and Replication

INPRS engaged Nyhart to perform an actuarial peer review and replication of the June 30, 2016 actuarial valuation of the Public Employees' Retirement Fund in order to provide INPRS with an actuarial opinion as to the completeness, accuracy, and compliance with Actuarial Standards of Practice ("ASOPs") of the results and report prepared by PwC, the Fund Actuary.

We performed our review and replication of the valuation results in a manner consistent with the process we would follow to perform the full actuarial valuation of the fund as if we were the newly retained Fund Actuary. We initially prepared a replication of the June 30, 2016 valuation results based on the underlying census, assumptions, methods, and provisions data provided to us, but independent of any knowledge of specific valuation coding or mathematical techniques applied by the Fund Actuary. We then conducted a review of selected individual sample life valuations in order to identify any differences in coding or mathematical techniques that resulted in differences between our valuation results and those of the Fund Actuary.

Our review and replication procedures were not audit procedures performed in accordance with auditing standards prescribed by the American Institute of Certified Public Accountants. Therefore, the results presented in this report should not be construed as an audit opinion, but rather an actuarial statement of opinion.

In particular, the scope of our review and replication procedures included the following steps:

- Request information from the Fund Actuary, including a copy of the June 30, 2016 actuarial valuation report, a copy of the most recent experience study completed in April 2015, the member census data and assets used in the actuarial valuation, and detailed output for individual "sample life" valuations for selected members.
- Review and validate the member census data and market value of asset data provided by the Fund Actuary by replicating various statistics shown in the Fund Actuary's actuarial valuation report.
- Review the assumption recommendations contained in the Fund Actuary's 2015 experience study report for consistency with the historical experience and future expectations summarized in the report and for consistency with the assumption development guidance in ASOP 27 and ASOP 35. We note that the study was primarily based on member experience during the period from June 30, 2011 to June 30, 2014.
- Confirm that the recommended actuarial assumptions presented in the Fund Actuary's experience study report and subsequently adopted by the Board were properly reflected in the June 30, 2016 actuarial valuation and disclosed in the actuarial valuation report.
- Independently value the June 30, 2015 benefit liabilities, in particular the actuarial accrued liability and normal cost based on the member census data provided and the actuarial assumptions, methods, and plan provisions summarized in the actuarial valuation report.
- Review and replicate the roll forward of benefit liabilities from June 30, 2015, the date of the underlying member census data, to June 30, 2016, including application of the interest rate to reflect the time value of money, the benefit distributions reflected, and other adjustments for known activity during the roll forward period.
- Review sample life output for certain selected individuals provided by the Fund's Actuary to identify any differences in programming or mathematical technique in the Fund Actuary's valuation and our independent valuation of the benefit liabilities.

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- Review the calculation of the actuarial value of assets based on the investment gain/losses for each of the past five years disclosed in the Fund Actuary's actuarial valuation report and our understanding of the five-year smoothing method selected by the Board as part of its funding policy.
- Review the calculation of the actuarially determined contributions based on outstanding liability gains/losses disclosed in the Fund Actuary's actuarial valuation report and our understanding of the unfunded actuarial accrued liability amortization method selected by the Board as part of its funding policy.
- Review the June 30, 2016 actuarial valuation report for compliance with ASOP 41, Actuarial Communications, and other applicable ASOPs.
- Confirm the credentials of the actuaries who signed the June 30, 2016 actuarial valuation report and their ability to certify the results and render the opinions contained in their report.
- Identify recommendations and considerations for INPRS and the Fund Actuary for improving future valuations and reports.

Note that scope of our review and replication did not include the following:

- Audit of the member census and asset data, or otherwise review the data for reasonableness. We relied on the member census and asset data provided by the Fund Actuary as is. It is our understanding that the member census and asset data utilized by the Fund Actuary are audited by the independent accounting firm retained by INPRS.
- Independent replication of the experience study analysis supporting the assumptions selected by the Board for the June 30, 2016 valuations. Rather, we relied on the analysis completed by the Fund Actuary and summarized in their experience study report for validating the assumptions selected by the Board and used in the June 30, 2016 actuarial valuation.
- Verification of the benefit provisions summarized in the actuarial valuation report to the applicable sections of the Indiana Code. A comparison of the benefit provisions summarized in the report to the Indiana Code was performed by INPRS legal staff and they confirmed to us that the significant benefit provisions summarized the report are consistent with Indiana Code. No exceptions were noted. In addition, since Nyhart is the Fund Actuary for the Indiana State Teachers' Retirement Funds we did review the summary provisions for reasonableness and consistency with our understanding of the TRF provisions, given the similarity of the two Funds.
- Replication of information prepared by the Fund Actuary in accordance with GASB 67 and GASB 68 for financial reporting. It is our understanding that financial reporting information prepared by the Fund Actuary is audited by the independent accounting firm retained by INPRS. We replicated the valuation of benefit liabilities and calculation of the actuarial determined contributions on a funding basis only. However, we note that the "total pension liability" valuation for financial reporting purposes is based on the same underlying member census data, actuarial assumptions, actuarial methods, benefit provisions, and valuation date as the valuation performed for funding purposes, resulting in the total pension liability being equal to the "actuarial accrued liability" for funding purposes.

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Conclusions

Our replication of the actuarial valuation results and funding policy calculations matched those of the Fund Actuary to within a small margin, generally less than 1%. We did not identify any significant errors or omissions on the part of the Fund Actuary. We also found the actuarial valuation and report prepared by the Fund Actuary to be generally in compliance with applicable ASOPs.

Specifically:

- We were able to match the summary of member census data without any significant differences.
- The actuarial assumptions selected by the Board pursuant to the results of the 2015 experience study completed by the Fund Actuary do not appear unreasonable based on the underlying experience and future expectations summarized in the study. The analysis summarized in the experience study report appears consistent with the assumption development guidance in ASOP 27 and ASOP 35.
- The actuarial assumptions used in the June 30, 2016 actuarial valuation and disclosed in the actuarial valuation report match the Fund Actuary's recommendations contained in the 2015 experience study report.
- We were able to replicate the actuarial accrued liability and normal cost in aggregate, and for the individual sample lives provided, to within a small margin. Generally less than 1%.
- The calculations performed for the liability roll-forward from June 30, 2015 to June 30, 2016, the actuarial value of assets, and the actuarially determined contributions are consistent with customary actuarial practices and appear to be consistent with the Board funding policy.
- The actuarial valuation report prepared by the Fund Actuary generally complies with ASOP 41.
- The signing actuaries have the actuarial credentials that we generally consider appropriate for purposes of preparing pension actuarial valuations. We have also verified that the signing actuaries, as applicable, have satisfied the continuing education requirements of the Society of Actuaries for the period ended December 31, 2015, based on documentation on the Society of Actuaries website (www.soa.org).

Executive Summary

The remainder of this report is divided into the following sections that align with the steps taken during our review and replication.

- Member Census Data
- Actuarial Assumptions and Methods
- Valuation Replication
- Actuarial Value of Assets
- Actuarially Determined Contributions
- Actuarial Report

Additional detailed conclusions are presented at the end of each section of the report and identify a number of recommendations and considerations for INPRS and the Fund Actuary for improving future valuations. However, we note that the individual and cumulative impact of the various recommendations and considerations presented in this report would have only a minor impact on the valuation of the benefit liabilities and funding policy calculations.

Member Data

The table below summarizes the member data used in the valuation. The June 30, 2016 valuation is based on June 30, 2015 census data, with liabilities rolled-forward to the June 30, 2016 measurement date. The data summarized in this section is as of the June 30, 2015 census collection date.

	Nyhart	Fund Actuary
	June 30, 2015	June 30, 2015
Number of Actives		
State	38,194	38,194
Political Subdivisions	92,175	92,175
ASA Only	<u>724</u>	<u>724</u>
Total	131,093	131,093
Average Age	47.8	47.8
Average Service	11.5	11.5
Anticipated Payroll		
State	\$1,650,347,194	\$1,654,540,326
Political Subdivisions	<u>3,365,627,089</u>	<u>3,359,471,622</u>
Total	\$5,015,974,283	\$5,014,011,948
Number of Inactive Vesteds	29,702	29,702
Average Age	53.3	53.3
Average Service	11.8	11.8
Number of Inactive Nonvesteds	50,212	50,212
Number of Retirees and Beneficiaries	83,188	83,188
Average Age	73.1	72.5
Annual Benefits Payable		
Pension	\$601,454,022	\$601,327,808
ASA Annuities	<u>128,073,573</u>	<u>128,038,484</u>
Total	\$729,527,595	\$729,366,292
Total Number of Members	294,195	294,195

Member Data

Conclusions:

We note the following conclusions with respect to our review and analysis of the member census data provided to us by the Fund Actuary:

- Our summary statistics of the member census data provided by the Fund Actuary are consistent with the same statistics presented in the Fund Actuary's valuation reports with no significant differences noted. This provided assurance that the data provided to us is the same data used in the June 30, 2016 valuation. Note that slight differences in the total pay for active members and total annual pension for retired members are the result of different calculation procedures between Nyhart and the Fund Actuary with respect to application of assumed salary growth, cost-of-living adjustments, and inclusion or exclusion of members assumed to decrement immediately following the valuation date.

As a result of our review and analysis, we offer the following recommended revisions to INPRS and the Fund Actuary for implementation in the next actuarial valuation:

- None.

As a result of our review and analysis, we offer the following additional considerations to INPRS and the Fund Actuary for implementation in future actuarial valuations:

- We understand the Fund Actuary uses data override assumptions for active and deferred vested members over the age of 80 when calculating Fund obligations. A review/cleanup of the census data on the front end may be a preferable approach if information is available to review those records

Actuarial Assumptions and Methods

The selection of actuarial assumptions and methods are the responsibility of the Board and the Fund Actuary. The assumptions and methods used in this replication are those described in the Actuarial Assumptions and Methods section of the Fund Actuary's valuation report. Nyhart relied on the description found in the valuation report and did not review the assumptions for reasonableness.

Nyhart reviewed the results of the 2015 experience study performed by the Fund Actuary for consistency with the assumptions used in the valuation. Nyhart also reviewed the actuarial methods and Funding policies disclosed in the Fund Actuary's valuation report for consistency with Nyhart's understanding of INPRS policies.

Actuarial Methods used by the Fund Actuary:

Actuarial Cost Method:	Entry Age Normal Cost Method
Actuarial Asset Valuation Method:	5-year smoothing of investment gains and losses, with a 20% corridor
Calculated Contribution Rate:	Normal cost plus 20-year (30-year prior to 2016) closed level dollar amortization of the unfunded accrued liability

Conclusions:

- Actuarial Standard of Practice (ASOP) No. 27 provides recommendations for economic assumptions and ASOP No. 35 provides guidance for the selection of demographic and other noneconomic assumptions. ASOP 27 and 35 recognize the uncertain nature in which assumptions are selected and that a range of assumptions may be reasonable. Under both standards, a reasonable assumption should have the following characteristics.
 - Appropriate for the purpose of the measurement
 - Reflects the actuary's professional judgement
 - Reflects historical and current (economic or non-economic) data as of the measurement date
 - Reflects estimates of future experience
 - Should be unbiased
- Nyhart did not review the assumptions for reasonableness. Nyhart performed a cursory review of the actuarial assumptions and methods as they pertained to the relevant replication computations.
- The assumptions developed by the Fund Actuary based on the 2015 experience study for the Fund are reasonable representations of Fund experience over the period. This conclusion is based on a review of the assumption study report presented by the Fund Actuary, and the data and conclusions contained in the report. Replication of the results of the experience study is outside of the scope of this review.
- The assumptions developed in the 2015 experience study were used in the June 30, 2016 valuation by the Fund Actuary

Actuarial Assumptions and Methods

Conclusions (cont):

- The actuarial cost method, asset valuation method, and funding policies used in the June 30, 2016 valuation by the Fund Actuary are consistent with Nyhart's understanding of the actuarial policies established by INPRS.

As a result of our review, we offer the following recommended revisions to INPRS and the Fund Actuary for implementation in the next actuarial valuation of the Public Employees' Retirement Fund:

- None.

As a result of our review, we offer the following additional considerations to INPRS and the Fund Actuary for implementation in future actuarial valuation of the Public Employees' Retirement Fund:

- The 1% ad hoc COLA assumption used in the valuation should continue to be monitored. The COLA assumption is a forward-looking assumption and prior COLA history is not necessarily an accurate indicator of future COLA's. However, a 13th check has been granted in lieu of a 1% COLA annually since 2009. The 1% COLA assumption adds approximately \$1.2 billion to the Fund's accrued liability.
- The actuarial valuations for the Teachers' Retirement Fund include a benefit load for unused sick days that can be converted to pension-eligible earnings at retirement. A review of the PERF pay definition and experience may be appropriate to determine if a similar assumption should be included in the PERF valuation.

Actuarial Accrued Liability and Normal Cost

The following analysis was performed by Nyhart to review the Actuarial Accrued Liability and Normal Cost of the Fund as determined by the Fund Actuary:

- Calculate the Actuarial Accrued Liability and Normal Cost for the Fund in total based on the census data provided and the assumptions and Fund provisions described in the Fund Actuary's Actuarial Valuation Report.
- Confirm that the roll-forward methodology used by the Fund Actuary to estimate benefit obligations on the June 30, 2016 measurement date from the June 30, 2015 census data and liability valuation date is consistent with standard practices.
- Review the individual liability of sample lives requested by Nyhart and provided by the Fund Actuary.

To provide some context on the replication results below, we generally expect to be within a smaller range on the calculation of the present value of future benefits (PVFB) (within 1%-2%) and within a wider range on the calculation of the actuarial accrued liability and normal cost (within 5%). The wider range on the latter items is because there tends to be more variability in the methodologies used to allocate the total liability (PVFB) to past and future years of service. Nevertheless, we analyzed both measures in our review of individual sample life liabilities and kept a continued focus on the Entry Age Normal measurements actually used to compute the ultimate Fund cost.

Total Fund Liability Replication:

	Nyhart	Fund Actuary
	June 30, 2015	June 30, 2015
Entry Age Normal Accrued Liability:		
ASA Account Balance	\$ 2,717,173,311	\$ 2,717,173,311
ASA Annuities (Retiree/Beneficiary/Disabled)	1,311,270,803	1,310,033,039
Pension (Retiree/Beneficiary/Disabled)	6,471,230,072	6,461,053,465
Pension (Active and Inactive)	7,444,738,332	7,494,669,428
Total Accrued Liability	\$ 17,944,412,518	\$ 17,982,929,243
<i>Difference (\$)</i>	\$ (38,516,725)	
<i>Difference (%)</i>	(0.21)%	
Entry Age Normal Cost	\$ 172,441,569	\$ 184,132,474
<i>Difference (\$)</i>	\$ (11,690,905)	
<i>Difference (%)</i>	(6.4)%	

Actuarial Accrued Liability and Normal Cost

Review of Liability Roll-Forward:

The June 30, 2016 valuation is based on census data as of June 30, 2015 and a valuation of benefit obligations on the census collection date. The resulting obligations are then rolled forward to June 30, 2016 at the valuation interest rate and using actual distributions and ASA returns during the period, and further adjusted for any material events during the period.

The table below shows Nyhart's replication of the liability roll-forward. Results of the review of the liability roll-forward are summarized under conclusions on the following pages.

Liability, Normal Cost and Payroll Roll-Forward

	Nyhart	Fund Actuary
	June 30, 2015	June 30, 2015
	to	to
	June 30, 2016	June 30, 2016
1. Total Accrued Liability, beginning of year	\$ 17,944,412,518	\$ 17,982,929,243
2. ASA Account balance, beginning of year	2,717,173,311	2,717,173,311
3. Accrued Liability, Net of ASA Account Balance, Beginning of year [(1) – (2)]	15,227,239,207	15,265,755,932
4. Normal Cost	172,441,569	184,132,474
5. Actual Benefit Payments	792,048,055	792,048,055
6. Actual Transfers ¹	493,690	493,690
7. Actual ASA Annuityizations ¹	75,035,755	75,035,755
8. Expected Interest [0.0675 * ((3) + (4) - 0.5*(5) + 0.5*(6) +0.5*(7))]	1,015,295,950	1,018,684,964
9. Total Accrued Liability, Net of ASA Account Balance, end of year [(3) + (4) - (5) + (6) + (7) + (8)]	15,698,458,116	15,752,054,760
10. ASA Account Balance, end of year	<u>2,656,892,220</u>	<u>2,656,892,220</u>
11. Total Accrued Liability, end of year	18,355,350,336	18,408,946,980
<i>Difference (\$)</i>	\$ (53,596,644)	
<i>Difference (%)</i>	(0.29%)	
12. Normal Cost for Fiscal 2017	\$ 198,144,143	\$ 194,101,310
<i>Difference (\$)</i>	\$ 4,042,833	
<i>Difference (%)</i>	2.08%	
13. Payroll for Fiscal 2017	\$ 5,016,024,584	\$ 5,014,011,948
<i>Difference (\$)</i>	\$ 2,012,636	
<i>Difference (%)</i>	0.04%	

¹ Actual transfers (Service Purchases) and ASA annuityizations provided by the Fund Actuary were used in Nyhart's replication.

Actuarial Accrued Liability and Normal Cost

Review of Sample Lives:

Sample lives produced from the Fund Actuary's valuation system were requested and reviewed.

A successful replication of liabilities for the Fund in total does not necessarily provide enough information to conclude that the Fund provisions and assumptions disclosed in the valuation report are accurately used in the valuation of benefit obligations. For example, an error or omission that inflates liabilities by 5% can be offset by a separate error or omission that results in a 5% liability reduction. The net result of the two errors can produce a reasonable match.

Sample lives provide details on the benefits and liabilities calculated at each age for every benefit offered under the Fund. Review of the sample valuation output and replication of individual results can provide the details that might get missed when only reviewing the Fund in total. Eight samples representing a thorough cross-section of participants of varying age, gender, years of service, and status were reviewed in detail. The following sample lives were chosen for review:

No.	Fund	PID	Description
1	PERF	348227	Active participant, age 49 with 15 years of service and pay of \$42,082
2	PERF	506324	Active participant, age 36 with 11 years of service and pay of \$26,508
3	PERF	1048272	Active participant, age 21 with 1 year of service and pay of \$26,453
4	PERF	665187	Deferred vested participant, age 46 with 20 years of service
5	PERF	397695	Deferred vested participant, age 34 with 10 years of service
6	PERF	3663	Beneficiary, age 105 with monthly benefit of \$379
7	PERF	39730	Retiree, age 98 with 50% joint and survivor form of payment and monthly benefit of \$578
8	PERF	533129	Retiree, age 55 with social security leveling form of payment and monthly benefit of \$1,769

We reviewed the valuation output for the sample lives above provided by the Fund Actuary. We compared the assumptions used and the benefits calculated against those summarized in the valuation report. We also ran the same individuals through our valuation software used to match total Fund results and compared individual liability results for consistency. Results of the review showed consistency between the Fund Actuary and our individual liabilities. We achieved a very close match on the computation of the present value of future benefits, and were consistently close on the Entry Age Normal liabilities and normal cost.

Actuarial Accrued Liability and Normal Cost

Results of our individual member valuations were consistent with Fund Actuary, as shown in the tables below:

As of June 30, 2015								
No.	Present Value of Future Benefits				Entry Age Normal - Actuarial Accrued Liability			
	Nyhart	Fund Actuary	Diff. (\$)	Diff. (%)	Nyhart	Fund Actuary	Diff. (\$)	Diff. (%)
1	\$77,457	\$77,735	(\$278)	(0.4)%	\$61,615	\$61,863	(\$248)	(0.4)%
2	32,871	32,019	852	2.6%	23,910	24,101	(191)	(0.8)%
3	127	95	32	25.2%	43	0	43	100%
4	11,672	7,403	4,269	36.6%	11,672	7,403	4,269	36.6%
5	5,787	5,937	(150)	(2.6)%	5,787	5,937	(150)	(2.6)%
6	9,316	9,316	0	0.0%	9,316	9,316	0	0.0%
7	25,696	25,696	0	0.0%	25,696	25,696	0	0.0%
8	186,236	186,236	0	0.0%	186,236	186,236	0	0.0%
Tot.	\$349,162	\$344,437	\$4,725	1.4%	\$324,275	\$320,552	\$3,723	1.1%

As of June 30, 2015				
No.	Entry Age Normal - Normal Cost Active Participants Only			
	Nyhart	Fund Actuary	Diff. (\$)	Diff. (%)
1	\$1,705	\$1,708	(\$3)	(0.2)%
2	787	689	98	12.5%
3	28	32	(4)	(14.3)%
Tot.	\$2,520	\$2,429	\$91	3.6%

Conclusions:

- The total Fund liability replication is well within a reasonable expectation for matching liability results and well within the actuarial standards generally used as a guideline for that purpose. Replication of accrued liability and normal cost within 5% are generally considered to be an acceptable match. Our match produced an accrued liability that is 0.29% lower than the Fund Actuary, and a Normal Cost that is 2.08% higher than the Fund Actuary.
- The total Fund replication was performed based on Nyhart's independent coding of the Fund provisions and assumptions summarized in the Fund Actuary's valuation report. We used the sample lives provided to by the Fund Actuary to help interpret how to use the data provided and for general guidance, but we did not attempt to replicate or rely on the coding used to produce the sample lives in our match.

Actuarial Accrued Liability and Normal Cost

- The Fund Actuary disclosed the impact on liabilities for providing a 13th check in lieu of the 1% assumed COLA in 2017. We matched their calculation of the impact of the change within an acceptable margin.
- We have replicated the roll-forward of liabilities from the June 30, 2015 valuation date to June 30, 2016 performed by the Fund Actuary and confirm that the interest adjustments and other adjustment used are consistent with our methodology and standard actuarial practices.
- Our review of the sample lives confirm that the assumptions and provisions summarized in the Fund Actuary's report were generally used in the liability calculations. We matched the liabilities and normal costs of all sample lives within a reasonable percentage. As shown above, sample lives #3 and #4 are more significantly different than the others. Sample life #3 is a new entrant with a very small liability which causes a larger percent difference for any small difference in methodology. The liability difference for sample life #4, a deferred vested participant, can be attributed to different data overrides used to calculate deferred vested benefits with missing information.
- The total fund replication did not attempt to match the Fund Actuary's results by status code (e.g. retired, disabled, beneficiary) or by active decrement source (e.g. retirement, death, disability, termination) since liabilities at that level of detail were not contained in the Fund Actuary's report. We do not believe that disclosure of liabilities at that level of detail are necessary in the valuation report.

As a result of our review, we offer the following recommended revisions to INPRS and the Fund Actuary for implementation in the next actuarial valuation of the Public Employees' Retirement Fund:

- The only situation where we found that the current provisions were not used in the valuation was discovered in the review of sample lives. The prior definition of actuarial equivalence was used in the conversion to a survivor annuity under the Fund's death benefit. Updating to the current definition of actuarial equivalence will not have a material impact on the benefit or valuation results.

As a result of our review, we offer the following additional considerations to INPRS and the Fund Actuary for implementation in the next actuarial valuation of the Public Employees' Retirement Fund:

- The Fund Actuary is projecting future pay using the most recent pay earned. The TRF valuations project future pays using the highest pay earned. Accrued liability and normal cost are about 1% higher than those calculated by the Fund Actuary using the TRF approach.
- The Fund Actuary assumes all future retirements elect to receive the Fund's normal form of payment upon retirement, namely the 5-year certain and life annuity. The optional annuity forms offered by the Fund are actuarially equivalent to the normal form so we do not believe there would be a material difference in valuation results by including an annuity election assumption that considers all of the annuity forms available. However, the addition of the optional forms may be something to consider adding to the valuation, or you may consider a review of the impact in order to document that their inclusion would not materially affect valuation results.

Development of the Actuarial Value of Assets

	Nyhart	Fund Actuary
	June 30, 2015	June 30, 2015
	thru	thru
	June 30, 2016	June 30, 2016
1. Market Value of Assets, beginning of year		
a. Total Market Value of Assets	\$ 13,907,666,213	\$ 13,907,666,213
b. Annuity Savings Account Balances	<u>(2,717,173,311)</u>	<u>(2,717,173,311)</u>
c. Market Value of Assets, Net of ASA Balances	11,190,492,902	11,190,492,902
2. Market Value of Assets, end of year		
a. Total Market Value of Assets	\$ 13,870,502,444	\$ 13,870,502,444
b. Annuity Savings Account Balances	<u>(2,656,892,220)</u>	<u>(2,656,892,220)</u>
c. Market Value of Assets, Net of ASA Balances	11,213,610,224	11,213,610,224
3. Expected Earnings		
a. Expected Earnings on Market Value	\$ 755,358,271	\$ 755,358,271
b. Receipts with Expected Earnings	641,287,591	641,287,591
c. Disbursements with Expected Earnings	(822,117,921)	(822,117,921)
d. ASA Annuitization with Expected Earnings	<u>77,568,212</u>	<u>77,568,212</u>
e. Total [(a) + (b) + (c) + (d)]	\$ 652,096,153	\$ 652,096,153
4. Expected Market Value of Assets, end of year, Net of ASA Account Balance [(1c) + (3e)]	\$ 11,842,589,055	\$ 11,842,589,055
5. Current Year Market Value Gain/(Loss) [(2c) – (4)]	\$ (628,978,831)	\$ (628,978,831)
6. Deferred Recognition of Investment Gain/(Loss)		
a. Current Fiscal Year (80% of (5))	\$ (503,183,065)	\$ (503,183,065)
b. Prior Fiscal Year - 1 (60%)	(476,115,173)	(476,115,173)
c. Prior Fiscal Year - 2 (40%)	328,350,518	328,350,518
d. Prior Fiscal Year - 3 (20%)	<u>(31,609,262)</u>	<u>(31,609,262)</u>
e. Total [(a) + (b) + (c) + (d)]	\$ (682,556,982)	\$ (682,556,982)
7. Preliminary Actuarial Value, Including ASA Account Balance, end of year [(2a) – (6e)]	\$ 14,553,059,426	\$ 14,553,059,426
a. 80% of Market Value of Assets, end of year	11,096,401,955	11,096,401,955
b. 120% of Market Value of Assets, end of year	16,644,602,933	16,644,602,933
8. Actuarial Value of Assets, end of year	\$ 14,553,059,426	\$ 14,553,059,426
9. Actuarial Value of Assets as a % of Market Value	104.9%	104.9%
10. Actuarial Value Net Rate of Return	4.2%	4.2%

Development of the Actuarial Value of Assets

Conclusions:

- The Actuarial Standard of Practice (ASOP) No. 44 governs the selection and use of asset valuation methods for pension valuations. ASOP 44 recommends the asset smoothing method satisfies each of the following conditions. The asset smoothing methodology utilized by the Fund meets these recommendations.
 - The actuarial value of assets method should produce smoothed values sometimes greater than and sometimes less than the market value of assets
 - The actuarial value of assets should fall within a reasonable range around market value
 - The differences between actuarial value of assets and market value of assets are recognized within a reasonable period of time

We believe the 5-year asset smoothing method with 20% corridor adopted by INPRS satisfies the criteria under ASOP 44.

- The actuarial value of assets developed by the Fund Actuary is consistent with the 5-year smoothing period and 20% corridor method disclosed in the Fund Actuary's Valuation Report.
- The market value of assets on June 30, 2016, and the contributions, distributions, expenses, and ASA annuitizations during fiscal 2016 used to develop the actuarial value of assets were consistent with the amounts reported in the INPRS financial statements.
- The expected return assumption of 6.75% is disclosed as net of administrative expenses in the assumption section of the report. The Fund Actuary includes administrative expenses in the disbursements category when calculating the expected return on assets used to develop the actuarial value of assets. This is consistent with the net return as disclosed.
- The 6.75% expected return assumption applies to pension Funds invested by INPRS. The Fund Actuary consistently excludes assets and cash flows related to ASA balances from the AVA development, adding the ASA balance to the smoothed asset value at the end of the smoothing process. We agree with this treatment of ASA balances in the development of the actuarial value of assets.

As a result of our review, we offer the following recommended revisions to INPRS and the Fund Actuary for implementation in the next actuarial valuation of the Public Employees' Retirement Fund

- None.

As a result of our review, we offer the following additional considerations to INPRS and the Fund Actuary for implementation in future actuarial valuations of the Public Employees' Retirement Fund

- Consider separating the disbursements shown in the report into benefit payments and administrative expenses in order to provide more transparency that the return is net of administrative expenses.

Calculated Employer Contribution Rate

This section of the report replicates the calculation of the employer contribution rate based on the funding policy as disclosed in the Fund Actuary's report. Please note that the liabilities and normal cost used in the replication are those determined by the Fund Actuary.

State:

	Nyhart	Fund Actuary
	June 30, 2016	June 30, 2016
Normal Cost	\$ 56,202,817	\$ 56,202,817
Percent of Projected Payroll for Fiscal 2017	3.40%	3.40%
Amortization of Unfunded Accrued Liability		
Unfunded Accrued Liability (UAL)	\$ 1,369,358,990	\$ 1,369,358,990
Unamortized UAL from Prior Years	1,449,232,314	1,449,232,314
Net Unamortized UAL	\$ (79,873,324)	(79,873,324)
Amortization Factor (20-years, level dollar)	11.5322	11.5322
Current Year Amortization Payment	\$ (6,926,098)	\$ (6,926,098)
Payments Established in Prior Years	114,273,153	114,273,153
Total Amortization Payments	\$ 107,347,055	\$ 107,347,055
Percent of Projected Payroll for Fiscal 2017	6.49%	6.49%
Total Calculated Employer Contribution Rate	9.89%	9.89%
Fiscal 2017 Projected Payroll	\$ 1,654,540,326	\$ 1,654,540,326

Amortization Schedule of Unfunded Accrued Liability (Fund Actuary):

Year	Remaining Amount	Remaining Period	Amortization Amount
6/30/2008	\$ 39,485,342	22	\$ 3,274,972
6/30/2009	251,686,332	23	20,471,745
6/30/2010	512,907,473	24	40,977,084
6/30/2011	225,420,620	25	17,714,135
6/30/2012	293,231,643	26	22,694,524
6/30/2013	(104,465,660)	27	(7,972,163)
6/30/2014	(86,099,765)	28	(6,485,747)
6/30/2015	317,066,329	29	23,598,603
6/30/2016	<u>(79,873,324)</u>	20	<u>(6,926,098)</u>
	\$ 1,369,358,990		\$ 107,347,055

Calculated Employer Contribution Rate

Political Subdivisions:

	Nyhart	Fund Actuary
	June 30, 2016	June 30, 2016
Normal Cost	\$ 137,898,493	\$ 137,898,493
Percent of Projected Payroll for Fiscal 2017	4.10%	4.10%
Amortization of Unfunded Accrued Liability		
Unfunded Accrued Liability (UAL)	\$ 2,486,528,564	\$ 2,486,528,564
Unamortized UAL from Prior Years	2,339,469,692	2,339,469,692
Net Unamortized UAL	\$ 147,058,872	147,058,872
Amortization Factor (20-years, level dollar)	11.5322	11.5322
Current Year Amortization Payment	\$ 12,751,994	\$ 12,751,994
Payments Established in Prior Years	185,276,132	185,276,132
Total Amortization Payments	\$ 198,028,126	\$ 198,028,126
Percent of Projected Payroll for Fiscal 2017	5.89%	5.89%
Total Calculated Employer Contribution Rate	9.99%	9.99%
Fiscal 2017 Projected Payroll	\$ 3,359,471,622	\$ 3,359,471,622

Amortization Schedule of Unfunded Accrued Liability (Fund Actuary):

Year	Remaining Amount	Remaining Period	Amortization Amount
6/30/2006	\$ 198,127,295	20	\$ 17,180,318
6/30/2007	3,999,167	21	338,826
6/30/2008	41,726,634	22	3,460,869
6/30/2009	308,228,047	23	25,070,753
6/30/2010	614,134,138	24	49,064,261
6/30/2011	513,053,434	25	40,317,066
6/30/2012	484,543,383	26	37,501,005
6/30/2013	(329,809,660)	27	(25,169,001)
6/30/2014	(120,921,063)	28	(9,108,776)
6/30/2015	626,388,317	29	46,620,811
6/30/2016	<u>147,058,872</u>	20	<u>12,751,994</u>
	\$ 2,486,528,564		\$ 198,028,126

Calculated Employer Contribution Rate

Conclusions:

- As part of its funding policy, the Board has adopted the methods used for determining the actuarially determined contributions of the Fund. The methods include the Entry Age Normal Level Percent of Pay actuarial cost method for computing the actuarial accrued liability, a five-year smoothing method for computing the actuarial value of assets, and level-dollar closed amortization methods for including payment towards the unfunded actuarial accrued liability.

Actuarial Standards of Practice (ASOP) No. 4 provides guidance on measuring pension obligations. The standard addresses actuarial cost methods and contribution allocation procedures. Under the standard, the actuary should select an actuarial cost method that meets the following criteria:

- The period over which normal costs are allocated for a participant should begin no earlier than the date of employment and should not extend beyond the last assumed retirement age. The period may be applied to each individual participant or to groups of participants on an aggregate basis.
- The attribution of normal costs should bear a reasonable relationship to some element of the plan's benefit formula or the participant's compensation or service. The attribution basis may be applied on an individual or group basis.
- Expenses should be considered when assigning periodic costs or actuarially determined contributions to time periods.
- The sum of the actuarial accrued liability and the actuarial present value of future normal costs should equal the actuarial present value of projected benefits and expenses, to the extent expenses are included in the actuarial accrued liability and normal cost.

Additionally, under ASOP 4, when selecting a cost allocation procedure or contribution allocation procedure, the actuary should consider factors such as the timing and duration of expected benefit payments and the nature and frequency of plan amendments. In addition, the actuary should consider relevant input received from the principal, such as a desire for stable or predictable periodic costs or actuarially determined contributions, or a desire to achieve a target funding level within a specified time frame. When selecting a contribution allocation procedure, the actuary should select a contribution allocation procedure that, in the actuary's professional judgment, is consistent with the plan accumulating adequate assets to make benefit payments when due, assuming that all actuarial assumptions will be realized and that the plan sponsor or other contributing entity will make actuarially determined contributions when due.

The Entry Age Normal cost method and contribution allocation procedure used by the Fund are in line with the recommendations of ASOP 4.

- The amortization payments for the individual years included in the amortization schedules are consistent with the disclosed unamortized unfunded liabilities, the remaining amortization periods, a 6.75% interest rate assumption, and the level dollar closed amortization policy adopted by INPRS.
- The remaining amortization years as disclosed in the amortization schedules are consistent with the INPRS policy of 30-year amortizations prior to 2016 (without restatement) and 20 years prospectively after 2015.
- The calculated contribution rate developed by the Fund's Actuary is consistent with the methods described in the assumption section of the report and with Nyhart's understanding of the Funding policies developed by INPRS.

Calculated Employer Contribution Rate

As a result of our review, we offer the following recommended revisions to INPRS and the Fund Actuary for implementation in the next actuarial valuation of the Public Employees' Retirement Fund

- None.

As a result of our review, we offer the following additional considerations to INPRS and the Fund Actuary for implementation in future actuarial valuations of the Public Employees' Retirement Fund

- None.

Actuarial Valuation Report

The actuarial report of the Fund Actuary has been reviewed for completeness and adherence to the Actuarial Standards for presenting actuarial results.

Conclusions:

- The report presented by the Fund Actuary is in compliance with Actuarial Standards. Actuarial Standards of Practice (ASOP) No. 41 provides guidance to actuaries with respect to actuarial communication. The actuarial report should state the actuarial findings and identify the methods, procedures, assumptions and data used with sufficient clarity. The following are additional requirements for actuarial communications as recommended by ASOP 41.
 - Principal and Scope of Engagement – actuary should identify the client or employer and make clear the scope of the assignment and limitations or constraints of results
 - Form and Content – actuary should ensure the communication is appropriate to the particular circumstances
 - Clarity – actuarial communication should be clear and use appropriate language, taking into account the intended users
 - Timing of Communication – results should be presented within a reasonable time period
 - Identification of Responsible Actuary – report should clearly identify the actuary responsible for the results and identify the party responsible for each material assumption and method
 - Additional Disclosures – report should include cautions regarding possible uncertainty or risk, any conflicts of interest, reliance on other sources for data or information, and any relevant subsequent events after findings have been communicated
- The summary of Fund provisions and assumptions and methods used in the valuation is concise, yet thorough.
- Cindy Fraterrigo, Brandon Robertson, and Antonio DeSario of PwC signed the actuarial valuation reports. Ms. Cindy Fraterrigo and Mr. Antonio Desario are both a Fellow of the Society of Actuaries, an Enrolled Actuary, and a Member of the American Academy of Actuaries. Mr. Brandon Robertson is an Associate of the Society of Actuaries, an Enrolled Actuary, and a Member of the American Academy of Actuaries. We verified their credentials on the Society of Actuary's website. The actuaries meet the "Qualification Standards of Actuaries Issuing Statements of Actuarial Opinion in the United States" relating to pension plans. As such, the actuaries qualify as specialists upon whose work we would normally rely on.

As a result of our review, we offer the following recommended revisions to INPRS and the Fund Actuary for implementation in the next actuarial valuation of the Public Employees' Retirement Fund

- The only instance we encountered where information necessary to replicate results was not disclosed in the report is the minimum monthly benefit of \$180. The minimum benefit was valued in the liability, but was not included in the Summary of Plan Provisions. We would recommend adding a description of the minimum in the report.

As a result of our review, we offer the following additional considerations to INPRS and the Fund Actuary for implementation in future actuarial valuations of the Public Employees' Retirement Fund

- None.