UNDERTAKING J3.7

Undertaking

TO UPDATE IR STAFF 172 SHOWING UPDATES FOR MEAN COSTS AND EXPLAINING DERIVATION OF THE SENSITIVITY ANALYSES SHOWING ANY FORMULA OR MODELLING

Response

The following response was prepared by Bates White:

Bates White used a productivity rate of 39% as an input in its cost model for labour costs. The point estimate of 39% represented the mean rate derived from two contractor productivity "wrench time" studies commissioned by OPG.

To carry out the sensitivity analysis, Bates White calculated two sets of construction cost estimates using 36 different labour productivity rates, ranging from 31% to 66%. One set of estimates represented the total cost of the project; the other set, the direct cost of construction (including fee and contingency). The results are shown in Chart 1 and Chart 2 below.

Bates White performed the sensitivity analyses using its cost model. This model started with an estimate of "overnight" costs, i.e., the cost estimate for performing all construction activities as if those activities were accomplished in late 2019. This estimate, based on a labour productivity rate of 39%, was $371.6 million. This sum comprised $55.0 million for construction-related labour and $212.3 million for process-related labour. This estimate includes a 10% fee that was subsequently removed and included in a separate cost category labeled "fee and contingency."

Bates White then de-escalated those 2019 cost estimates to reflect the nominal dollar values in the years those costs would be expended. The resulting direct cost of construction (without fee) was $303.3 million. The deflation-adjusted construction-related labour cost was $50.0 million, and the deflation-adjusted process-related labour cost was $193.0 million.

Because calculated labour cost was a function of the 39% productivity factor, Bates White could apply the distributive property of numbers and model the sum of labour costs as a function of a single productivity rate. Bates White then ran its cost model multiple times using different productivity rates, ranging from 31% to 66%. Each

different productivity rate changed the cost model's input values for overnight labour costs and resulted in a new set of output values. Because Bates White created its model in Microsoft Excel, it could perform this sensitivity analysis using Excel's "Data" tool, designed to calculate multiple results by changing one or two variables.

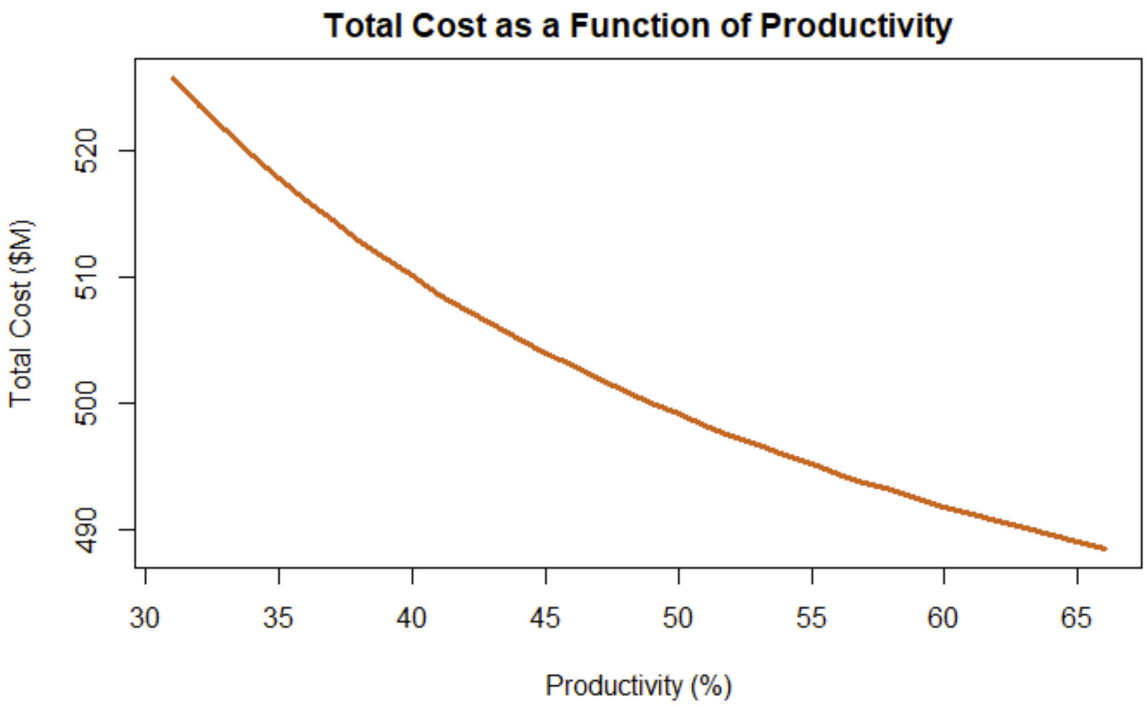
Chart 1 below describes the impact of different average labour productivity rates on the Bates White estimate of the project's total cost. The first column depicts average labour productivity rates ranging from 31% to 66%. The second column depicts the total construction cost associated with each row's productivity rate. The third column indicates the rate of change of the total construction cost with each percentage point increase in labour productivity.

1 **Chart 1: Impact of Labour Productivity Rates and Total Construction Costs**

Productivity (%)	Total Cost ($M)	Rate of Change (%)
31	525.8	0.00
32	523.6	-0.42%
33	521.6	-0.39%
34	519.6	-0.37%
35	517.8	-0.35%
36	516.1	-0.33%
37	514.5	-0.32%
38	512.9	-0.30%
39	**512.1**	**-0.29%**
40	510.1	-0.27%
41	508.7	-0.26%
42	507.5	-0.25%
43	506.3	-0.24%
44	505.1	-0.23%
45	504.0	-0.22%
46	503.0	-0.21%
47	502.0	-0.20%
48	501.0	-0.19%
49	500.1	-0.18%
50	499.2	-0.18%
51	498.3	-0.17%
52	497.5	-0.16%
53	496.7	-0.16%
54	496.0	-0.15%
55	495.2	-0.15%
56	494.5	-0.14%
57	493.8	-0.14%
58	493.2	-0.13%
59	492.5	-0.13%
60	491.9	-0.12%
61	491.3	-0.12%
62	490.8	-0.12%
63	490.2	-0.11%
64	489.7	-0.11%
65	489.1	-0.11%
66	488.6	-0.10%

Figure 1 is a graphical representation of this chart.

Figure 1: Total Construction Costs as a Function of Labour Productivity Rates



The cost-productivity function in Figure 1 is slightly nonlinear. That nonlinearity is a consequence of incorporating the annual inflation of wages and associated compensation costs (e.g., health and life insurance costs) over the six years of construction.

It should be noted that labour productivity affects only direct construction cost, not other elements in the total project cost. Chart 2 below depicts a sensitivity table of labour productivity rates on the Bates White estimate of direct construction cost.

1 **Chart 2: Impact of Labour Productivity Rates and Direct Construction Costs**

Productivity (%)	Direct Cost ($M)	Rate of Change (%)
31	314.0	0.00
32	312.3	-0.54%
33	310.7	-0.51%
34	309.2	-0.48%
35	307.8	-0.46%
36	306.5	-0.43%
37	305.2	-0.41%
38	304.0	-0.39%
39	**303.3**	**-0.37%**
40	301.8	-0.36%
41	300.8	-0.34%
42	299.8	-0.32%
43	298.9	-0.31%
44	298.0	-0.30%
45	297.1	-0.28%
46	296.3	-0.27%
47	295.5	-0.26%
48	294.8	-0.25%
49	294.1	-0.24%
50	293.4	-0.23%
51	292.7	-0.22%
52	292.1	-0.22%
53	291.5	-0.21%
54	290.9	-0.20%
55	290.4	-0.19%
56	289.8	-0.19%
57	289.3	-0.18%
58	288.8	-0.18%
59	288.3	-0.17%
60	287.8	-0.16%
61	287.3	-0.16%
62	286.9	-0.15%
63	286.5	-0.15%
64	286.1	-0.15%
65	285.7	-0.14%
66	285.3	-0.14%

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Figure 2 is a graphical representation of this chart.
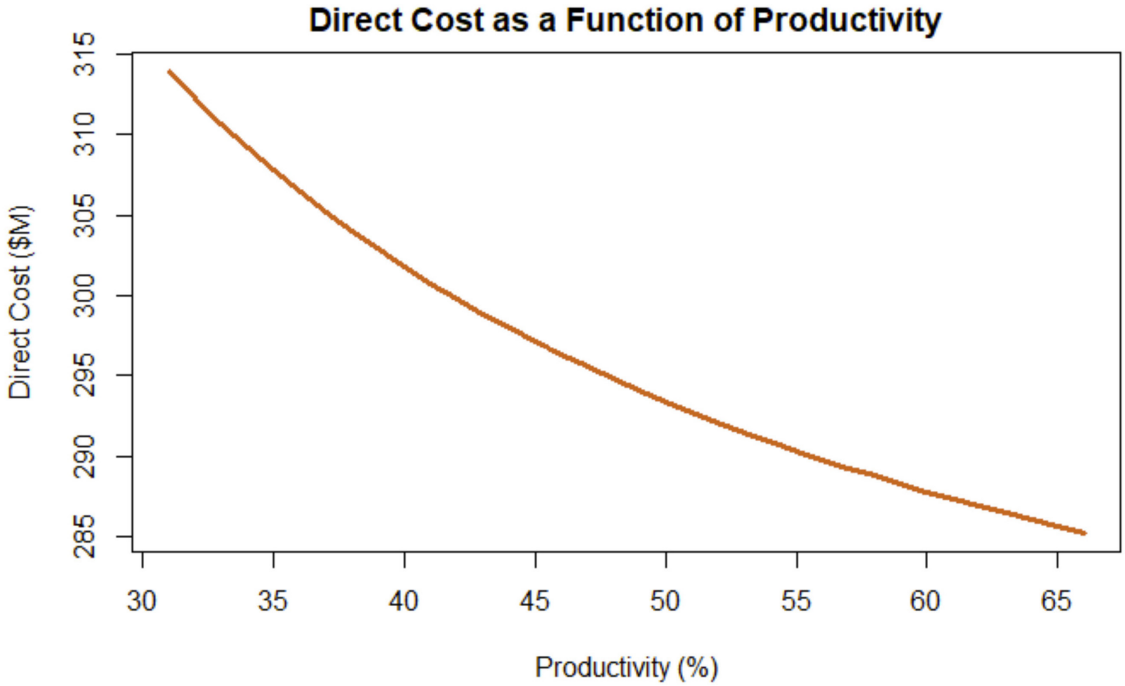
Figure 2: Direct Costs of Construction as a Function of Labour Productivity Rates