NEBRASKA
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DEPARTMENT OF REVENUE

Memorandum

To: Tax Equalization and Review Commission

CC:

From: Ruth Sorensen, Property Tax Administrator

Date: April 26, 2023

Re: Price Related Differential

The Price Related Differential (PRD) is used by the Department of Revenue, Property Assessment Division (Division) to measure vertical equity, which is the assessment level of lower-priced properties relative to the assessment level of higher-priced properties. Although the PRD is commonly used by assessing officials to measure vertical equity, its reliability has been subject to debate since its inception.

Examining the history of the PRD provides some insight as to how the measures use has changed over time. It was developed by the U.S. Census Bureau in 1957 to determine if there was any relationship between levels of assessed value and property price ranges. In 1980, the measure became popular in assessment ratio studies after being included in the definitions section of the first IAAO Standard on Ratio Studies (Standard). That reference briefly explained that the PRD itself contains a bias and that a PRD within the range of 90 to 110% was considered to be an inconclusive indicator of regressivity. (Gloudemans, 2011). More recent versions of the Standards have not contained this language yet continue to offer a number of cautions regarding the PRD. Some of the references in the 2013 IAAO Standard on Ratio Studies include the following.

The weighted mean and price-related differential (PRD) are sensitive to sales with high prices even if the ratios on higher priced sales do not appear unusual relative to other sales. (IAAO 2013, 12)

When samples are small, have high dispersion, or include properties with extreme values, the PRD may not provide an accurate indication of assessment regressivity or progressivity. (IAAO 2013,19)

The PRD is easily computed in that it uses two different averages, the mean of assessment to sale ratios, and the weighted mean, which divides the total assessed value, by the total sales price of properties. However, the mathematical calculation itself has a bias in that it produces more ratios above 100% than below. The Standard explains this as an inherent upward bias in that the mean is subject to outliers more than the weighted mean is; the Standard also introduced the Price Related Bias (PRB) as a measure of vertical equity that is more meaningful than the PRD. (IAAO 2013, 19)

However, more recent publications comparing and contrasting the PRD and the PRB and their usefulness in determinations of vertical equity also point out that the PRB can still provide false

indications of regressivity. In 2015, Bob Denne, from Almy, Gloudemans, Jacobs & Denne presented a discussion of the PRD and PRB at the IAAO annual conference and suggested that the thresholds used for the PRB may need to be changed, from those currently utilized in the Standard to reduce the rate of false positive findings for the PRB. In June 2016, in an article for Fair & Equitable magazine, Justin M. Carter, M.A. discussed both the PRD and the PRB, and the inherent problems associated with each calculation and concludes that there is a need for the assessment profession to determine which measure of vertical equity is best, what standards should exists for determining whether vertical bias exists, and whether new methods can be established that do not have the short comings of the current measures (PRD and the PRB), until then, Mr. Carter suggest that "the analyst must hedge his or her bets and use all these techniques when trying to determine whether vertical inequity exists in the data sample. This will make the analyst far more confident in declaring that vertical equity exists or does not exist, at least until the profession finally sets some standard for this determination." All of these cautions indicate that there is not presently a single stand-alone measure of vertical equity, and that assessment analysts must evaluate the calculated measures before making conclusions regarding vertical equity.

Analytical Process of the Division

Division teammates perform numerous analytical functions throughout the year to examine assessment ratio studies. The process begins in late May and early June with monthly reviews of sales that are imported into the State Sales file for the first time. Field liaisons (liaisons) screen both qualified and non-qualified sales to ensure that sales are properly qualified, and that non-qualified sales have sufficient documentation. Often, the liaison will follow-up with the county assessor (assessor) with questions or request the assessor gather more information or provide more explanation regarding specific sales. Assessors also make a thorough effort to qualify sales; but rely upon the accuracy of information that they receive from property owners and other stakeholders in the sales process. Ultimately, the professional judgment of the assessor is used to make final determinations regarding sales qualification unless the Division has compelling information to override the determination of the assessor.

Formal ratio studies begin in October to ensure that all sales are properly coded and stratified; assessors are required to complete sales file "clean-up" by December 1 each year, which involves making corrections to the sales file; however, assessors have "live" access to the sales file and are able to edit sales data up until the submission of the Abstract of Assessment, Form 45 on or before March 19 or March 25.

In January of each year, the liaison begins conducting preliminary analysis of the ratio studies to document areas where adjustments are needed to maintain acceptable levels of value and quality of assessment. Preliminary statistical spreadsheets are developed to allow the analysts to determine what factors are influencing the calculated statistics and make determinations of whether the sample is representative and reliable. Conversations are held with assessors regarding which assessment actions are planned and what actions are needed to maintain acceptable assessments. The liaisons also discuss the assessor's planned actions and ratio study internally with the Field Operations Tax Specialist Seniors, to ensure that all counties receive a consistent review of the ratio studies. This may include the analysis of broader statistics, trends, review of historical data or comparisons to comparable areas to ensure that the ratio studies are a reliable indicator of the preliminary level of value.

In February and early March, the liaison will work closely with the assessor as final valuation determinations are made. If the assessor completes the assessment process in February or early March, an Assessed Value Update (AVU) is submitted so that the liaison can analyze the proposed values. A ratio study is completed, if improvements to values are still needed, the liaison will communicate that with the assessor at that time. Spreadsheets are often developed to perform analytical testing on factors influencing the calculated statistics.

After the submission of the final AVU near March 19 or March 25, a final analytical spreadsheet will be developed to allow the liaison to make final determinations regarding the assessment level and quality of assessment. Typically, this is the fourth analysis completed by the liaison, but if the assessor did not make values available in February or early March, this may be the liaison's first chance to analyze the newly established assessed values. During this analysis, the liaison will not only examine the factors impacting the level of value and quality of assessment but will also compare the change of sales in individual classes and subclasses to the Abstract to ensure that the sales file adequately represents the population being measured. Final determinations are documented in the correlation section of the Reports and Opinions of the Property Tax Administrator (Report).

The liaisons will continue in May of each year, in a post-Statewide visit with each assessor where the Report, as well as concerns relayed by the Tax Equalization and Review Commission (Commission) are discussed with the assessor. The liaison and the assessor will discuss the assessment plans for the upcoming year including the six-year inspection and review cycle as well as needed changes to appraisal tables to resolve any concerns or maintain compliance with statutory requirements. If the assessor needs additional education, that will either be provided through routine educational offerings of the Division or by one-on-one trainings provided by the liaison or other Division teammates. Finally, the process begins to repeat through the cycle with monthly review of sales submissions resuming after Statewide Equalization.

**Analysis of Factors Influencing the PRD**

Sample Size

Analysis of statistics used in the 2023 Reports offer a practical demonstration of the factors that influence the PRD. Additional analysis was conducted of the approximately 390 residential valuation groupings used by Nebraska Assessors, with at least ten sales, it is evident that PRDs decrease as the sample size increases. The smallest samples were significantly more likely to have PRDs above the standard range as compared to the large samples.

Sample Size		Total # Samples	Average PRD	% of samples with PRDs >103%
	10	13	108.62	77%
11	25	125	107.62	65%
26	50	108	105.65	60%
51	100	58	104.88	40%
101	500	52	102.92	37%
501	50000	31	101.59	10%

Due to the impact of sample size on the PRD, the Property Tax Division of the South Dakota Department of Revenue will only consider a PRD on sample sizes of at least 30 sales. This practice could be adopted in Nebraska; and would eliminate 13 Nebraska Counties and 337 of 555 residential valuation groups from having any test of vertical equity. However, in order to enhance transparency and improve assessment processes, the Division has chosen to provide and analyze PRDs at all sample sizes; with the caution that PRDs must be examined to determine whether they truly provide indications of regressivity.

Graphically examining the smaller samples of less than 100 sales, the same trend is observed. As sample size increases, the PRDs decrease and approach 100%. This trend demonstrates the warnings given in the IAAO standards that the PRD calculation contains an upward bias as the mean calculation is impacted by outlier sales.
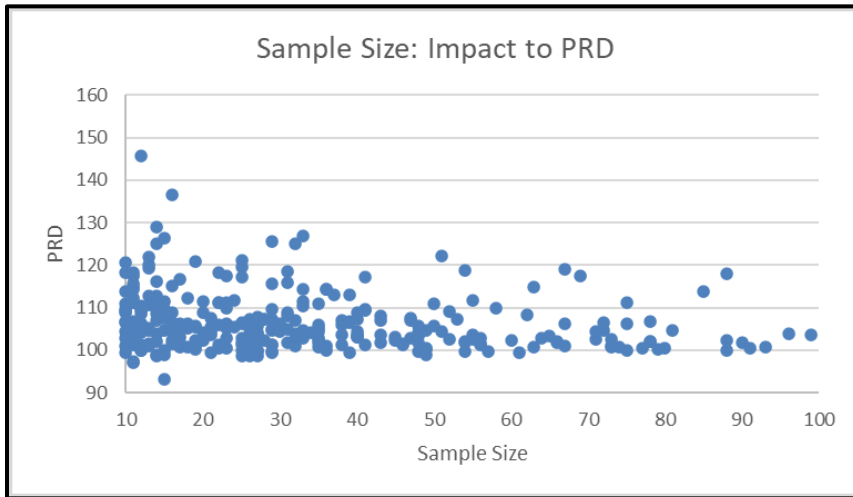
The professional literature also suggests that extreme sales prices skew PRDs. To examine this, samples of sales were stratified by average selling price, and were examined for the number of extreme transactions, relative to the average selling price. A sale price was considered to be an extreme low dollar sale if it was at least half of the average selling price, extreme selling prices on the low end were capped at $30,000, until the average selling price exceed $200,000. Sales prices were considered to be extremely high dollar sales when they were more than twice the average sale price. The number of transactions that met the prescribed parameters were counted and compared to the total number of sales in the sample to arrive at a percentage of the sample that consisted of extreme sale prices. When less than 5% of the sample consisted of extreme sale prices, the PRD was generally near the standard range, but the PRD rose with more dispersion in the sample, exceeding 110% when 15% or more of the sample was comprised of extreme sales prices.
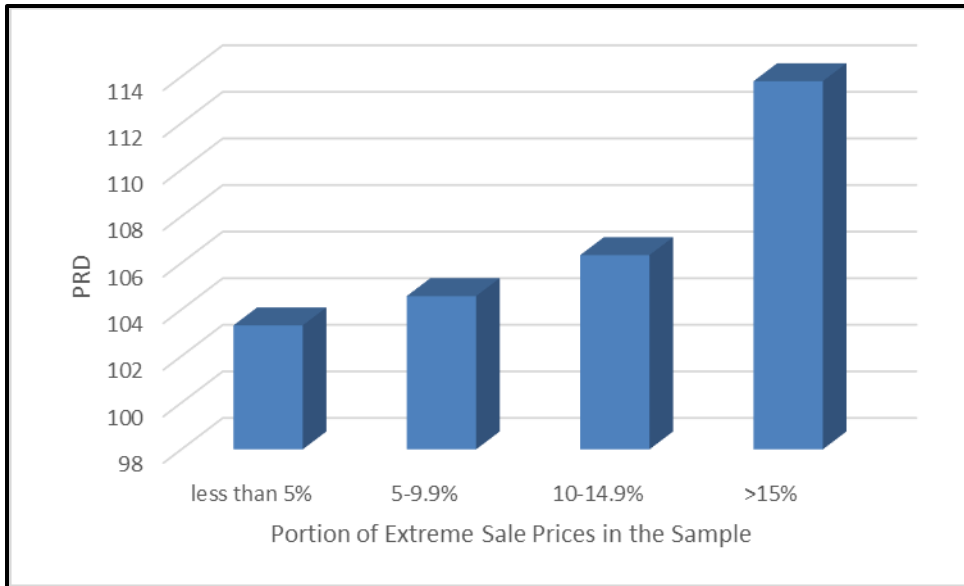
The 2023 Reports provide specific details regarding outlier ratios and their impacts to the PRD for 21 counties with CODs greater than 103%. After examination of the outliers, none of those samples were considered to be regressive. Frequently, an extremely low number of outlier sales has a significant impact on the PRD. For example, Antelope County, contains 138 residential sales with a PRD of 111%, however, three extreme low dollar sales with sales prices of $2,000 to $9,000 and assessment-to-sale ratios of 234% to 813% inflate the PRD, which is 111% but drops to 103.75% when the low dollars are removed. There is not a significant pattern of regressivity as sale price increases (See Exhibit 02, Page 11 and 20-21). Further, review of the minimum and maximum sale price ratio shows low and high ratios at all sale price levels.

A further review of the median ratio of these incremental ranges, which often gives the perception of regressivity, indicates that in 0 to 4,999 range, one ratio is actually low and the other extremely high. In the 5,000 to 14,999 range, four sales exist but only represent three properties. Two properties have assessment-to-sale ratios of 96% and 154%; the remaining property sold twice in the study period for $9,000 in June 2021 and $5,000 in June 2022, which raises the question as to which sale price is correct? The assessor cannot assess the same property differently for each sale, indicating that at least one of these transactions will be an outlier. In truth, the assessor's analysis showed that neither sales price is typical for the market. The assessor's responsibility is to determine the most probable sale price, not merely value the property at the actual sales price.

			COUNT	MEDIAN	MEAN	WGT.MEAN	COD	PRD	MIN	MAX
__Incremental Ranges__										
0	TO	4,999	2	445.63	445.63	323.33	82.33	137.83	78.75	812.50
5,000	TO	14,999	4	194.18	181.25	171.68	28.94	105.57	96.25	240.39
15,000	TO	29,999	7	126.50	130.80	132.78	28.36	98.51	68.61	184.48
30,000	TO	59,999	32	100.52	101.88	102.03	15.54	99.85	51.45	140.32
60,000	TO	99,999	31	102.94	105.77	105.27	17.60	100.47	58.52	172.51
100,000	TO	149,999	26	93.41	88.33	87.92	15.48	100.47	34.97	121.71
150,000	TO	249,999	29	94.32	94.15	94.73	15.38	99.39	50.83	144.16
250,000	TO	499,999	7	95.71	98.12	96.90	15.38	101.26	73.98	120.44
500,000	TO	999,999								
1,000,000 +										
_____ALL_____			138	97.74	107.14	96.60	25.12	110.91	34.97	812.50

Another example of an extreme sale price impacting the PRD can be found in Grant County (See Exhibit 38, page 10-11 and 21) where a single high dollar sale inflated the PRD by six percentage points.

Dispersion in the Sample

PRDs are impacted by dispersion in the sample. The Coefficient of Dispersion (COD) quantifies the amount of dispersion in a ratio study, when CODs are plotted against PRDs a nearly linear pattern emerges indicating that PRDs increase with dispersion in the sample. Since CODs are also a measure used to analyze assessment quality, this analysis does not prove that PRDs are necessarily false indicators of vertical inequity, but it does demonstrate that sample dispersion should be examined before placing any reliance on a PRD. Sample dispersion can exist for a number of reasons. Some of the causes of sample dispersion may be reflective of assessment models that do not accurately capture market characteristics, while others are caused by economic influences such as rapidly increasing or decreasing markets or unrepresentative samples, or lax or unreliable sales verification practices.
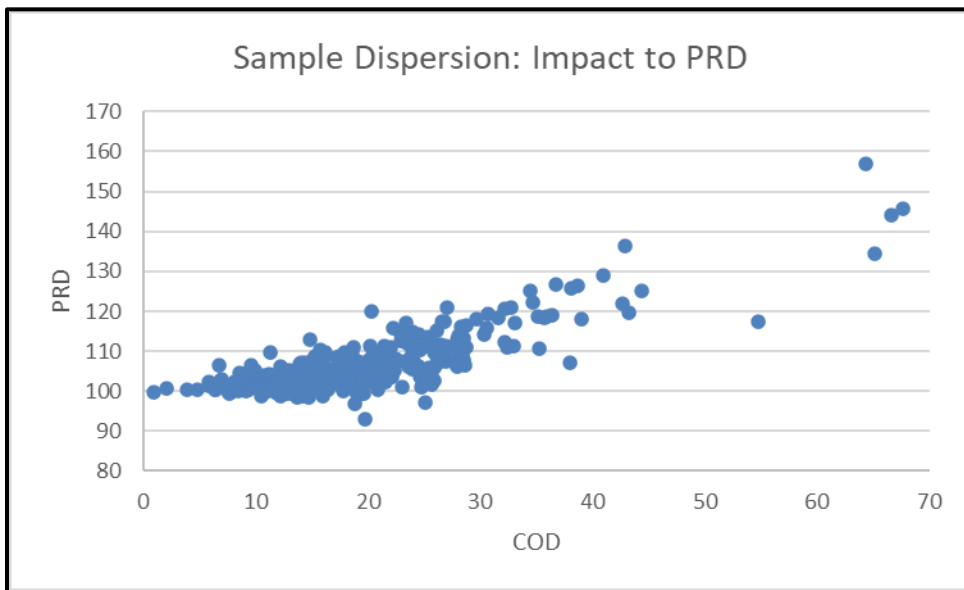
Several examples of dispersion impacting the PRD were written about in the 2023 Reports. For example, the Report for Dawes County (See Exhibit 23, pages 10 – 11 and 22) discusses the assessor's sales qualification practices, which utilizes a higher percentage of sales than most counties, presenting more outlier sales in the ratios study.

In Garden County (See Exhibit 35, Page 10-11 and 20), three high ratios are skewing the PRD. The three high ratios have sale prices of $15,000; $20,000; and $40,000 in a county where the average sale price is $92,604. The removal of these ratios from the sample of 92 sales reduces the PRD from 109% to 103%. The sale price substratum shows no patterns of assessment regressivity.

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__Incremental Ranges__		COUNT	MEDIAN	MEAN	WGT.MEAN	COD	PRD
0 TO	4,999						
5,000 TO	14,999	3	94.92	88.07	89.91	09.52	97.95
15,000 TO	29,999	8	96.00	138.91	124.19	60.01	111.85
30,000 TO	59,999	25	106.10	121.20	118.92	29.29	101.92
60,000 TO	99,999	25	93.79	88.98	89.51	09.73	99.41
100,000 TO	149,999	14	92.91	91.59	91.24	07.62	100.38
150,000 TO	249,999	14	88.86	89.19	89.59	09.78	99.55
250,000 TO	499,999	3	91.94	88.70	87.21	07.34	101.71
500,000 TO	999,999						
1,000,000 +							
____ALL____		92	95.04	102.47	94.35	21.28	108.61

Madison County is a unique example of dispersion impacting the PRD. In Madison County, the dispersion in the sample is both caused by a significantly rising market, which increased 22 percentage points in the two-year study period and a large amount of dispersion in ratios in each individual study period. (See Exhibit 59, Page 11 and 23-24 and Exhibit 112.) With multiple factors impacting the PRD, it is difficult to make conclusions regarding regressivity.

DATE OF SALE * RANGE	COUNT	MEDIAN	MEAN	WGT.MEAN	COD	PRD	MIN	MAX
____Qrtrs____								
01-OCT-20 To 31-DEC-20	142	106.95	115.69	105.46	18.85	109.70	60.75	361.64
01-JAN-21 To 31-MAR-21	129	99.74	106.82	100.46	17.48	106.33	51.46	309.16
01-APR-21 To 30-JUN-21	232	96.97	101.59	96.62	16.00	105.14	50.69	389.42
01-JUL-21 To 30-SEP-21	190	95.94	101.52	95.10	17.44	106.75	41.87	289.18
01-OCT-21 To 31-DEC-21	148	93.53	96.29	91.95	16.40	104.72	52.03	185.90
01-JAN-22 To 31-MAR-22	127	93.32	95.87	92.30	17.77	103.87	51.14	232.33
01-APR-22 To 30-JUN-22	167	84.99	90.21	84.86	19.44	106.30	21.60	294.19
01-JUL-22 To 30-SEP-22	142	84.83	91.69	86.61	19.07	105.87	42.29	212.04

Regressivity in the 2023 Reports & Opinions of the Property Tax Administrator

In the 2023 Reports 58 counties had a PRD above 103%, as described 21 counties do not have a regressive sample and have a description of outliers impacting the PRD. Additionally, five counties have a PRD that could not be determined to be regressive or not; two counties, Arthur and Blaine were due to extremely small sample size (See Exhibits 03 and 05), while others such as Cheyenne County (Exhibit 17), Madison County (Exhibit 59), and Sherman County (Exhibit 82) have unique or multiple factors impacting the PRD that make it difficult to determine regressivity, as described in the Report for each county.

That leaves 32 counties that do have patterns of regressivity, of those, the correlations attempt to detail the cause of the regressivity; for example, Dawson County (Exhibit 24) and Gage County (Exhibit 34) have utilized percentage adjustments to increase value for the last several assessment cycles, and an update to the depreciation tables are in order. In some, the assessor has taken action to improve vertical equity but did not achieve a PRD within the range. The correlation in these instances, detail the work that the assessor completed and recognize the improvement made. Examples of this includes Clay County (Exhibit 18), Hayes County (Exhibit 43) and Nemaha County (Exhibit 64).

Overall, improvements to vertical equity have been made in assessments in Nebraska counties. Comparison of the 2022 Reports to the 2023 Reports indicates that 50 counties have improved the PRD over the prior year; however, when compared to statistics produced from the same samples

of sales prior to 2023 assessed valuation determinations, the measure was improved in 70 counties. Adams County (Exhibit 01) is an example of improvements in vertical equity for the current assessment year; review of the 2022 Reports for Adams County showed a PRD that was in range for the overall class; but that had two valuation groups with a high PRD; the 2023 Report cites an update to costing and depreciation tables with a desk review of all properties that had not been recently reviewed. The PRD improved by two percentage points and none of the individual valuation groups have a regressive pattern. Sherman County had the largest improvement in the PRD, improving the overall PRD by 27 percentage points over the preliminary values; and yet the correlation says the assessments *may* still be slightly regressive. (See Exhibit 82, Page 10.)

Regressivity in Other States

Research of assessment ratio studies in other states was conducted to determine how Nebraska counties compare to other states. Data was collected from the property tax oversight authority in each state. All states that use the PRD and have a ratio study that was publicly available online were reviewed; the results are summarized in the chart below and reflect the most recent ratio study that each state has published.

	Total # Counties	# Counties with PRD >103	Maximum PRD	Range of Sample Sizes
Iowa	99	85	162%	56-8960
Idaho	44	16	114%	21-4231
Illinois	102	83	149%	28-32488
Kansas*	105	41	124%	15-325
Nebraska	93	58	188%	7 - 1,277
New Mexico	33	9	139%	12-1263
New York**	577	307	N/A	N/A
North Dakota	53	44	615%	30-154
South Dakota	66	47	179%	06 - 35
Texas	107	25	115%	39 - 6288
Utah	29	2	105%	20 - 14722
Virginia Suburban	94	53	126%	11- 4766
Virginia Urban	89	30	141%	1 - 14264

*PRDs from Kansas are produced from trimmed samples

**New York publishes ratio studies by municipality

As discussed, South Dakota calculates a PRD for all samples; but only considers the PRD useful when the sample contains at least 30 sales; counties in Kansas have a PRD in excess of 103% approximately 40% of the time; however, those results are produced from samples that have already had extreme outliers trimmed. Additionally, the Utah Property Tax Division evaluates the PRD for insights regarding sample tendencies but does not consider the PRD in determining compliance with legal standards. The data collected from other states supports that PRDs are evaluated pursuant to the IAAO standard, but that no known state adheres to strict compliance of the PRD in determinations of assessment quality.

Addressing Vertical Equity

There are numerous ways to improve calculated PRDs but only one way to improve vertical equity. Assessors can improve calculated PRDs by excessively trimming samples or by selectively

reappraising sold properties. However, vertical equity is only improved through meaningful reappraisal activities, such as improved property listings or updating appraisal models (land, costing, and depreciation). The Division will continue to focus efforts on educating assessors on mass appraisal processes and working with individual assessors to improve assessment processes. PRDs will continue to be analyzed for patterns of regressivity; however, PRDs will not be used solely to guide the Division's discussion with assessors or its determinations of assessment quality.

Conclusions

In conclusion, the PRD is a measure of vertical equity that is highly influenced by a number of different factors. The PRD was developed to identify whether there was any correlation between assessed value and selling price. The calculation contains an inherent upward bias that can make the result unreliable when samples are small, contain extreme selling prices, or too much dispersion. Although the PRD is a useful calculation for analyzing assessment performance, additional analysis must be conducted to examine the factors influencing the PRD. For that reason, the Division will continue to evaluate sample PRDs, but will base opinions regarding assessment quality on a correlation of statistical analysis and the verified assessment practices of each county.

The Commission can trust that the Division will continue its thorough analysis of ratio studies and assessment practices; and will seek improvements in the assessment function where improvements are warranted; however, the Commission should not make conclusions regarding the efforts of the Division or assessors based on the calculated PRD alone.

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