VALE	**DISL**	**GEORGINA PHOSPHATE PROJECT**

TITLE **LOGISTICS SOLUTION FOR GEORGINA PHOSPHATE PROJECT - COMMENTS ON MINEMAKERS REPORT**	Nº VALE **N/A**	PAGE **1/13**
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1.0 INTRODUCTION

1.1 PROJECT OVERVIEW

Vale Exploration is studying some phosphate assets for the Georgina Phosphate Project, located in the Northern Territory, Australia.

The planned ultimate annual capacity to be delivered is 3 Mtpa. The assumed phosphate properties being 1.6 t/m^3 bulk density and 3% moisture.

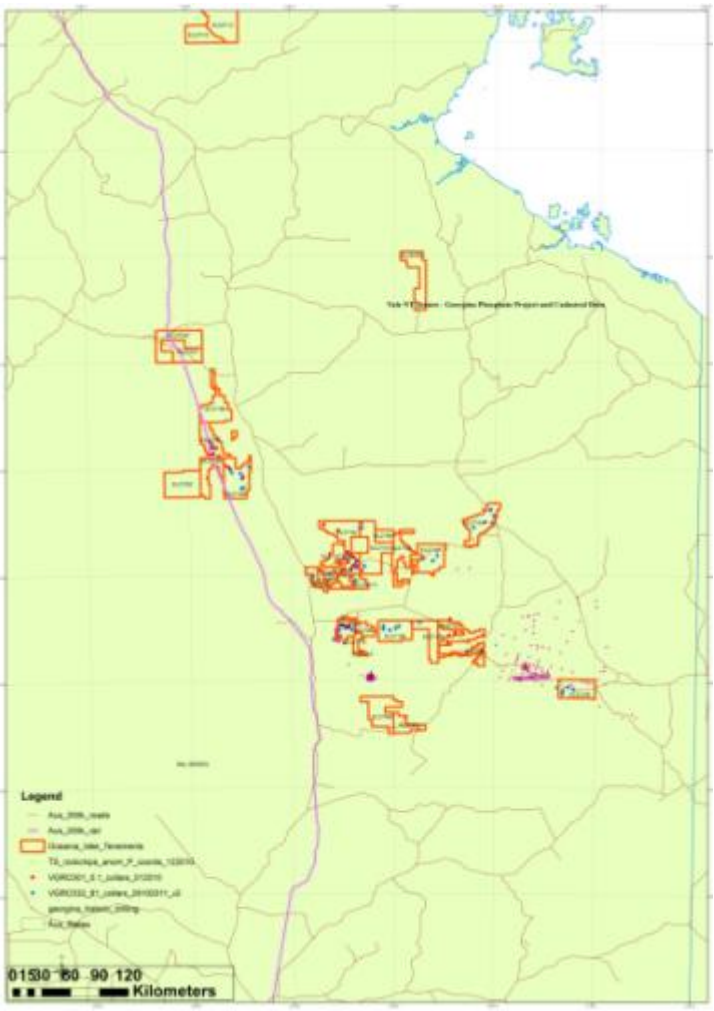


Figure 1 - Georgina Phosphate tenements

1.2 OBJECTIVE

For the feasibility assessments, overall logistics costs must be estimated including handling, storage and transport operations. During initial researches by Internet, a document entitled "Export Transport Logistics Study"[1] was found, containing very similar scope needed for Vale project. Such 2009 dated document was produced by Worley Parsons (WP), which had been engaged by Minemakers Australia Pty to provide a logistics recommendation to transport phosphate rock from its mine to the port in the Northern Territory.

Due to the preliminary and early stage of this project, the above mentioned document has been used as a reference. The present study hereafter aims to provide updates to WP's document, drawing conclusions and recommendations applicable to Vale's phosphate logistics.

1.3 ASSUMPTIONS

Due to the reduced time frame and preliminary stage for this work, main project assumptions were followed as per WP Minemakers' report. Some are stated below:

- Differently than Minemakers, Vale's tenements are located much closer to the Adelaide-Darwin railway. For the purpose of this report, a distance of 100Km has been assumed.
- Tennant Creek is the location for loading the phosphate from the mine to the rail.
- Operation concept at all facilities has been assumed exactly the same, especially regarding handling and storage.
- All operations are performed by third parties.

Following such assumptions, there won't be any significant modification in the CAPEX and OPEX estimations. And yet, minor differences could not be recalculated as the costs are not sufficiently detailed at WP Minemakers' report.

Final section of this report contains recommendations that could either reduce costs or improve operational efficiency.

[1] The report is publicly available by Internet at http://www.minemakers.com.au/downloads/Appendix_12BTransportLogistics.pdf (on March 27th 2012)

2.0 LOGISTICS CHAIN

Figure 2 below illustrates the proposed logistics chain to deliver the phosphate from mine to the port. Storage facilities are required at mine, rail facility and port, avoiding any disruptions including those by any third party.

Figure 2 - Logistics chain

2.1 MINE-TO-RAIL

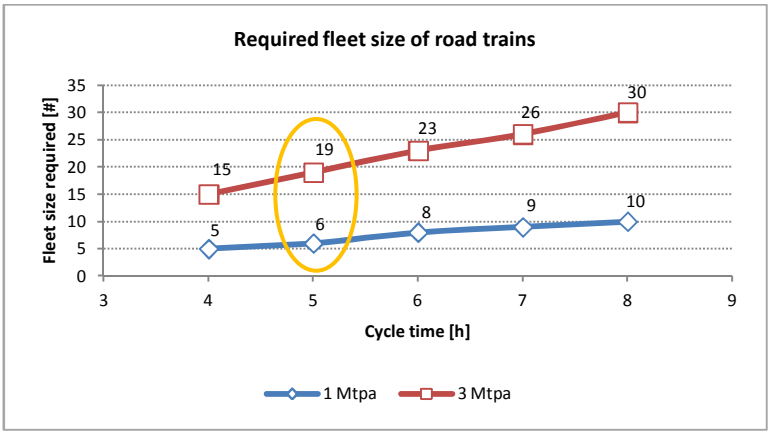
Table 1 below summarises the production and handling needs at mining site.

Incoming	***Storage***	***Outgoing***
8,547t per day delivered by 192t mine trucks. Stockpile inloading operation performed by 1 front-end loader.	Open storage facility of 26,000t at mine, corresponding to three days mine production. Stockpile size 86 m x 45 m x 6 m height.	Same as mine production, resulting in one road train (94.6t) at every 16 minutes. Road trains loaded by 2 front-end loaders (+1 spare).

Table 1 – Mine-to-rail summary

The transport operation from mine to rail holds the largest difference when comparing Vale to Minemakers project. The reason is that the distance between rail facility to Vale's assets is assumed no more than 100Km whereas Minemakers' is over 300Km. Therefore, road trains cycle time is much lower and the fleet can be substantially reduced, as well as the fuel consumption.

Graph 1 below shows a sensibility analysis of the required fleet according to the total cycle time. WP's report estimates 12 hours cycle time for Minemakers, through Barkly Highway, therefore Vale's cycle time will be likely around 4 to 5 hours. The resulting fleet size will be 19 vehicles for 3 Mtpa, whereas Minemakers need 45 road trains.



Graph 1 – Required fleet x cycle time between mine and rail

It is envisaged a road maintenance cost for the route, in order to offset the impact of additional traffic and to maintain the safety of operations on the existing road network.

2.2 RAIL-TO-PORT

Handling and storage needs at rail facility are summarised at Table 2 below.

Incoming	***Storage***	***Outgoing***
8,547t per day delivered by 94.6t road trains, giving frequency of one road train at every 16 minutes. Product dumped by road train and cleared to the stockpile by a front-end loader.	Covered storage facility of 26,000t. Stockpile size 86 m x 45 m x 6 m height.	Train set: 100 wagons x 62t. Trains loaded in a new rail siding using 2 front-end loaders (+1 spare). Frequency approximately 10 rail trains per week.

Table 2 – Rail-to-port summary

The rail facility is located in Tennant Creek on the existing Adelaide-Darwin Railway (ADR), 936Km from Darwin. ADR is a standard gauge, owned and operated by a third party. The total cycle time is estimated between 42 to 47 hours, as follows:

Loading at Tennant Creek	6 to 8 hours
Trip time – Loaded train from Tennant Creek to Darwin	14 hours
Unloading at Port of Darwin (assembly, inspection, scheduled maintenance)	8 to 11 hours
Trip time – Empty train from Darwin to Tennant Creek	14 hours

Table 3 - Rail cycle time from Tennant Creek to Darwin

Rail fleet requirements have been assessed at WP's report, according the table below:

Annual transport volume	***1.000.000***	***2.000.000***	***3.000.000***
Required train loads per week	3,51	7,02	10,53
Fleet requirements			
Train-sets required	1	2	3
Locomotives required (4,000 hp)	3	6	9
Wagons required (incl. 8% spares)	99	199	298

Table 4 - Rail fleet requirements

Further details on wagons and locomotives can be found at the above mentioned report.

It is also mentioned that there's no immediate requirement for additional crossing loops, however the potential for congestion could lead to some delays. Therefore one crossing loop was included in the cost estimates.

2.3 PORT OPERATIONS

Bulk operations at Darwin are carried out through a 600m multipurpose berth, part of the East Arm complex and equipped with 2,000 tph shiploader.

Figure 3 - East Arm complex at Port of Darwin

Table 5 below details the operations at the port:

Incoming	***Storage***	***Outloading***
Necessary extension of existing rail to accommodate a standard train length. Monthly frequency to unload: 40 trains.	Covered storage facility to keep a 150,000 stockpile. Road trains loaded by 2 front-end loaders (+1 spare).	Total return haul distance from storage to shiploader is 8Km. Frequency to maintain a peak loading rate at 1,800 tph: 20 road trains per hour. Road trains dump cargo and front-end loaders complete the operation onto shiploader.

Table 5 - Port operations summary

WP also assesses some restrictions faced at the Port of Darwin such as ship congestion at bulk export facility. It also mentions the occurrence of cyclones and high winds. However, all restrictions have been taken into account and none of them jeopardize the 3 Mtpa required capacity.

3.0 COST ESTIMATES

3.1 CAPITAL COST

As previously mentioned, CAPEX and OPEX are not sufficiently detailed to get some items modified. Similarly, no substantial difference to affect such assumption has been detected. These are the main drivers:

- Front-end loaders and road trains will be leased and, therefore, those equipments have been excluded from CAPEX.
- No land acquisition estimated.
- Port facilities assumed available and able to handle phosphate. Upgrades included only for the inloading system (rail siding).
- Mine stockpile not included.

	Stage 1 (1 Mtpa)	Stage 2 (3 Mtpa)
Tennant Creek - Rail loading facility	**20,748,800.00**	**27,748,800.00**
Infrastructure	1,640,000.00	1,640,000.00
Rail Loading Siding	9,716,000.00	9,716,000.00
Buildings	5,242,800.00	5,242,800.00
Accommodation	4,150,000.00	11,150,000.00
Main Rail Line Crossing Loops	**-**	**6,300,000.00**
Port of Darwin	**35,376,979.00**	**39,411,979.00**
Infrastructure	1,212,000.00	1,212,000.00
Rail Unloading Siding	-	3,960,000.00
Materials Handling	20,516,979.00	20,516,979.00
Buildings	13,423,000.00	13,423,000.00
Accommodation	225,000.00	300,000.00
General	**6,960,000.00**	**8,060,000.00**
Contractor Total	**26,496,027.00**	**34,238,727.00**
EPCM Costs	7,570,293.00	9,782,493.00
Contingency	18,925,734.00	24,456,234.00
CAPEX TOTAL	**89,581,806.00**	**115,759,506.00**

All figures in A$

Table 6 - CAPEX Logistics

3.2 OPERATING AND MAINTENANCE COST

The following considerations have been assumed:

- Product stockpiling, road train outloading and accommodation at the mine.
- Road train haulage costs and accommodation for road train crews at Tennant Creek.
- Road train inloading, product stockpiling and trains outloading at Tennant Creek.
- Tennant Creek to Port of Darwin rail haulage costs including costs of lease, crew, fuel, maintenance and train control and rail access fees.
- Road train ouloading, haulage and unloading costs at Port of Darwin.
- Handling charges of third parties at Tennant Creek and Port of Darwin.
- Service provider contract management personnel and mobilisation/demobilisation of personnel.

	Stage 1 (1 Mtpa)	Stage 2 (3 Mtpa)
Annualised OPEX	**74.30**	**61.49**

All figures in A$

Table 7 - OPEX Logistics

3.3 ESCALATION

As WP report was produced in 2009, it's prudent to update all costs with inflation rates. For Australia, we decided to use the Consumer Price Index (CPI), which measures quarterly changes of goods and services prices.

	Stage 1 (1 Mtpa)	Stage 2 (3 Mtpa)
CAPEX	**89,581,806.00**	**115,759,506.00**
OPEX	**74.30**	**61.49**
	CPI Rate (Darwin) = 7.975%	
Updated CAPEX	**96,725,955.03**	**124,991,326.60**
Updated OPEX	**80.22**	**66.39**

All figures in A$
Source: Australian Bureau of Statistics – All groups CPI; Darwin

Table 8 - Updated CAPEX and OPEX

4.0 RECOMMENDATIONS / OPPORTUNITIES

This document has been fully based on WP Minemakers' report, keeping all assumptions and operational concepts due to time frame restrictions and preliminary scope at this stage. However, some important considerations must be drawn:

- All logistics rely on third party operators; therefore any step forward must be conditioned to negotiations to secure capacity and cost predictability.
- Distance between tenements and rail loading facility is much shorter for Vale, which positively impact on road trains cycle time and, consistently, reduce fleet of vehicles as demonstrated.
- Vale's tenements location closer to Darwin can justify the construction of a new rail loading facility opposite to Tennant Creek, reducing rail distance.
- In the case more users or smaller ships call the bulk port facility, berth commitment can be compromised and capacity reduced.
- Road maintenance and rail facilities upgrades can be done in partnership with other players, with possible synergy.

In the meantime, it's important to mention that Minemakers requested a minimum investment driver, which can eventually compromise operational costs and efficiency over the upcoming years. Some alternative solutions should be evaluated by Vale:

- Full acquisition of front-end loaders, road trains, locomotives, wagons.
- Own operation and personnel for the front-end loaders, road trains and trains.
- Build a greenfield connecting rail from the mine to a junction point on the existing Adelaide-Darwin railway. All costs related to the road trains from mine to rail facility can be avoided.
- Evaluate a mobile shiploader (see ANNEX 1 – MOBILE SHIPLOADER) that can be fed directly by road trains, avoiding use of front-end loaders. This option can also reduce the number of road trains needed.
- Evaluate an alternative space at Port of Darwin, opposite to the large distance (8Km) between storage and shiploader.

ANNEX 1 – MOBILE SHIPLOADER

As a reference, a mobile shiploader can be used for loading operations. It's a tailored design with a radial outloading boom conveyor able to receive material either from tipping trucks and front-end loaders, which will dump the material into three hoppers connected to the shiploader. The design rate can be averaged 2,600 tph.

Below some illustrations:

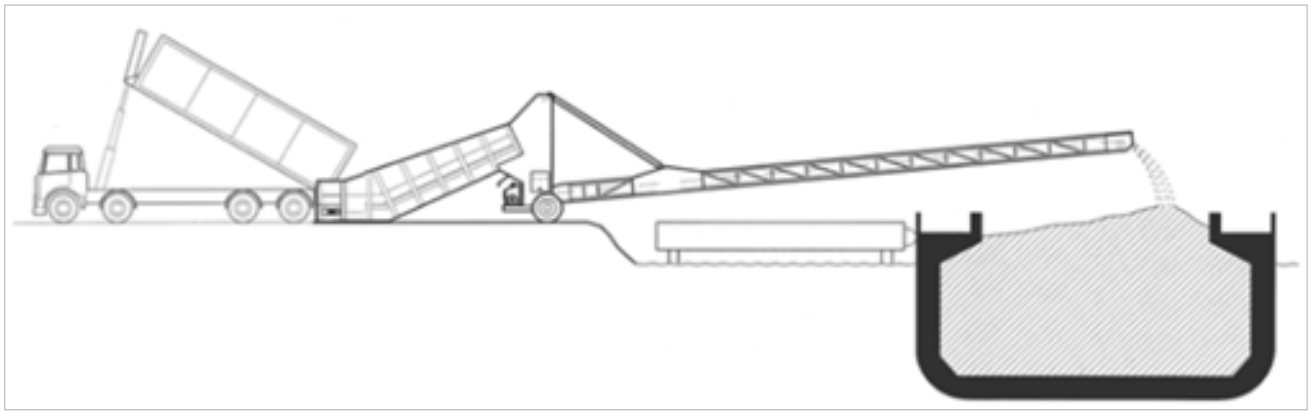


Figure 4 - Truck feeding the shiploading operation

Figure 5 - Barge being loaded by mobile shiploader and truck