Estimating the direct cost of rail access

31 January 2024

1 What this is about

The pricing principles of the NSW Rail Access Undertaking include a floor test which sets a minimum access price based on the "direct cost" of access. This direct cost is the infrastructure provider's cost that would be avoided if one train did not run. The access price paid for that train should not be less than this amount.

Measuring the direct cost is not straightforward. In 2000, the Queensland Competition Authority published a working paper "Usage-related infrastructure maintenance costs in railways" that provided engineering-based estimates of the direct cost.

Recently, IPART employed regression analysis to estimate the direct costs for coal trains. The data on gross-tonne-kilometres and maintenance costs for several coal rail networks was sourced from regulatory reports made by ARTC and Aurizon networks to the ACCC and the QCA, respectively. This work is summarised in this information paper.

This work establishes a plausible range for the direct cost rate, in units of dollars per gross-tonne-kilometre (GTK), that could be used in regulatory floor tests under the NSW Rail Access Undertaking. The regression results are expressed in 2020 dollars.

Direct costs are expressed as a rate of dollars per thousand gross-tonne-kilometres (gtk), and these can be directly compared to access prices if they are expressed in the same units.

We welcome your comments on the proposed method used to calculate direct costs and the suitability of the range for use in assessing compliance with the NSW rail Undertaking requirements. These can be made by email to our web site

https://www.ipart.nsw.gov.au/review/transport-rail-access/measuring-direct-cost-floor-test

until March 31, 2024.

2 Previous work on direct cost estimates

In 2000, the QCA was considering Queensland Rail's first access undertaking. In support of its analysis, the QCA published a working paper on usage-related infrastructure maintenance costs in railways. This working paper adopted an engineering-based approach. It derived the estimates of incremental maintenance costs shown in Table 1 below.

Network	Incremental maintenance cost
Moura	$1.00 per '000 Gtk
Blackwater	$0.54 per '000 Gtk
Goonyella	$0.37 per '000 Gtk
Newlands	$1.04 per '000 Gtk

The incremental maintenance cost is the direct cost of usage.

These QCA figures are in dollars of the year 2000. The regression results reported below are in dollars of the year 2020. While there has been considerable inflation over the 20 year gap, we expect that efficiency improvements would have partly counteracted the inflationary effect.

We would like to hear from stakeholders on the following questions:

1. Are there any other studies of rail direct cost that you are aware of that we should take into account?
2. If we were to use the QCA estimates from 2000, what adjustments should be made for movements in the relevant cost indices and any advances in rail maintenance technology since then?

3 Current IPART estimates of direct cost

3.1 Summary of IPART results

IPART undertook regression analysis to derive new estimates of the direct cost rate. This work relied on regulatory reports submitted by ARTC to the ACCC and by Aurizon networks to the QCA for years between 2018 and 2021. There were four different networks in Queensland for the 2021 financial year, and two different networks in the NSW Hunter Valley for each of the calendar years 2018-2020. Each network-year combination was treated as a separate data point. The data consisted of traffic levels (GTK), track length, and maintenance costs including major periodic maintenance (renewal allowance).

Regression on the entire data set yielded a maintenance cost function:

Cost = $99,000 per track-km + **$1.18 per ‘000 GTK**

Regression on a restricted data set in which an apparent outlier (Newlands – Goonyella-Abbot Point Expansion) was excluded yielded the following maintenance cost function:

Cost = $124,000 per track-km + **$0.77 per ‘000 GTK**

The rate per track-km represents the fixed cost of maintenance, and the rate per ‘000 GTK represents the variable (direct) cost.

These raw results suggest a range of direct cost estimates from $0.77 per ’000 GTK (lower regression result) to $1.18 per ‘000 GTK (higher regression result). Both ends of this range are expressed in dollars of the year 2020.

While this is a large range which was derived principally from examining coal freight networks, it is still useful for establishing rough pricing boundaries for the floor test.

We would like to hear from stakeholders on the following questions:

3. Can you suggest any alternative methods of establishing the direct cost, apart from the regression approach outlined in this information paper?
4. Are you aware of any additional data that could be used to improve the regression analysis?
5. Is the use of coal railway maintenance costs suitable for estimating the floor price for other types of railways (including lighter axle-load freight trains or passenger trains)?
6. Do you agree with our interpretation of the regression results?

3.2 Regression method and data

Maintenance costs for railway tracks have a variable component that depends mainly on the number of gross tonne-kilometres (gtk) carried and a fixed component that depends on the length of track that must be maintained (track-km).

The maintenance task consists of routine maintenance (RM), also called routine corrective and reactive maintenance, and major-periodic maintenance (MPM), which captures the cyclical renewals of rail, sleepers and ballast. Because MPM tends to be lumpy and infrequent, it is common to estimate an annual allowance for MPM rather than rely on actual MPM expenditures in a given year.

From regulatory submissions by ARTC and Aurizon networks, we compiled a data set of annual RM, MPM, and gtk for the major coal networks in NSW and Queensland for available years between 2018 and 2021. We were able to determine track-km for each network by examining track diagrams or from information packs provided by the network owners. This data set had 10 data points with matched inputs.

The excel workbook "mtce cost function for coal railways.xlsx" contains the data and analysis described in this paper. This excel workbook can be provided upon request to interested stakeholders. ARTC data is in the tab of the same name. Aurizon data is in the tab of that name. Tab CPI contains inflation data used to convert all dollar figures to real values of 2020.

The tab "Data" contains the data set used for regression analysis.

We used this data to estimate the parameters of the following maintenance cost function:

Total cost = Y track-km + Z bgtk

This functional form has been used as we consider that maintenance costs are driven by two main factors. The fixed costs are proportional to the track length that must be maintained. The variable costs are proportional to the wear and tear caused by the passage of trains, quantified using gross-tonne-kilometres.

3.3 Regression results in detail

The results of this regression are contained in the tab "cost model" and shown below:

Regression Statistics	
Multiple R	0.99043
R Square	0.980951
Adjusted R Square	0.85357
Standard Error	16.51183
Observations	10

Y = track mtce cost incl MPM ($m 2020)

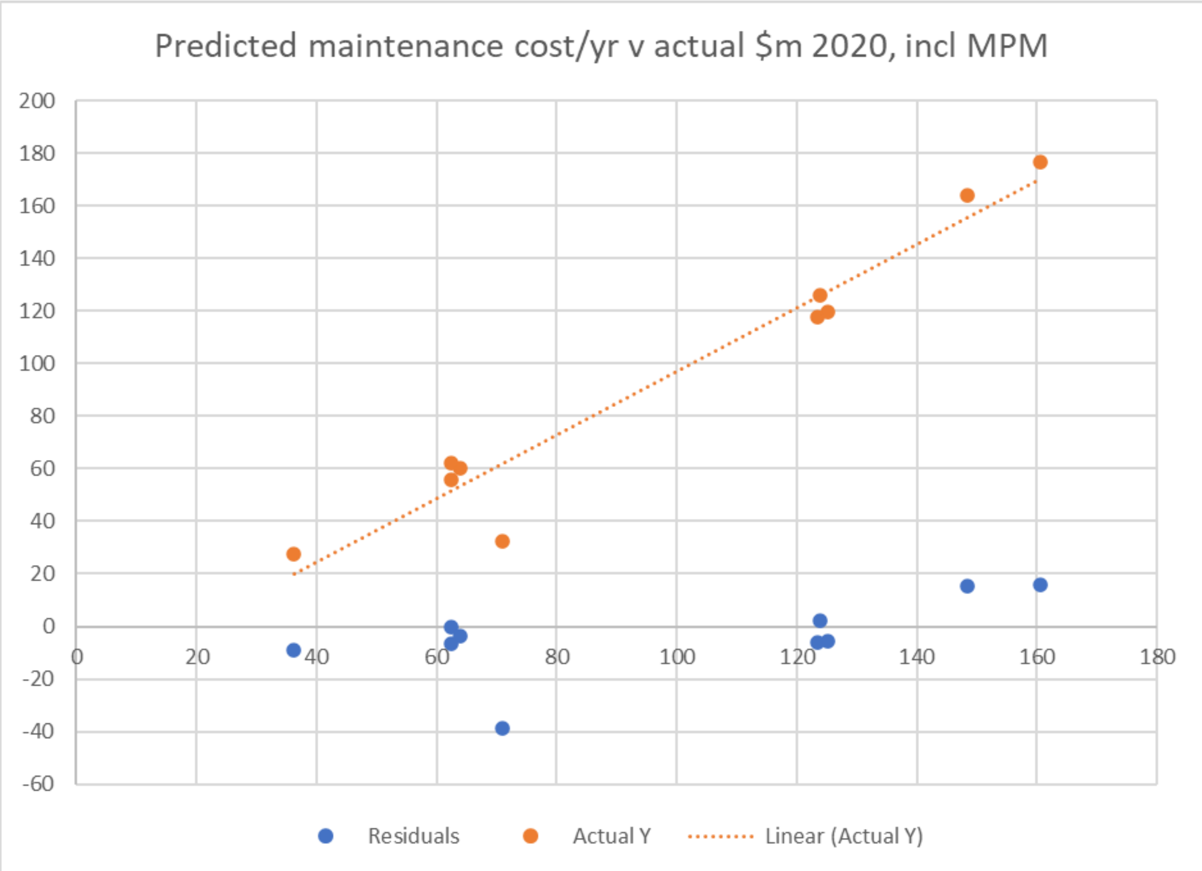
ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	112322	56161	205.9	6.03E-07
Residual	8	2181.123	272.64		
Total	10	114503.2			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0	#N/A	#N/A	#N/A	#N/A	#N/A
Track-km	0.099	0.020	4.880	0.001	0.052	0.146
Billion gtk	1.176	0.402	2.925	0.019	0.249	2.104

This model is a good statistical fit to the data, with both coefficients significant at the 2% level. The fixed cost coefficient estimated here is $99,000 per track-km per annum. The variable cost coefficient estimated here is $1.176m per billion gtk, equivalent to $1.18/'000 gtk.

The comparison of predicted versus actual maintenance costs is in tab "cost model chart" and also shown below:


Predicted maintenance cost/yr v actual $m 2020, incl MPM
200
180
160
140
120
100
80
60
40
20
0
-20
-40
-60
0
20
40
60
80
100
120
140
160
180
Residuals
Actual Y
Linear (Actual Y)

The apparent outlier on this chart corresponds to the combined Newlands and Goonyella-Abbot Point Expansion networks. They were combined because separate cost data was not provided for these two networks.

If the Newlands+GAPE data point is excluded, then the cost model result is as shown below (also in tab "cost model excl GAPE":

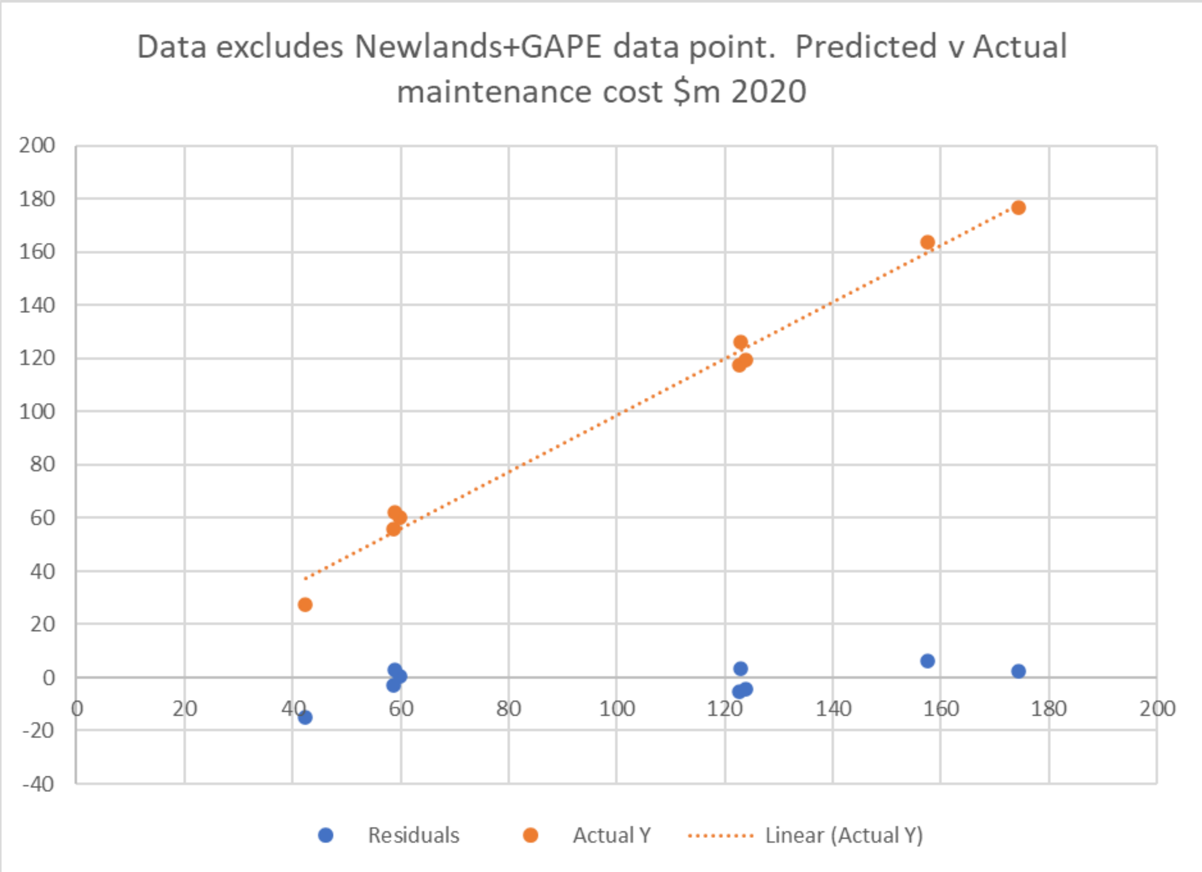
Regression Statistics		Y =	track mtce cost incl MPM ($m 2020)
Multiple R	0.998492		
R Square	0.996986		
Adjusted R Square	0.853698		
Standard Error	6.988993		
Observations	9		

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	113101	56550	1157	1.73E-08
Residual	7	341.9222	48.846		
Total	9	113443			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0	#N/A	#N/A	#N/A	#N/A	#N/A
Track-km	0.124	0.010	13.046	0.000	0.102	0.147
Billion gtk	0.767	0.183	4.196	0.004	0.335	1.199

The effect of excluding this outlier point is to slightly improve the quality of fit, to increase the fixed cost and decrease the variable cost coefficients. This result is plotted below and in tab "cost model chart excl GAPE".


Data excludes Newlands+GAPE data point. Predicted v Actual maintenance cost $m 2020
200
180
160
140
120
100
80
60
40
20
0
-20
-40
0
20
40
60
80
100
120
140
160
180
200
Residuals
Actual Y
Linear (Actual Y)