NATIONAL COMPETITION COUNCIL

QUESTIONS FOR RAIL CAPACITY EXPERTS

re

BHP & FMG

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Disclaimer

This report has been prepared with limited availability of contemporary data specific to BHP railway operations in the Pilbara. In contrast to G13 normal practice, data, analyses and conclusions have not been formulated or tested with the benefit of on-site observation and dialogue with railway personnel. To this extent, the judgements and conclusions in this report must be considered as provisional.

Nevertheless, G13 has made all inquiries which G13 believes are desirable and appropriate in the circumstances; and all matters of significance which G13 regards as relevant have been considered.

G13 & Associates Pty Ltd
APR Pty Ltd

26 February 2006

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Abbreviations

Application	Application for a Declaration pursuant to the TPA
APR	Asia Pacific Rail Pty Ltd, prime consultant to G13
B	billion
BHP	BHP Billiton Iron Ore Pty Ltd
c/ntkm	cents to carry one tonne of cargo over one kilometre
FMG	Fortescue Metals Group Limited
G13	G13 & Associates Pty Ltd as assisted by APR
h	hour
km	kilometre
km/h	speed in kilometres per hour
loop	deviation from the main line to allow trains to pass or overtake
M	million
NCC	National Competition Council
nt	net tonne (weight of cargo)
ntkm	nt x km (being a measure of cargo transported)
Pilbara	Iron ore province in North West Australia
RioTinto	Rio Tinto Limited, owners of the Hamersley Iron Railway
ROM	G13 Railway Operations Model
t	tonne
TPA	Trade Practices Act 1974 Part IIIA

1 PURPOSE

This report responds to questions posed by the NCC to G13. The response has been:

- Prepared by Mike Purcell[1] - a railway manager and Principal of G13[2], operational and management consultants to the railway industry;
- With the assistance of Henry van Ginkel[3] - a railway engineer of APR[4], railway consultants and construction engineers.

These questions arise from an Application[5] by FMG related to railway tracks controlled by BHP in the Pilbara. FMG asks BHP to provide a "Service"; this service being access for FMG trains to the BHP tracks for the purpose of transporting iron ore from Mindy Mindy to a port near Port Hedland[6]. BHP opposes this Application.

[1] Ref Attachment G – Mike Purcell's CV

[2] Ref Attachment F – G13's statement of capability

[3] Ref Attachment I – Henry van Ginkel's CV

[4] Ref Attachment H – APR's statement of capability

[5] Fortescue Metals Group Limited Application Under Part IIIA of the Trade Practices Act 1974 (11-Jun-2004)

[6] Ref Attachment E – a map of BHP's Mt Newman – Port Hedland railway line

2 ISSUES & QUESTIONS

As part of its evaluation of the Application under the TPA, the NCC must consider whether it would be uneconomic for anyone to develop another facility to provide the service. In doing so the NCC must form a view on:

- The ability of the Mt Newman Line to provide the service for that level of foreseeable demand and the cost of doing so; and
- The cost of constructing another facility to provide the service.

To this end, the NCC has been provided with information by BHP, RioTinto, FMG and the State Government of Western Australia, some of which is conflicting. Accordingly, the NCC has asked G13 for independent engineering/technical advice on the issues set out below.

Specifically the NCC asks:

- How is capacity of a railway line such as the Mt Newman Line usually estimated?
- What factors are usually taken into account in estimating the capacity of a railway line, and does this include adjustment for mine and port effects[7], train running effects, maintenance?
- Has the capacity information provided to the NCC by BHP, RioTinto, FMG and/or the State Government of Western Australia been estimated in this[8] manner and, if not, what impact does this have upon the reliability and/or usefulness of the information provided?
- What is the maximum capacity of the Mt Newman Line as a single track with the maximum number of passing loops or, alternatively, as a double track?
- How would double track be achieved, for example:
    - o Would the railway owner by-pass existing loops or incorporate them into the dual track;
    - o What are the relevant factors in making this decision; and
    - o Are there factors other than cost?
- What is the likely cost of building another facility from Mindy Mindy to Port Hedland?
- What is the likely cost of augmenting the Mt Newman line (through loops/partial/full double tracking) to accommodate access under various BHP "base case" scenarios?

3 METHOD

The objective is to evaluate the reliability and usefulness of material supplied to the NCC by BHP, RioTinto, FMG and the State Government of Western Australia.

G13 has used the G13 Railway Operations Model (ROM)[9] to determine the configurations of track required to provide capacity for the various iron ore haulage scenarios postulated by the NCC[10], viz

SCENARIOS MODELLED						
Scenario	**BHP**	**+FMG**	**150**	**200**	**250**	**400**
Ore Source	**Mt/y**	**Mt/y**	**Mt/y**	**Mt/y**	**Mt/y**	**Mt/y**
Newman	43	43	93	143	193	343
Area C & Yandi	57	57	57	57	57	57
BHP	100	100	150	200	250	400
FMG + Junior Explorers #	-	10	10	10	10	10
Total	**100**	**110**	**160**	**210**	**260**	**410**
# FMG 5 Mt/y + Junior Explorers 5Mt/y, all ex Mindy Mindy region						
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[7] i.e. Influence of capacity

[8] i.e. The way capacity is usually estimated

[9] Ref Attachment J

[10] Ref also Attachment A

With the assistance of APR, G13 also estimated the incremental capital cost of providing these configurations for both BHP and FMG[11] on the BHP Railway and, alternatively, for FMG on a “stand-alone” railway.

The basis for these estimates[12] is two cases:

- FMG stand-alone single track; and
- Ultimate duplication of the BHP track between Mindy Siding and Goldsworthy Junction.

From these estimates the following unit costs are derived:

Single Track	$M/km	**2.280**
+ Duplication	$M/km	**1.660**
= Double Track	$M/km	**3.940**
Loops +Signals	km/loop	**4.0**
Single Track	$M/loop	**9.493**
Double Track	$M/loop	**5.134**

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These unit costs are then used to estimate the costs of the various scenarios of interest to the NCC[13].

The sources of data for evaluations and judgements by G13 are;

- Material provided to G13 by the NCC[14];
- G13 and APR assumptions[15] and industry knowledge, both personal and corporate (but excluding information provided to G13 and APR by clients other than the NCC); and
- Public information.

4 ANSWERS

4.1 *General Questions*

4.1.1 How is capacity of a railway line usually estimated?

Capacity, in terms of transport of iron ore cargo, is determined by the:

- Number of trains which can occupy the railway line without colliding;
- Frequency of trains entering the railway line; and
- Carrying capacity of iron ore trains.

These determinants are, themselves, a function of, inter alia:

- Configuration of the railway:
    - Number of tracks;
    - Distribution and length of “crossing loops”;
    - Spacing of signals;
    - Combination of permitted speed and axle load;
    - Vertical and horizontal geometry[16]; and
    - Hydrology[17].

[11] Plus “junior explorers”

[12] Ref Attachment B

[13] Ref above and Attachment A

[14] Ref Attachment D

[15] Ref Attachments B & C

[16] Generally a function of topography

[17] Need for bridges, culverts and other drainage

- Erosion of the availability of the railway for iron ore carrying trains caused by:
  - Mine stockpiles and loaders;
  - Port unloaders and stockpiles;
  - Works[18];
  - Trains carrying goods other than iron ore;
  - Equipment failure[19];
  - Track failure;[20]
  - Labour availability[21] and aberration[22];
  - Acts of God[23];
  - Accidents[24];and
  - Other disruptions[25].

- Ore train specification:

  - Axle load and wagon volume;
  - Number of wagons; and
  - Locomotive power and numbers.

Capacity is estimated by evaluating these parameters having regard to:

- Forecast values (which can be uncertain); and
- Inter-relationships between parameters (which can be complex).

Capacity estimates are, inevitably, a compromise between:

- Simplicity in the interests of comprehension and recognition of the uncertainties; and
- Complexity in the interests of reality and relevance.

In this context, it is necessary to estimate capacity by a sequential but iterative analysis progressing from simple to complex, viz:

- Deductive reasoning by analogy with other situations[26];
- Static model quantification and sensitivity analysis[27]; and
- Inductive dynamic modelling to simulate "reality"[28].

4.1.2 Mine and port effects, train running effects, maintenance?

The determinants and factors taken into account include, *inter alia*, mine and port effects, train running effects, and maintenance. This reflects the fundamental truth that the railway is part of an interdependent supply chain influenced by, and influencing, the capacity and behaviour of other parts of the supply chain.

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[18] Maintenance and construction

[19] Locomotive, wagons, signals, communications

[20] Rail breaks, failure of sleepers, bridges, culverts, embankments, etc

[21] e.g. train drivers

[22] e.g. fatigue

[23] Storms & floods

[24] Collisions, derailments

[25] Strikes, rock-falls

[26] Usually by personnel (such as Mike Purcell of G13) with general management and industry operational experience

[27] e.g. the G13 ROM or as used by BHP: Ref Attachment D (5) Evans & Peck <u>Pilbara Rail Network - Production Capacity Modelling</u> (Dec-05)

[28] e.g. as used by BHP (ref Attachment D (3)). G13 would note that dynamic modelling is inherently complex and detailed and, in consequence, generally unsuited to strategic and business analysis.

In this context, it is important to distinguish between the effects of *base capacity mismatch* and effects of *variability*.

- Capacity mismatch occurs when the mine or port have a base capacity different to the railway. It is self-evident that, if the port has a capacity of (say) 200Mt/y, this will be the limit of the railway output even if the capacity of the railway, assessed in isolation, is (say) 250Mt/y.
- Variability of operations erodes capacity notwithstanding that the engineering and operational design capacities of the mines, railway and port might be well matched. If, for example, the port operation falters, the railway ability to deliver might falter causing (say) 10 trains to be cancelled. Railway capacity would have, thereby, been eroded by the equivalent of 10 trains.

For various planned levels of output, it can be assumed that the base capacity of components of the supply chain will be matched, and furthermore, these base capacities will be designed to accommodate erosion of capacity from expected, but unavoidable, variability[29].

4.1.3 Have BHP, RioTinto, and FMG etc estimated in this manner?

BHP and RioTinto seem to have estimated capacity generally in the same manner as would G13. G13 cannot, of course, categorically agree with the BHP estimates because the detail of both data and operational parameters[30] are not sufficiently known to G13. Furthermore, G13 does not endorse BHP's method insofar as BHP evaluates railway capacity by reference *inter alia* to base port capacity. This would be a relevant consideration when assessing the capacity of BHP's iron ore supply chain. It is not, however, relevant in the context of possible use of the railway by FMG so long as FMG does not wish to use the BHP port.

4.2 *Usefulness of the Information Provided?*

BHP argues that capacity is profoundly influenced by non-railway elements of the supply chain; and is influenced by variability throughout the supply chain, including railway variability. Capacity needs to accommodate these uncertainties and risks. G13 agrees with this.

It is, however, further argued that third party access would erode BHP's ability to manage these risks. FMG counters by asserting that this erosion would not occur if FMG adopted the same operating practices as BHP judged optimum for BHP.

FMG's position appears reasonable in that the addition of new sources of ore would require an increase in supply chain capacity including, perhaps, the railway. There is BHP precedent for such behaviour[31]. In such circumstances, the impact would be the same as if BHP was exploiting the FMG properties so long as FMG adopted BHP *modus operandi*.

4.3 *Specific Questions*

4.3.1 Maximum single track capacity of the Mt Newman Line?

With loops spaced at less than 20 km, BHP single track capacity would be about **210Mt/y**[32].

In estimating this figure, G13 assumes that the capacity of the track is governed by the "headway"[33], which, in turn, is governed by the "ruling section time"[34]. It is also assumed that the time a train takes to traverse a section is proportional to the length of the section.

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[29] G13 has assumed that the unrecoverable capacity caused by variability is 10% of design capacity.

[30] E.g. numbers of loops, train performance, operational variability, maintenance and inspection practices

[31] i.e. Successive expansions of the regional Mt Whaleback area and introduction of the satellite mining areas of Jimblebar, Yandi, and Area C.

[32] Ref Attachment A – 200Mt/y scenario

[33] Frequency with which trains can enter the track

G13 then postulates the progressive addition of loops placed to reduce the maximum section length, thereby increasing capacity. Production is then increased until capacity utilisation approaches 90%. At this point, another loop is added. When the maximum section length reaches less than 20km, it is assumed that the track must be duplicated.

4.3.2 Maximum double track capacity of the Mt Newman Line?

With bidirectional signals and "cross overs"[35] spaced at less than 20km, BHP double track capacity would be about **400Mt/y**[36].

4.3.3 How would double track be configured?

The options are to retain existing loops or incorporate them into the double track. The best option is to incorporate the loops as part of the double track, but to preserve ability to move trains from one track to another[37].

4.3.4 Relevant factors in making the decision about loops in duplication?

The advantage of preservation of loops is that capacity, and management of risks associated with operational and works variability, are enhanced.

But, the capacity provided by two tracks makes preservation of existing loops[38] unnecessary. Consequently it is best to use existing loops as part of the duplication and avoid the cost of about 100km[39] of track construction.

4.3.5 Cost of building another facility from Mindy Mindy to Anderson Point

A "stand alone" single track (with two loops) is estimated at **$1020M**[40]

4.3.6 Cost of augmenting the BHP Railway for Various Scenarios?

FMG's planned Mindy Mindy output is assumed to start at 5Mt/y together with 5Mt/y from junior explorers. Demand external to BHP is, therefore, 10Mt/y.

BHP's current output is assumed to be marginally less than 100Mt/y. G13 estimates that the current BHP track will need to be augmented to allow haulage of 100Mt/y and, consequently, is currently unable to accommodate any haulage by FMG. Augmentation to allow BHP to haul 100Mt/y might be 3 loops costing $25M[41].

From this stage, BHP can expand capacity in stages according to the haulage required[42] until ultimately 347km of track is duplicated at an incremental cost of **$609M**, viz:

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[34] Longest travelling time between loops

[35] Ability for a train to change to the adjacent track

[36] Ref Attachment A – 450Mt/y scenario

[37] i.e. install "crossovers"

[38] i.e. effectively short sections of triple track

[39] Being the aggregate length of loops which would exist prior to duplication

[40] Ref Attachment A - cf. FMG Investment

[41] Ref Attachment A – cf. Scenario "+FMG"

[42] Ref Attachment A – cf. Output Scenarios

BHP Augmentation Cost		
Mt/y	**Augmentation**	**$M**
100	+ 3 loops #	28
150	+ 4 loops	38
200	duplication	542
250	surplus capacity	-
300	nil	-
		609
	km	347
	$M/km	**1.8**
# not attributable to FMG		

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G13 estimates of the cost of duplication differ from those by BHP[43], viz:

Comparative Capital Estimates			
	km	**$M/km**	**$M**
BHP	401	4.4	1747
G13	347	1.8	609
Difference	**54**	**2.6**	**1138**
Related to			
distance	54	4.4	237
unit cost	347	2.6	901

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Some of this difference is attributable to the track distance relevant to accommodating FMG. G13 thinks track not used by FMG is irrelevant. But the bulk of the difference is the unit cost of track. G13 cannot rationalise this difference. G13 recognises the possibility of factors unique to the BHP's situation. It is, however, not clear to G13 what these factors might be. Consequently, G13 cannot endorse the BHP estimates.

It is not possible to identify the costs of augmentation attributable to FMG. After any augmentation required for BHP, the BHP system will have significant spare capacity[44]; and could accommodate FMG at near zero incremental cost. If FMG is the cause of the augmentation, the attributable cost would be as indicated by the above table.

A possible "accounting type'" view of FMG's cost[45] when sharing the BHP[46] track, is to allocate the cost of track[47] in proportion to the respective use by BHP and FMG[48]. On this basis, FMG's contribution would not exceed **$316M**, viz:

BHP	Total Value	FMG
Mt/y	**$M**	**$M**
100	1197	**316**
150	1235	280
200	1777	290
250	1777	274
400	1777	250

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This should be compared with the cost, to FMG, of a stand-alone track of **$1020M**.

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43 Ref Attachment D – Document 4 p.7

44 Ref Attachment A – cf. "Utilisation %"

45 Being the shared cost of the shared part of the BHP railway plus 100% of the cost of the 78km FMG connection to BHP.

46 The sharing being confined to track north of the FMG connection at Mindy Junction

47 Taken to be the replacement cost

48 Ref Attachment A – cf. "Total Investment' v "FMG Investment Share"

4.3.7 Triple Track?

It would be possible to add a third track to the Mt Newman line if capacity of a double track, enhanced with further passing loops, was exceeded by demand. This would not be required until haulage exceeded **400Mt/y**.

5 RELATIVE COST

A measure of the relative cost for FMG access to BHP track, as contrasted with stand-alone track, is the unit capital charge. Measured in terms of c/ntkm, FMG's capital charges for a stand-alone railway would be 4.8c/ntkm[49] or about $21/t. This represents about 63% of the fob[50] price of iron ore[51].

In contrast, BHP's comparative cost is 1/6th of this at 0.7c/ntkm, representing about 9% of the price of iron ore. If FMG shared the BHP track, the FMG cost could be reduced to 1.4c/ntkm which is about 1/3 of the stand-alone cost and about 19% of the iron ore price.

These results reflect the:

- High fixed cost of a railway track and consequent economies of large scale; and
- Small scale of FMG's project.

6 CONCLUSIONS

It may be concluded that:

1. Current BHP railway capacity is insufficient to accommodate FMG access, but can readily be expanded to do so;
2. Incremental expansion of the BHP railway is significantly less costly than constructing a stand-alone railway.

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[49] Ref Attachment C – GMG Standalone at 10Mt/y

[50] Delivered to the ship at the export port

[51] (say) cUS40/Fe unit for 62% Fe at $A1.00:$US0.75 = $US33/t