WEIGHTED AVERAGE GDP GROWTH

DPU EXHIBIT2.2

DOCKET NO. 04-035-42

In direct testimony, PacifiCorp witness Dr. Hadaway uses what he refers to as the average growth of GDP as a proxy for the growth rate in his DCF analysis. The average turns out to be a weighted average of the means of four different 10-year periods with greater weight being given to the most recent periods. The weight for the average of the most recent 10-year period is $\frac{25}{48} = 0.52$; the weight for the average of the next previous 10-year period is $\frac{13}{48} = 0.27$; the weight for the next previous 10-year period is $\frac{7}{48} = 0.15$; and for the next previous 10-year period $\frac{3}{48} = 0.06$. While the weights add to one as would be expected, Dr. Hadaway offers no clear explanation or justification of these particular weights. The Division submits that the weighting scheme Dr. Hadaway uses is arbitrary. That is, any other weighting scheme could have been used.

Derivation of Dr. Hadaway's Weighting Scheme

In Exhibit UP&L_(SCH-3), Dr. Hadaway explains that the average growth in GDP is found by taking the "average of GDP growth During the Last 10 year, 20 year, 30 year, and 40 year growth periods." A response from PacifiCorp to DPU data request 4.27

confirms that the average growth rate Dr. Hadaway uses is the average of the averages for these four time periods:[1]

$$\textit{Average GDP Growth} = \bar{\bar{X}} = \frac{1}{4}\left(\bar{X}_{10} + \bar{X}_{20} + \bar{X}_{30} + \bar{X}_{40}\right)$$

where (1)

$$\bar{X}_m = \frac{1}{m}\sum_{i=1}^{m} X_i \qquad m = 10,\ 20,\ 30,\ or\ 40$$

Each of the individual means, $\bar{X}_m$, can be expanded and written in terms of successive ten-year averages. For example, $\bar{X}_{40}$, can be rewritten as

$$\bar{X}_{40} = \frac{1}{40}\sum_{i=1}^{40} X_i = \frac{1}{40}\left[\sum_{i=1}^{10} X_i + \sum_{i=11}^{20} X_i + \sum_{i=21}^{30} X_i + \sum_{i=31}^{40} X_i\right]$$

$$= \frac{10}{40}\left[\frac{1}{10}\sum_{i=1}^{10} X_i + \frac{1}{10}\sum_{i=11}^{20} X_i + \frac{1}{10}\sum_{i=21}^{30} X_i + \frac{1}{10}\sum_{i=31}^{40} X_i\right] \qquad (2)$$

$$= \frac{10}{40}\left[\bar{X}_1 + \bar{X}_2 + \bar{X}_3 + \bar{X}_4\right]$$

Where the subscripts 1, 2, 3, and 4 represent 10-year periods starting with the most recent 10 years, $\bar{X}_1$; the next previous 10-years, $\bar{X}_2$; the next previous 10-years, $\bar{X}_3$, and the

[1] Typically, the index for a summation would run from the most distant past year to the most recent year in the data set, i.e. 1964, 1965, …, 2003. For purposes of the presentation in this note, the index runs from the most recent year to the most distant past year in the data set, i.e. 2003, 2002, …, 1964.

next previous 10-years, $\bar{X}_4$. Substituting similar results for all four means into Equation (1), the weighted average, $\bar{\bar{X}}$, can be rewritten as,

$$\bar{\bar{X}} = \frac{1}{4}\left[10\left\{\bar{X}_1\left(\frac{1}{10}+\frac{1}{20}+\frac{1}{30}+\frac{1}{40}\right)+\bar{X}_2\left(\frac{1}{20}+\frac{1}{30}+\frac{1}{40}\right)\right.\right.$$

$$\left.\left.\bar{X}_3\left(\frac{1}{30}+\frac{1}{40}\right)+\bar{X}_4\left(\frac{1}{40}\right)\right\}\right]$$

$$= \frac{1}{4}\left[\bar{X}_1\left(\frac{25}{12}\right)+\bar{X}_2\left(\frac{13}{12}\right)+\bar{X}_3\left(\frac{7}{12}\right)+\bar{X}_4\left(\frac{3}{12}\right)\right] \quad (3)$$

$$= \bar{X}_1\left(\frac{25}{48}\right)+\bar{X}_2\left(\frac{13}{48}\right)+\bar{X}_3\left(\frac{7}{48}\right)+\bar{X}_4\left(\frac{3}{48}\right)$$

QED

Alternative Weighting Schemes

In a previous Utah rate case (Docket No. 03-2035-02), Dr. Hadaway argued for the use an average of the most recent twenty-year period: "The 20-year historical GDP growth rate is a reasonable estimate of long-term expectations".[2] The twenty year average[3] can be viewed as a weighted average of the four 10-year averages defined previously, with equal weight (1/2) being given to the averages of the two most recent periods and no weight being given to the averages of the two previous periods. That is,

[2] "Direct Testimony of Samuel C. Hadaway," Docket No. 03-2035-02, p. 28.

[3] Dr. Hadaway uses the twenty year average GDP growth as a proxy for the growth in the DCF model in a recent Washington State rate case (Docket No. UE-032065).

$$\bar{X}_{20} = \frac{1}{20}\sum_{i=1}^{20} X_i = \frac{1}{20}\left[\sum_{i=1}^{10} X_i + \sum_{i=11}^{20} X_i\right]$$

$$= \frac{1}{20}\left[10\left(\bar{X}_1 + \bar{X}_2\right)\right] \qquad (4)$$

$$= \frac{1}{2}\left(\bar{X}_1 + \bar{X}_2\right)$$