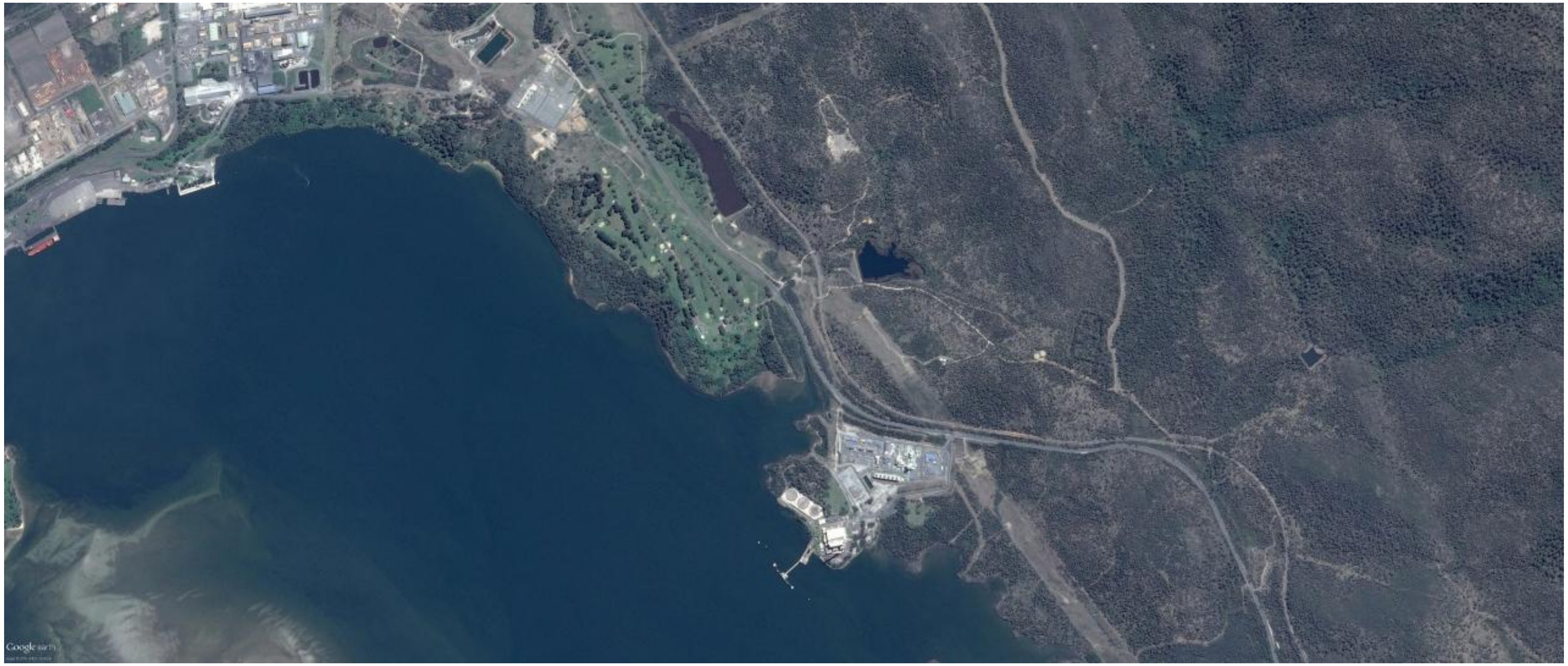

Preliminary Analysis Options for the potential processing and export of aggregates from Northern Tasmania, Australia

FINAL REPORT

Pacific Basin Bluestone Pty. Ltd.

May 2016

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Introduction

As part of strategic considerations for Pacific Basin Bluestone, GHD has been engaged to develop the understanding of aggregate marketability from a proposed export quarry operation in Northern Tasmania, Australia

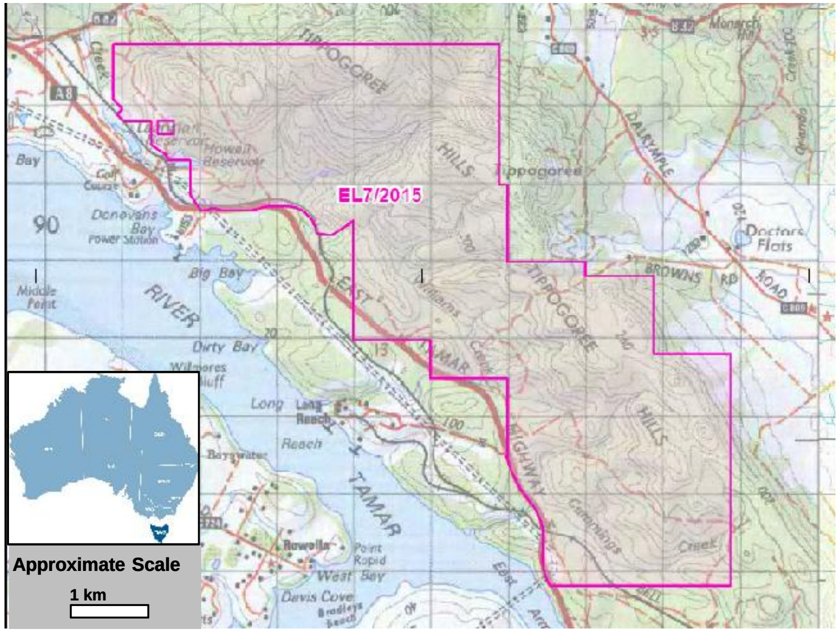
Study background

As part of strategic pursuit considerations, Pacific Basin Bluestone Pty. Ltd. have engaged GHD to undertake an options analysis to increase the understanding of product marketability to key demand centres (notionally Sydney, Melbourne, Brisbane and Asia) from a potential quarry and processing operation located at a Dolerite resource near Bell Bay in Northern Tasmania, Tasmania (EL7/2015 as per Figure 1)

Because of the low unit value and wide availability of construction materials, there has been no significant interstate or international trade for aggregates from Tasmania, although rising demand, decreased local (interstate) availability at key metropolitan centres, and increasing quality and specification issues in South East Asia has raised interest in the opportunity to export hard-rock from Tasmania.

Prior to this study, Delta Materials Pty Ltd proposed to host a crushed dolerite quarry suitable for bulk export to the Australian market on a portion of the current EL7/2015 held by Pacific Bluestone Pty Ltd. However, Delta Materials relinquished the Exploration Licence as a result of the potential customer discontinued interest to purchase the aggregate.

Figure 1: Location of Bell Bay Dolerite (EL7/2015)[1]



Source: Mineral Resources Tasmania

[1] http://www.mrt.tas.gov.au/mrtdoc/tasxplor/download/13_6789/Final_RelinquishmentReportEL4_2012.pdf

This study assesses the potential costs for extracting and exporting Dolerite aggregates from Bell Bay and distributing to mainland Australia markets

Study scope

The aim of this study is to provide Pacific Basin Bluestone with an increased understanding of the potential delivered cost to market and product prices at these locations.

In achieving the aim of this study, the scope of works includes:

- Development of indicative extraction costs and processing operations
- Establishment of capability and potential capital expenditure to facilitate aggregate exports at Bell Bay
- Development of the logistics costs (shipping and distribution costs) to identified potential markets of Melbourne, Sydney and Brisbane
- Analysis of the Dolerite resource at Bell Bay at market suitability
- Assessment of market competitiveness

Based on the outcomes of this study, potential market penetration opportunities are identified for further investigation in subsequent more detailed studies and market sounding.

Study limitations

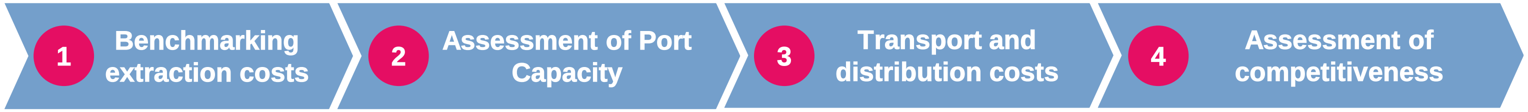
There are a number of potential limitations to this study and the accuracy of the outcomes. This is primarily due to the fact that the project is still in the initial phases, and as such critical infrastructure is yet to be constructed and commercial arrangements are not yet in place. Therefore, there is a reliance on indicative capacities and intended operational procedures that underpin the analysis processes.

Potential volatility in the shipping and commodities markets, and fuel/energy prices may have significant impact on the results, particularly when logistics costs contribute a significant proportion of the intended market price of the export product.

The integrated nature of the major players in the concrete and aggregates markets within the region limits the visibility and availability of market data – in particular, where business use internal supply channels of aggregates as part of their business strategy – particularly concrete production.

A series of tasks have been undertaken to develop an understanding of the market competitiveness for aggregates exported from different scale quarry operations in Northern Tasmania, Australia

Figure 2: Analytical approach undertaken



Key tasks

Key tasks undertaken include:

- Research price of aggregate (and other products) for each of the target markets, primarily including Sydney, Melbourne and Brisbane (additional analysis has been also included on potential Asian markets).
- Desktop analysis of hard rock extraction costs, including the development of a conceptual plant design and layout
- Develop potential operational options for the export of aggregates from Bell Bay to target markets. This includes extraction, transfer conveyors, marine infrastructure and shipping for extraction rates of 2.5Mtpa, 5 Mtpa and 10Mtpa, and engaging with vendors to obtain crushing circuit recommendations and equipment costs.
- Review of the operational environment, capacity and capability of potential facilities within Bell Bay port to facilitate the cost effective export of quarry product
- Develop operational logistics costs to provide high level transport cost comparison to key destination markets
- Compare the cost to market outcome with available market rates for each destination.
- Identify potentially penetrable markets, and more importantly those which export product is not competitive

These outcome of this study (as per the approach provided in Figure 2) helps inform what markets Pacific Basin Bluestone Pty. Ltd. may want to target, and to inform subsequent more detailed studies related to market sizing and price impacts, as well as business case development

Applications for the Bell Bay resource

With high density and low water absorption, along with superior mechanical (hardness) properties, Bell Bay material appears suitable for all concretes, including high performance concretes

Qualities of Dolerite

Dolerite is an igneous rock closely related to Basalt and has a range of benefits and qualities, including:

- Concrete specifications for airport pavements, often prescribe the use of basaltic aggregate due to the superior properties of this material.
- The density and structure of the material result in concrete made with this rock having higher than standard elastic modulus making it sought after for high rise construction.
- The thermal properties heat of low expansion and dissipation result in above average crack control and heat insulation resulting in improved crack resistance in mass concrete applications. These thermal properties and better than average frication and polished aggregate values are why it is sought after for pavement.
- The abrasion resistance also makes the aggregate suitable for asphalt pavement, and any hard wearing floor.
- Many aggregates are susceptible to alkali-silica reaction and although not yet confirmed it is expected that Tasmanian Dolerite would be innocuous to ASR.
- The low water absorption shows durability but also means the aggregate will be suitable for pumping concrete particularly where high pressure or long distances are required. Similarly any manufactured sands produced from this material with appropriate processing (to remove clay like particles) would be considered suitable for use in concrete and road base applications.
- The density of the material (>2.8 t/m3) will give a high density concrete, however this additional weight is easily compensated for by the anticipated strength performance improvement of the mix, this would allow a cement content reduction compared to lower grade material. Of course the actual mix proportions would depend of many factors not just the aggregate performance.
- This material can be considered suitable for use in all types of concrete, road pavements, road bases, rail ballast, rip-rap and architectural facing stone.

When used for construction purposes aggregate should be tested to compliance standard - physically and chemically - to verify its suitability for use

Sampling, testing and aggregate Standards
In order to be utilised as a concrete aggregate, the quality of the aggregate is usually required to comply with specific regulations and quality control standards. In general for concrete aggregate the following are adopted: • Australian Standard AS2758.1 (AS); • Philippines and Indonesia commonly use the ASTM C33 standard (ASTM); and • Malaysia and Thailand typically adopt EN 12620 (EN). Geological mapping, surface rock sampling, a geophysical gravity and magnetic survey and a total of 2,460.9 metres of diamond drilling in 21 holes has been carried out by others to date. From the rock core obtained from drilling, composite samples from the core were selected, crushed and tested to determine whether the dolerite meets specific parts of the Australian Standard, including tests for concrete aggregate (AS2758.1).

A review of the composite sample results in the context of ASTM and EN concrete aggregate standards has been considered as they are commonly adopted

Comparison of Standards

A summary of the key quality/specification requirements for each of the standards (AS, ASTM and EN) are presented in Appendix A

Key difference between the standard are:

- ASTM and EN 12620 standards do not test for Wet and Dry Strength variation and particle shape ratios
- ASTM standard has a category for clay lumps and friable particles and requires a higher Los Angeles abrasion tolerance limit
- Particle densities and water absorption minimum thresholds also vary between the standards
- Properties in the EN 12620 standard are subject to whether the purchaser considers it as requirement based on the intended use of the aggregate, This gives the use a lot of discretion and latitude in the selection of aggregate.

Partial Size Distribution

The Particle Size Distribution (PSD) or “grading” is a critical parameter for most uses of aggregate. The PSD is intricately related to the crushing process and as such cannot be readily assessed at this time. However, the design and selection of the crusher circuit on site will be key in the development of a saleable product and early selection of target PSD and the fines content, along with target crushed product volumes are required to enable a crushing circuit design to be developed.

Assessment of suitability for the Dolerite resource was undertaken against critical parameters for concrete aggregates

Critical parameters for concrete aggregate

Evaluation of the drill core composite sample for concrete aggregate was based on three critical parameters in accordance with widely used standard with due cognisance of parameters that cannot be modified by processing.

These parameters are:

1. **Coarse Fraction Particle Density** - is the density of the aggregate which affects the strength and durability of the concrete. An aggregate with higher density typically exhibits greater strength and lower water absorption.
2. **Sodium Sulphate Soundness Loss** - determines an aggregate's resistance to disintegration by weathering action. A lower value is indicative of a higher resistance.
3. **Los Angeles Abrasion Loss** - is a measure of the degradation of aggregates resulting from a combination of actions including abrasion, impact, and grinding in a rotating steel drum containing a specified number of steel spheres. It is used to indicate aggregate toughness and abrasion characteristics which correlate to the ability of the aggregate to resist the abrasive effect of traffic over a long period of time.

Table 1: Critical Parameters and Standards for Evaluating concrete aggregate

	AS	ASTM	EN
Coarse Fraction Particle Density	<3.2T/m3 and ≥2.1T/m3	>2.4T/m3 and >2.0T/m3	>2.4T/m3 and >2.0T/m3
Sodium Sulphate Soundness Loss	<6%	<10%	unrequired if the aggregate is to be used in a frost free region' and <4% in salty road conditions
Los Angeles Abrasion Loss	≤30%	≤50%	≤30%

Source: Australian Standards AS2758.1, ASTM C33 and EN 12620

The Dolerite resource has been split into 3 parts based on the geology encountered, namely the West, Central and East that largely conform to the standard specifications for concrete aggregates

Quarry Resources Boundaries

Each resource area is bounded by fault zones that are considered not usable for concrete aggregate and has been classified as "waste" in the Coffey 2010 mine model. The East Resource has only one composite sample and has therefore been combined with the adjacent Central Resource.

Interpretation of the testing

The West, Central and East resources largely conform to the standard specification limits for the three critical parameters for use as a concrete aggregate. The main exceptions being lower quality material associated with weathered dolerite found near surface and strongly jointed intersections adjacent to steeply dipping NW-SE, E-W and NE-SW fault zones.

The low Water Absorption limit of EN 12620 may pose an issue if the product is for use in in regions of freezing and thawing as only one of twenty four samples possessed values under 1%. However, due to the climatic regimes of the proposed product destinations and because the standard states that many satisfactory aggregates have higher absorption values (in excess of 2 to 4%) this should not be an issue.

The results from the composite samples are inevitably biased towards the fresher rock or the more weathered rock, depending on the drill core interval tested. As part of the quarry development it is usual practise to blend and manage the resource on site, say to mix fresh rock with more weathered material to maximise the resource whilst still meeting specification requirements.

Where unsuitable materials are in significant quantities that exceed what can be reasonably be blended they are considered "waste" in the resource assessment report, generally comprising the weathered overburden and the fault zones. These materials typically fail on the % passing the 75 micron sieve and on the sodium sulphate soundness. However, there would be opportunity to utilise on-site for facilities, such as haul roads, fill pads and other road related specifications where these parameters are of lesser importance. It is probable that the "waste" from the fault zones and the weathered overburden may be a locally saleable product for general fill, road base, and or as a landscaping material

The Dolerite resource at Bell Bay primarily meets the Australian, Philippines, Indonesian, Malaysian and Thai standards

Table 2: Fresh and Weathered Dolerite – West Resource

Fresh and Weathered Dolerite – West Resource	Meets AS2753.1	Meets ASTM C33	Meets EN 12620
Coarse Fraction Apparent Particle Density	✓	✓	✓
Coarse Fraction Water Absorption	✓	✓	✗(Note 1)
Sodium Sulphate Soundness Loss	✓	✓	✓
Los Angeles Abrasion Loss	✓	✓	✓

AS2758.1 - Australian Standard

ASTM C33 - Philippines and Indonesia

EN 12620 - Malaysia and Thailand

Table 3: Fresh and Weathered Dolerite – Central Resource

	Meets AS2753.1	Meets ASTM C33	Meets EN 12620
Coarse Fraction Apparent Particle Density	✓	✓	✓
Coarse Fraction Water Absorption	✓	✓	✗(Note 1)
Sodium Sulphate Soundness Loss	✓	✓	✓
Los Angeles Abrasion Loss	✓	✓	✓

Note 1: ≤1.0% required, however the standard mentions that values in excess of 4% have been shown to have adequate freeze thaw resistance. Freeze thaw not likely to be a major issue for markets considered in this assessment.

Production and shipping costs

The full supply chain has been considered in this study, including definition of a potential operation, key constraints for extraction, bulk terminal, marine infrastructure and shipping

In order to develop indicative market delivered costs, an end-to-end full conceptual supply chain needs to be defined. Additionally, a range of operational assumptions and rules need to be defined that reflect the potential operational environment and its constraints. Key assumptions and constraints for the proposed operational supply chain used in the analysis are provided below

Extraction

Two plant sizes have been costed:

- Plant option 1: 1,200 tph
- Plant option 2: 2,400 tph

The plants have been used to achieved volumes of:

- 2.5 Mtpa – Plant option 1 (single shift)
- 5 Mtpa – Plant option 1 (double shift)
- 5 Mtpa – Plant option 2 (single shift)
- 10 Mtpa – Plant option 2 (double shift)

A number of provision have been included in the costing exercise, including power, water supply, access road and site facilities

Additional details on the extraction assumptions can be found in Appendix C

Terminal and Vessel Loading

The terminal comprises:

- A conveyor system direct from mine site to terminal stockpile (approximately 2 km)
- A stockpile located upon the former woodchip stockpile connected by current infrastructure to WC1
- A reclaimer and new conveyor system to the ship loaders

Associated berth and loading infrastructure comprises:

- Demolition and rebuild of the wharf (WC1) to facilitate increased product density at higher transfer rates and Supramax class ships
- Enclosed radial ship loaders to avoid the warping of vessels at berth, minimising ships time at berth, and minimising fugitive dust emissions during loading operations

Additional detail on the terminal and vessel loading assumptions can be found in Appendix C

Shipping

Shipping assumptions comprise:

- Vessel size limited to Supramax. Approximately 52,000 DWT
- Limited draught entry to Bell Bay at 11.5 meters maximum
- Vessels light loaded to a maximum draught of 11.5m – assumed at 47,500 cargo tonnes
- Vessel movements restricted to tides
- Sailing distance to export locations ranging from 240 Nm to 4,386 NM

Additional detail on the Shipping assumptions can be found in Appendix C

Extraction

As part establishing potential costs, an operating plan and potential layout were considered to define a project footprint for three different production rates

Quarry Operating Footprint
For each of the potential production scenarios, an indicative operating foot print has been developed (Figure 3). The three white boxes indicate the land space required for each operation. These being: • Footprint A – Footprint of quarry for 10 years production @ 2,500,000 tpa • Footprint B – Footprint of quarry for 10 years production @ 5,000,000 tpa • Footprint C - Footprint of quarry for 10 years production @ 10,000,000 tpa The yellow boundary line represents the limit of the potential quarry area. The boundary line has been determined by providing a 500 metre buffer distance to any residences, buildings or major roads.

Figure 3: Indicative Operation Footprints for various annual volumes

Source: GHD

An indicative alignment for the conveyor system connecting the mine site to the terminal has been used to developed project costs

Assumption regarding Conveyor System
Transfer of quarry products to the terminal located behind Wood Chip Berth 1 (WC1) would be via an overland conveyor being approximately 2 km in length (Figure 4). The conveyor would require an easement and approvals, as it will traverse the East Tamar Highway and railway line. The transfer conveyor assumed for this operation and costing is 1,200 tph at 2.5mtpa (and 5mtpa single shift), and 2,400 tph (for 5mtpa single shift and 10mtpa). With the slope of the terrain between the proposed processing and terminal areas, there are potential opportunities to reduce energy usage and generate power. The quantification of potential benefits would need to be considered in subsequent materials handling studies for mine planning, extraction and processing.

Figure 4: Potential alignment of the conveyor system

Source: GHD

Capital costs for planning and approvals, quarry development and plant capital have been estimated for all volume scenarios

Operations Description

The crushing and screening plant will be located approximately 2 kilometres east of the existing northern berth at Long Reach. The development of the quarry will follow a detailed quarry development plan required for approval by the Department of State Growth. After the site is stripped and cleared of overburden, the general operation will consist of drill and blast to fracture and break up the solid rock formation followed by loading and hauling the blasted rock to the primary crusher feed hopper. From the feed hopper the blasted rock will pass over a grizzly feeder and scalper and enter the primary jaw crusher that will crush it to a size suitable for the secondary crusher(s). It is typical of high production quarries for primary crushed rock to discharge to a surge pile, which allows for maintenance and emergency down-time of the single unit primary crusher. Primary crushed rock would feed either directly to the secondary crushers or via stockpile reclaimer and would then pass through the first screening circuit. Screened secondary rock would then be transferred to the tertiary crushers for shaping followed by the final screening circuit for size classification. (Refer Appendix D)

Development of Quarry Cost Estimate

For the purposes of this study benchmark extraction rates across quarries operating within Australia were intended to be used for the competitiveness analysis. Due to the proposed scale of quarry operations (2.5Mtpa to 10Mtpa), there were limited opportunities to benchmark extraction costs. As such, a build-up of costs necessary to develop appropriate estimates for the cost of extraction was performed. In developing the costs, it has been assumed that:

- The initial quarry location is centrally located within the current Exploration Licence area, adjacent to WC1, extending north and south over time
- Costs include production of crushed aggregates from the quarry and delivery to the ship loading stockpile at WC1 berth, as well as quarry development, start-up and provision for quarry closure costs.
- Plant and equipment is consistent with the circuit and specifications provided by Metso, as per Appendix D

A number of provisions have been included to develop the cost estimate for the operation. These provision include:

- An access road from the East Tamar Highway. This is a Limited Access highway that will require Planning Approval and will be subject to special access conditions.
- Power, portable water supply and site facilities
- Water storage dam (This will provide water for dust suppression and process water as well as aggregate washing if it is required)
- Hardstand for stockpile areas.

The level of capital required to establish an owner operated quarry, including 30% contingency is approximately $100M to achieve a 5Mtpa operation and $179M to achieve 10Mtpa

Based on the proposed quarry operations described and implementation options, indicative capital (Table 4) and operational costs (Table 5) have been developed. A breakdown of the key cost components is provided below (see Appendix C for more detailed breakdown in costs.

Table 4: Potential capital costs – quarry operations

Fixed Cost	2.5 Mtpa Single Shift	5 Mtpa Double Shift	5 Mtpa Single Shift	10 Mtpa Double Shift
Planning and Approvals	600,000	840,000	840,000	1,200,000
Quarry Development	10,926,452	14,483,791	14,483,791	19,006,997
Quarry closure	1,072,904	1,877,583	1,877,583	3,621,053
Fixed Plant	42,370,000	42,370,000	82,490,000	82,490,000
Mobile Plant	9,743,000	9,743,000	17,841,000	17,841,000
Transfer to port (conveyor system)	8,650,000	8,650,000	14,250,000	14,250,000
Total fixed costs	73,362,357	77,964,374	131,782,374	138,409,050
Contingency (30%)	22,008,707	23,389,312	39,534,712	41,522,715
Total fixed costs including contingency	**95,371,064**	**101,353,687**	**171,317,087**	**179,931,764**

Source: GHD Estimates based on industry sources

Table 5: Potential annual operating costs – quarry operations

	2.5 Mtpa Single shift	5.0 Mtpa Double shift	5.0 Mtpa Single shift	10 Mtpa Double shift
Power	1,053,000	2,106,000	2,187,900	4,375,800
Fuel	1,560,000	3,120,000	2,711,280	5,422,560
Labour	1,521,000	3,042,000	1,859,000	3,718,000
Water	77,000	154,000	120,000	210,000
Royalty	1,875,000	3,750,000	3,750,000	7,500,000
Drill & Blast	3,245,614	6,491,228	5,964,912	10,526,316
R & M	4,545,700	9,091,400	8,555,900	15,080,260
Contingency (30%)	4,163,194	8,326,388	7,544,698	14,049,881
Grand Total	**18,040,508**	**36,081,016**	**32,693,690**	**60,882,817**

Source: GHD Estimates based on industry sources

The cost of quarry operations (extraction) is estimated at $9-11 per revenue tonne based on a 24 hour operation – with a $2 per tonne cost premium to operate 12 hours per day.

Extraction costs

Based on the capital and operating costs presented in Table 4 and Table 5, the extraction cost per tonne has been calculated for saleable product. For the purposes of the analysis, dust is considered a waste product, with the target product being premium aggregates

As shown in Table 6:

- The 10 Mtpa – the double shift quarry operations scenario generated the lowest cost of production, at approximately $9.50 per tonne. This is due to the high utilisation of the extraction plant and the ability to socialise fixed costs, as well as the scale of economies generated by a larger operation.
- The 5 Mtpa double shift scenario also benefits from higher levels of plant utilisation t, which operate at approximately $10.50 compared to the 5 Mtpa single shift scenario which operates at approximately $12.40 per tonne.
- The smaller scale single shift operation, which lacks the economies of scale achieved by the larger operations is high (as for both single shift operations). Despite the additional operating costs in providing a 24 hour operations, the increased utilisation of plant generates a quarry operation saving in the order of $2 per tonne

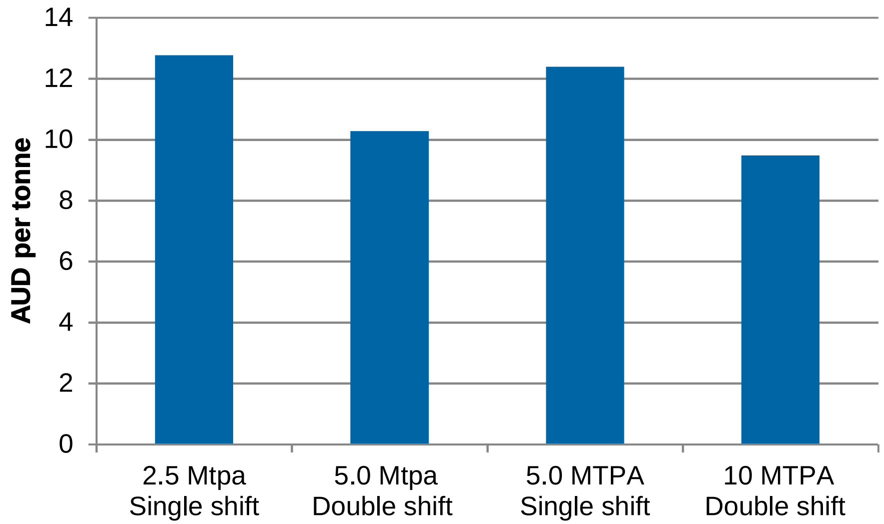
Additional detail on the breakdown of the rate per tonne calculation is provided in Appendix C

Table 6: Extraction Cost per tonne

	2.5 Mtpa Single shift	5.0 Mtpa Double shift	5.0 MTPA Single shift	10 MTPA Double shift
CAPEX	5.6	3.1	5.9	3.4
OPEX	7.2	7.2	6.5	6.1
Total	12.8	10.3	12.4	9.5

Source: GHD calculations

Figure 5: Extraction - cost per tonne



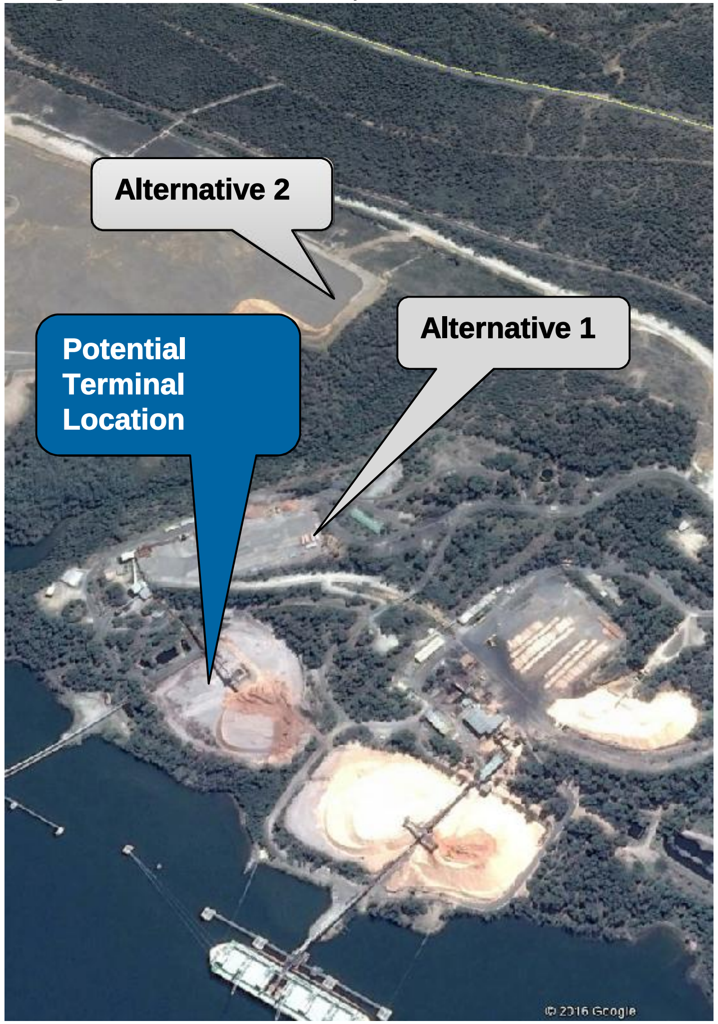
Source: GHD calculations

Terminal and ship loading

The ultimate location of the ship loading terminal and berth will depend on negotiations with infrastructure owners and the status of current agreement; however, there are potential alternatives nearby

Potential Stockpile Location
Three potential terminal locations have been identified near the mine site and the WC1 berth. These are **Preferred** – located directly adjacent to the WC1 facility and was previously used for wood chip exports (as shown in Figure 6). **Alternative 1** – Is located near the potential transfer conveyor alignment, and is adjacent to the preferred location option. However, this area appears to be occupied by local wood chip industry or other freight/industrial related activities, as shown in Figure 6. **Alternative 2**– This area was originally prepared for the Gunns Pulp Mill; however construction did not commence beyond civil works. There may be potential to use a portion of the land for stockpiling if neither woodchip site locations can be secured. Similarly, there is the potential that access to WC1 cannot be secure for the purposes of the quarry export operations. However, alternative berth locations within Bell Bay include the former H.E.C. oil berth, to the North (approximately 4 km via road from the quarry site). Due to the unknown potential for remediation works and the cost, or liable party for the removal of oil containing pipes , the berth has not been considered within this analysis

Figure 6: Potential Stockpile Location



Source: Adapted from Google Maps

Due to the condition and capability of existing maritime infrastructure at WC1, the existing wharf structures will need to be rebuilt

Ship loading Findings and Assumptions

Berthing capacity and mooring capacity of WoodChip Berth 1 is not adequate for Supramax requirements. This is based on installed furniture Bollards / fenders and assuming that the berth is in reasonable condition and capable of supporting the mooring and berthing furniture installed. As a result it has been assumed:

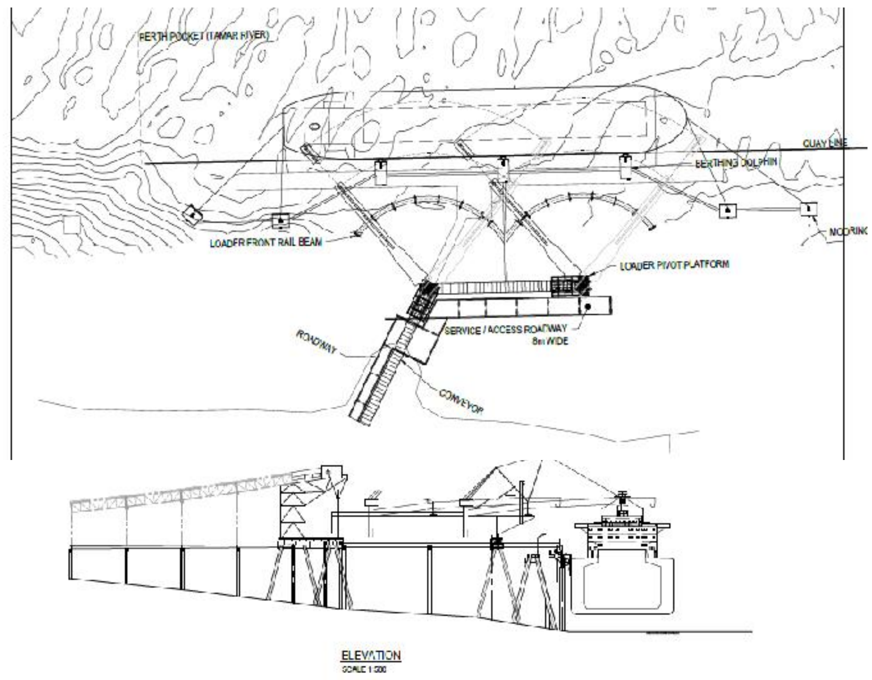
- Demolition and rebuild will be required for the operation
- A berth pocket of approximately 11.8 meters
- Potential capital cost ranging from $60M to $90M. This includes the berth structure and materials handling (similar to that provided in Figure 7), excluding any required dredging
- Configuration for 2 x quadrant radial ship loaders at 2,000tph each

Critical considerations

Terminal and ship loading infrastructure will need to minimise the generated dust. As such, the stockpiling area will require dust suppression, and the ship loading system will need to be enclosed.

Cross-contamination mitigation through dust suppression will be a critical consideration for the storage and loading of product, particularly due to the proximity of current woodchip operations and the minimisation of environmental impact – particularly the Tamar River (which includes an existing aquaculture operation opposite WC1)

Figure 7: Potential replacement maritime infrastructure



Source: GHD

Berth Loading Capacity

Vessel Load Time: 32 hours (includes pre/post and berth changeover - 10.5 hours) – assuming a net load rate of 2,000tph

Operating Days per year: 355

Maximum Capacity: 12 Mtpa

Utilisation of berth: 42% (5Mtpa) and 83% (10Mtpa)

The cost of terminal operations is estimated at between $3 and $8 per tonne, driven by the economies of scale achieved in the terminal operation.

Extraction costs

Based on the identified capital costs (assumed at $90M) and potential operating costs based on benchmarked bulk terminals throughout Australia, the terminal and ship loading cost per tonne has been calculated for saleable product.

As shown in Table 7:

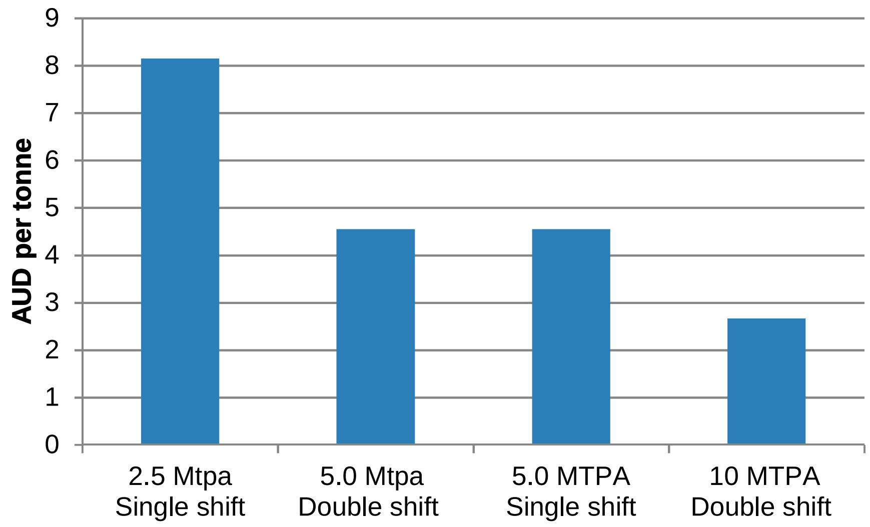
- 10 Mtpa provided the lowest cost, at approximately $2.70 per tonne. This is due to the high utilisation of the infrastructure, and the ability to socialise fixed costs. Despite this, high utilisation of a single berth operation may result in queuing or system stress due to a range of operational factors, such as weather or breakdowns
- The lower volume scenarios – both of which require the same enabling infrastructure as 10mtpa – produce higher rates per tonne, ($4.60 per tonne at 5mtpa, and $8.10 at 2.5mtpa) almost exclusively due to the ability to limited ability to generate economies of scale (through low utilisation of infrastructure)
- While opportunity may exist to reduce the level of capital required, it is critical that the environmental impact of the operation is minimal – particularly in seeking approval to operate at that location in the Tamar River
- Additional detail on the breakdown of the rate per tonne calculation is provided in Appendix C

Table 7: Terminal and ship loading - cost per tonne

	2.5 Mtpa	5.0 Mtpa	10 MTPA
CAPEX	5.9	2.9	1.5
OPEX	2.3	1.6	1.2
Total	8.1	4.6	2.7

Source: GHD calculations

Figure 8: Terminal and ship loading - cost per tonne



Source: GHD calculations

Shipping operation

The size of the vessel is limited by the channel depth at Bell Bay, and as a result the maximum allowable operable vessel draught is 11.5m

Vessels Type

With an allowable draft of up to 11.5 meters, the study has assumed the use of light loaded Supramax vessels. The departure draught at the time of sailing will be dependant on the specification of the individual vessel, and the consignment tonnes loaded on the vessel and optimised for the tide.

For the purposes of this study it has been assumed that on average the payload of each vessel will be 47,500 tonnes. Further assumption and specification of the Supramax class vessels are listed in Table 8.

Table 8: Example of Supramax (geared)

Supramax		
Vessel DWT	52,000	Tonnes
Cargo Tonnes (light loaded**)**	47,500	Tonnes
GRT	30,000	Tonnes
Service speed	14.0	Knots
Average Consumption Sea	30	t/day
Average Consumption Port	4	t/day

Source: GHD based on Clarksons SIN

Charter Rates and Fuel Price

There is little consensus with respect to long term charter rate, as they are largely a function of supply and demand for a particular vessel class.

Despite the volatility that is present in the shipping market, the underlying commercial requirement of shipowner allow estimation of a likely long term rate for a vessel.

For the purposes of the analysis, four ship charter rates have been included.

1. International current 1 year timecharter rate (AUD 5,600 per day) – with current fuel rates ex Singapore (USD 150 per tonne)
2. Coastal current 1 year timecharter rate (AUD 11,333 per day) – with current fuel rates ex Singapore (USD 150 per tonne) The additional cost of coastal shipping is due to premium paid for Australian crew as required under Cabotage Law.
3. A charter rate estimated for a Supramax vessel using an underlying commercial requirement^ (see Appendix B), which seeks an average return over the life of the vessel, which takes into account the fluctuations in the charter market. The calculated rate is AUD31,807. In addition, the fuel rate applied is based on the long term average price of USD 600 per tonne
4. A coastal charter rate estimated for a Supramax vessel using an underlying commercial requirement, similar to (3) at AUD37,540. but with an applied premium for Australian Crew

^ Assuming a return of 15% over 20 years (see Appendix B)
* Braemar ACM Shipbroking - Weekly Scope 10 February 2016

Sailing time to the Brisbane will be approximately 3 days and which is considerable more than sailing to Melbourne (0.7 days)

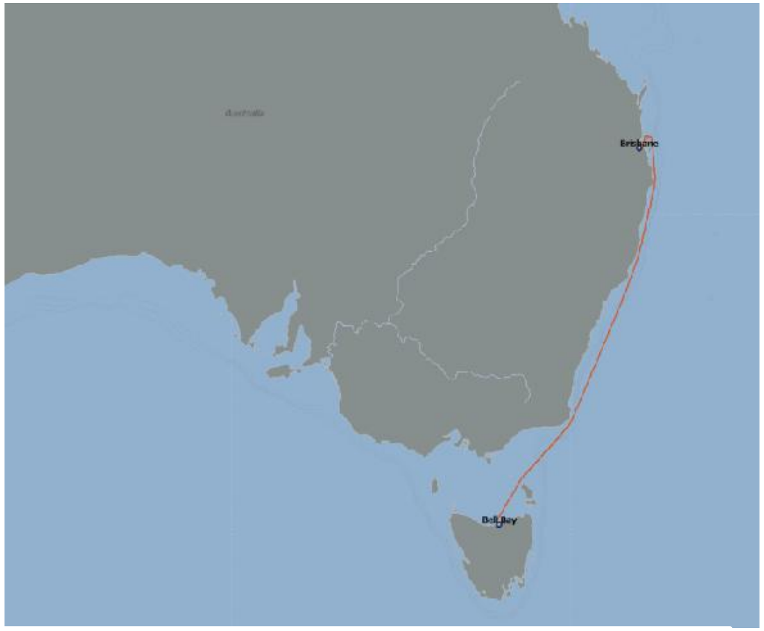
Distances and Duration
The sailing distance from Bell Bay to the various potential markets will have a direct impact to the delivery cost of the product, and the potential ability to sell to the market. Sailing distances have been sourced using Netpas*. An example of the routes used in the analysis are shown in Figure 9. The sailing time has been calculated for each destination, and are provided in Table 9. The journey time has been calculated to Sydney (1.5 days) and Melbourne (0.7 days).

Table 9: Sailing time and distance to product destinations

Markey Location	Nautical Mile (one way)	Trip Time - days (@ 14 knots)
NSW (Sydney Region)	512	1.5
Queensland (South East)	985	2.95
Victoria (Melbourne)	238	0.7

Source: Calculated using Netpas

Figure 9: Shipping Route - Brisbane



Source: Calculated using Netpas

* Source Calculated using Netpas

The volatility of the vessel charter rate will have a greater impact to the overall cost to deliver quarry products to market

Shipping Cost

Based on the charter rate and fuel cost assumptions described, and the distance between Bell Bay and destination ports, shipping costs have been estimated (inclusive of Tasports port charges). The outcomes are summarised in Table 10 below, where it can be seen that the there is a large disparity between current shipping rates, and that which is considered an appropriate market independent rate, based on a commercial return basis over the life of the vessel. As such, consideration must be given in any future financial analysis in the viability of the project on what impact a recovery in the shipping market may have on the project

Table 10: Shipping Cost per tonne

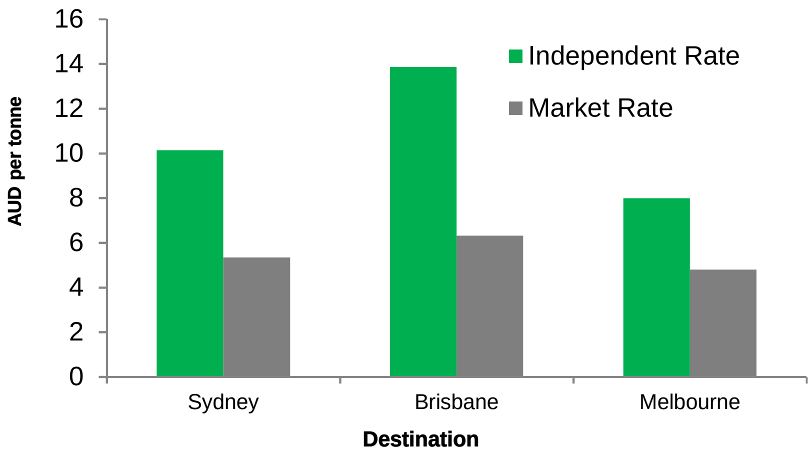
		Market Independent			Current Market		
Port Location	Port (Bell Bay)	Fuel (Ship)	Charter Rate	Total	Fuel (Ship)	Charter Rate	Total
Sydney Region	3.7	1.8	4.7	10.1	0.5	1.2	5.3
Brisbane	3.7	3.3	6.9	13.9	0.9	1.8	6.3
Melbourne	3.7	0.9	3.4	8.0	0.2	0.9	4.8

Source: GHD calculations

Charter Rate Influence to total Ship cost

The influence of the charter rate can have to the total cost is evident in Table 10. The direct comparison the different charter rates show a significant difference between estimated cost. The variation between cost is greater the longer the distance. This is evident Brisbane. For example the Brisbane is increased from $5 to $13/t (variation of $8/t), and Melbourne is increased from $5 to $8/t, which results in a much lower variation of only $3/t.

Figure 10: Long Term Estimate Shipping Cost



Source: GHD calculations

Transport and distribution cost

Combining the extraction and ship loading costs indicates that the comparative FOB cost will be between $12 and $21 per tonne

Landside Cost
The 10 Mtpa - double shift scenario is estimated to operate at the lowest cost, at approximately $12 per tonne – representative of an FOB cost. This low cost for the 10 Mtpa scenario is a result of a high utilisation of the extraction plant with double shifts and also a function of the scale of economies. The 5 Mtpa double shift scenario also benefits from the increase utilisation of the extraction plant, which operate at approximately $15 compared to the 5 Mtpa single shift scenario which operates at approximately $17 per tonne.

Table 11: Extraction Cost per tonne

	2.5 Mtpa Single shift	5.0 Mtpa Double shift	5.0 Mtpa Single shift	10 Mtpa Double shift
CAPEX	5.6	3.1	5.9	3.4
OPEX	7.2	7.2	6.5	6.1
Total	12.8	10.3	12.4	9.5

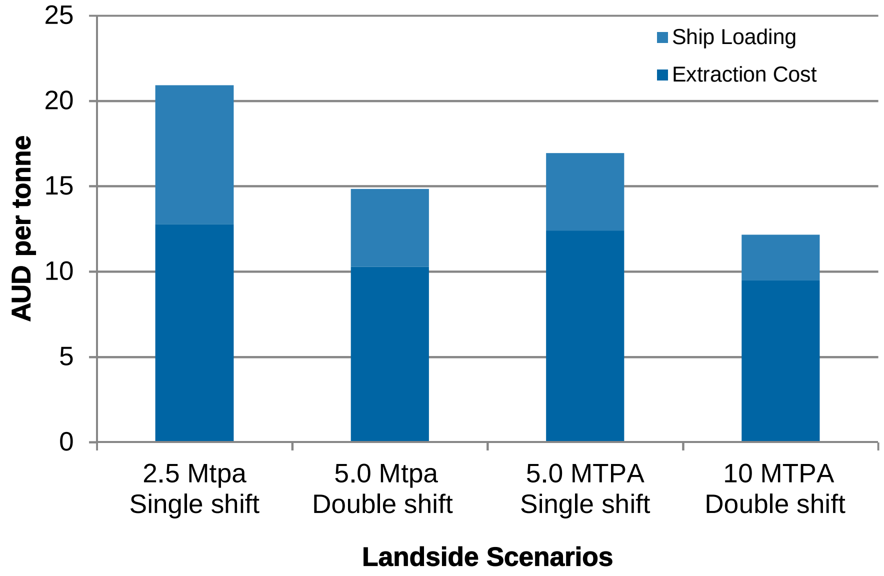
Source: GHD calculations

Table 12: Berth and Ship Loader Cost per tonne*

	2.5 Mtpa	5.0 Mtpa	10 Mtpa
CAPEX	5.9	2.9	1.5
OPEX	2.3	1.6	1.2
Total	8.1	4.6	2.7

Source: GHD calculations

Figure 11: Extraction and Ship loading - cost per tonne



Source: GHD calculations

*Cost is based on the $90M indicative capital estimate

The study has combined the FOB and the maritime costs to demonstrate a representative CFR rate to destination markets

Table 13: Extraction Cost (AUD per tonne)

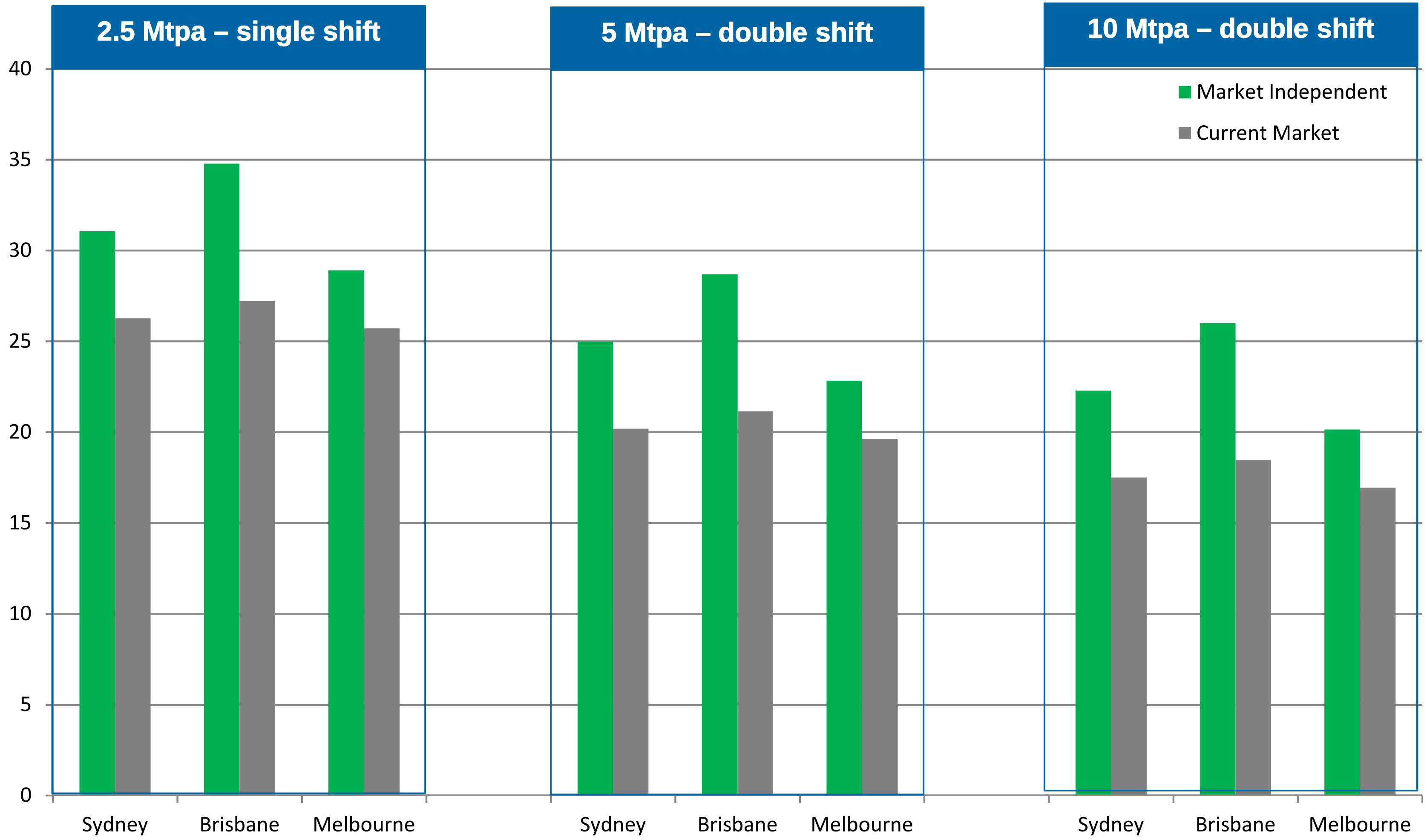
Destination	Extraction	Berth and Ship loader	Market Independent		Market Dependant	
			Shipping	Total	Shipping	Total
2.5 Mtpa - Single Shift						
Sydney Region	12.8	8.1	10.1	31.1	5.3	26.3
Brisbane	12.8	8.1	13.9	34.8	6.3	27.2
Melbourne	12.8	8.1	8.0	28.9	4.8	25.7
5.0 Mtpa – Double Shift						
Sydney Region	10.3	4.6	10.1	25.0	5.3	20.2
Brisbane	10.3	4.6	13.9	28.7	6.3	21.1
Melbourne	10.3	4.6	8.0	22.8	4.8	19.6
10.0 Mtpa – Double Shift						
Sydney Region	9.5	2.7	10.1	22.3	5.3	17.5
Brisbane	9.5	2.7	13.9	26.0	6.3	18.5
Melbourne	9.5	2.7	8.0	20.1	4.8	16.9

Source: GHD calculations

*cost is based on the $90M indicative capital estimate

Comparing the cost between the market independent and the current market scenarios demonstrate a variation between the logistics costs

Figure 12: Total Cost per tonne – Extraction to Destination



Source: GHD calculations

Considered markets - cost of aggregates

A comparison of the researched prices for 20 mm aggregates indicates that the Australian price for aggregates ranges from $30 to $50 per tonne

Comparison of Markets – International versus Domestic

Enquiries to date have identified that 20 mm aggregate (as the prime priced product) in South East Queensland are in the order of $25 to $35 a tonne, with pricing ex bin in Sydney at approximately $50 per tonne; however, there are likely to be significant discounts for large volume sales, with further savings, which are likely to be significant for the larger integrated concrete businesses..

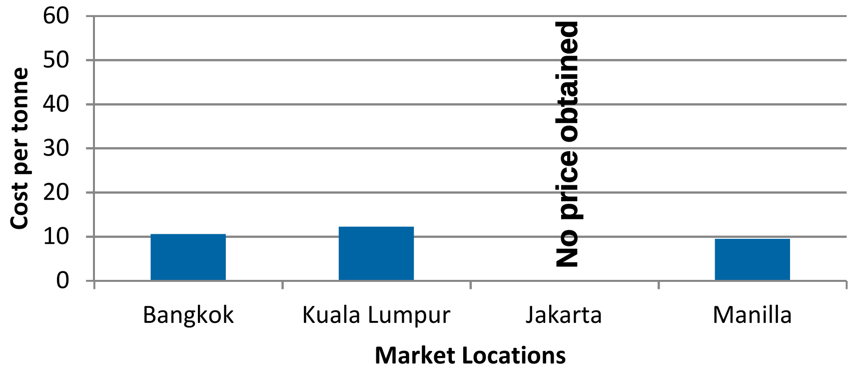
Anecdotal information suggests that there is typically a small variation between the capital cities at around 10%; however, the effect of supply and demand for aggregate in road construction and concrete influences the spot market price. For the purpose of the analysis pricing for Brisbane has been assumed at $30/t and Sydney at $50/t. Based of current levels of demand from construction activities a price of $40/t has been assumed for Melbourne – as the mid point between Brisbane and Sydney, for comparative purposes. When compared with Australian markets, Asian markets, the cost of aggregate is significantly lower (Figure 14), and based on the cost of production at Bell Bay, and arguably not penetrable as a regular supply destination. Analysis of Asian market competitiveness is provided in Appendix E.

Further market sounding is required to increase the level of confidence in the current and future market, particularly with the potential high level of demand for construction material in Sydney over the next 5 to 10 years.

Figure 13: Price of 20mm aggregate in target domestic markets

Source: Various industry sources

Figure 14: Price of 20mm aggregate in target international markets



Source: Various industry sources

Market potential

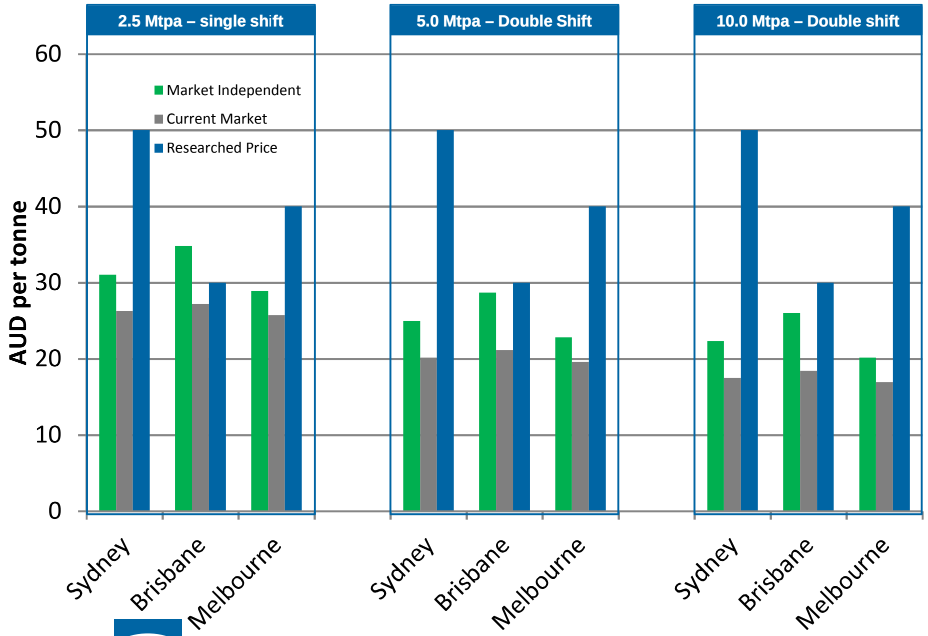
Based on the estimated supply cost of product from Bell Bay, there may be potential to access markets in Sydney and Melbourne

Domestic Price Competition

Comparing the identified domestic market prices with the estimated supply cost, Bell Bay product is potentially competitive in the domestic market (as per Figure 15), particularly Sydney and Melbourne The variation of price between the researched prices and estimated supply cost is provided in Figure 16. This shows that the Bell Bay product potentially has a buffer of up to $20 per tonne in Sydney, and up to $10 per tonne in the Melbourne market – which may be eroded by volume discounts. The buffer is low for Brisbane, and with potential correction in the shipping market, there is the potential for costs to exceed market price.

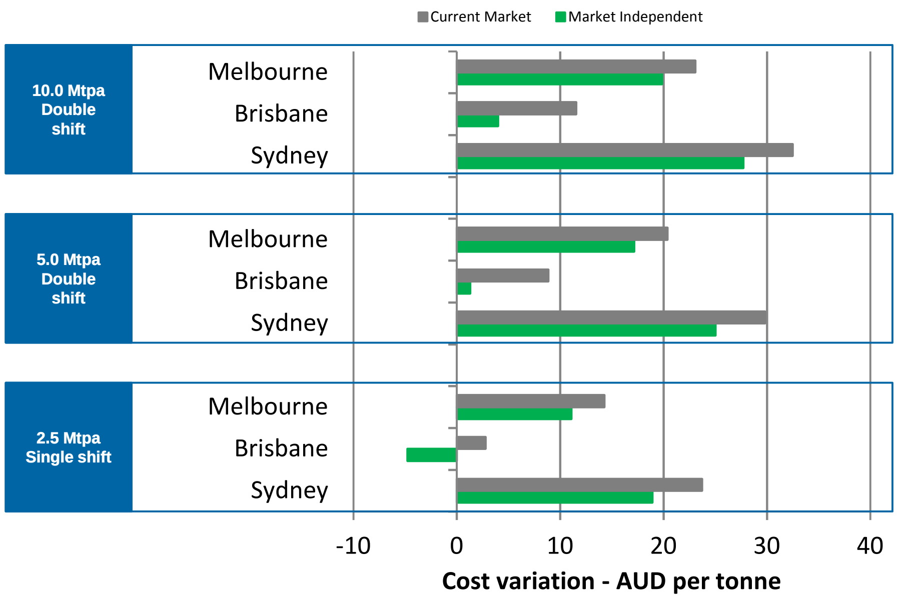
Despite the potential for export to Melbourne and Sydney, further market analysis is required, to identify the level of volume discount for large purchases, and potential customers for product, as large scale integrated businesses are unlikely to source material outside their supply chain. Furthermore, market sizing and potential downward price impacts from the injection of significant Bell Bay product into the market, may erode any potential margin, or create a price war between suppliers, where secured supply may be disrupted.

Figure 15: Side-by-side Comparison



Source: GHD calculations; Various industry sources

Figure 16: Variation between Sourced prices and Bell Bay Estimates



Source: GHD calculations; Various industry sources

GHD

Findings and next steps

Initial capital outlay for development of the dolerite resource at Bell Bay will be in the order of $160-270M for a scale of operation between 2.5-10 Mtpa with a processing cost of $9-11 per tonne

Findings and next steps

Based on the approach adopted in assessing options for the processing and export of quarry products from Northern Tasmania, numerous key findings and next steps were identified, these are:

- Assessment on the dolerite resource at Bell Bay primarily meets the Australian, Philippines, Indonesian, Malaysian and Thai standards, therefore presenting a range of potential market opportunities
- To meet benchmark production rates, the options of a 1,2000tph and 2,4000tph plant provided the ability to meet 2.5mtpa to 10mtpa through the use of single and double shifts.
- The level of capital required to establish the quarry operation is approximately $100M to achieve 5mtpa operation, and $179M to achieve 10mtpa
- The resulting cost of quarry operations (extraction) is estimated at $9-11 per revenue tonne based on a 24 hour operation – with a $2 per tonne cost premium to operate 12 hours per day. Under the 10 Mtpa scenario, the double shift operations generated the lowest cost of production, at approximately $9.50 per tonne
- Based on a review of potential terminal locations on the Tamar River, the preferred location is directly adjacent to the existing Woodchip Berth 1 facility formerly operated by Gunns Timber. As Gunns Timber is currently under administration, the disused wharf and associated land area may be obtainable. The ultimate location of the ship loading terminal and berth will depend on negotiations with infrastructure owners and the status of current agreements; however, there are potential alternatives nearby, including the former H.E.C. oil berth, to the North, but the potential for remediation works and associated costs and risks may be prohibitive
- To export product from Bell Bay to external markets, a ship loading terminal will need to be constructed. This will include a conveyor system from mine site to the terminal area, a stockpile and reclaimer, a ship loading conveyor, a replacement wharf structure and new ship loaders
- Potential capital costs for the berth and ship loaders range from $60M to $90M, excluding any required dredging. In consideration of these costs, the terminal and ship loading infrastructure will need to minimise dust, and the ship loading system will need to be enclosed.

The cost of processing and shipping to international markets from the Bell Bay resource is largely uncompetitive; however, there may be potential to access domestic markets in Sydney and Melbourne

Findings and next steps
• The cost of terminal operations is estimated at between \$3 and \$8 per tonne, driven by the economies of scale achieved in the terminal operation. At 10 Mtpa terminal cost, is estimated to be approximately \$2.70 per tonne. However, the high utilisation of a single berth operation may result in queuing or system stress due to a range of operational factors, such as weather or breakdowns • Cross-contamination mitigation through dust suppression will be a critical consideration for the storage and loading of product at the berth, particularly due to the proximity of current woodchip export operations and the need to minimise environmental impact on the Tamar River • To maximise shipping economies of scale, the maximum class vessel that can be handled at the facility is a Supramax of approximately 52,000 DWT. However, channel access restricts vessels to a draught of 11.5 meters. As a result, light loaded vessels will have a payload in the order of 47,500 cargo tonnes, and restricted to tidal movements only • The volatility of the vessel charter rate will have a greater impact to the overall cost to deliver quarry products to market, and the cost premium of using Australian crew for domestic shipping increases the charter rates paid for domestic markets as a result of Cabotage Law • A comparison of the researched prices for 20 mm aggregates indicates that the Australian price for aggregates is 3 to 5 times that of Asian sourced product. Enquiries to date have identified that 20 mm aggregate in South East Queensland are in the order of \$25 to \$35 a tonne, with pricing ex bin in Sydney at approximately \$50 per tonne; however, there are likely to be significant discounts for large volume sales, with further savings, which are likely to be significant for the larger integrated concrete businesses. • Bell Bay product appears to be potentially competitive in the domestic market, particularly Sydney and Melbourne. Analysis showed a potential buffer of up to \$20 per tonne in Sydney, and up to \$10 per tonne in the Melbourne market – which may be eroded by volume discounts. The price to cost buffer is low for Brisbane markets, and with likely correction in the shipping market, there is the potential for costs to exceed market price. • Despite the significant cost disadvantage for Bell Bay product supplied into regional Asian markets, potential may exist for one off supply contracts for specific construction projects, where the nature of the project is conducive with the quality and specifications of the Bell Bay product, and the purchaser is prepared to pay the price premium. The nature of this ad-hoc market is likely to be sporadic and opportunistic, rather than a secured supply arrangement with steady revenue streams.

Further work is required on market pricing and potential buyers due to the lack of visibility resulting from a highly integrated market before proceeding to detailed studies or business case development

Findings and next steps

Based on the findings of the analysis, a number of key next steps are suggested. These steps should be completed before progressing to pre-feasibility, financial analysis of the project and/or development of a business case. The next steps should be undertaken in two phases.

Phase 1:
A brief investigation (as an extension of this report) of potential alternative markets and products (including value add production), as well as potential cost savings to minimise start-up capital. The extension could include a brief investigation/assessment of:

- Market, pricing and competitive position for both Auckland NZ and Adelaide SA
- Investigation into the market, pricing and competitive position for Armour Rock and Gabion Stones
- Market, pricing and competitive position for pre-casting coastal defence blocks and/or concrete slabs
- The change from owned plant to leased mobile crushing equipment (limited to 5Mtpa)
- Potential for, and resulting cost savings from, reconfiguration of the berth to a single loader operation
- Potential, gains, and challenges associated with sourcing and installing a second hand transfer conveyor

Phase 2:
More detailed analysis on likely markets resulting from the analysis in this report, and potential additional market options identified in the Phase 1 extension investigation:

- Further market sounding to increase the level of confidence in the current and future market prices, particularly with potential high level of demand for construction material in Sydney over the next 5 to 10 years.
- Further market analysis is required, to identify the level of volume discount that is typical of the industry for large purchases, identification of potential customers for product, market sizing and an assessment/analysis of potential for downward price impacts from the injection of significant Bell Bay product into the market, which may erode any potential margin, or create a price war between suppliers.
- Engage with infrastructure owners and regulators to assess the potential and likely costs to secure access to berth and connected land infrastructure.

Appendix A – Summary of Aggregate Standard

Summary of Concrete Aggregate standards

Type of test	Specification Limits			Description
	Australian Standards AS2758.1	ASTM C33	EN 12620	
Los Angeles (LA) Abrasion Loss	≤30%	≤50%	≤30%	The amount of material lost to fines
Sodium Sulphate Soundness	Dependent on classification: Inland = A1 & A2 = <12% Coastal/tropical = B1 & B2 = <9% Tidal, spray or splash zones = C = <6%	<10%	Frost free region: n/a Salty conditions: <4%	The resistance to drying and wetting cycles of sea water or saturated air
Fine (<5mm) & Coarse (≥5mm) Aggregate Particle Density	<3.2T/m^3 & ≥2.1T/m^3	>2.4T/m^3	>2.0T/m^3	Ratio of the weight of a given volume of aggregate to the weight of an equal volume of water
Water Absorption	No defined limit but needs to be considered in cement mix design	No defined limit but needs to be considered in cement mix design	≤1.0%; however the standard mentions that values in excess of 4% have been shown to have adequate freeze-thaw resistance	The increase in weight due to water contained in the pores of the material
Materials finer than 75µm	≤4%	3% for concrete subject to abrasion 5% for all other concrete	≤4%	The amount of ≤75µm material naturally present or produced by crushing
Wet Strength Dry strength Wet/Dry variation	≥100kN >150kN ≤25%	n/a	n/a	Durability test used in Australian Standards
Particle Shape 2:1 and 3:1	≤35%	n/a	n/a	Particle shape used to identify variation from cubic pieces
Clay lumps and friable particles	n/a	Negligible weathering regions: 1N – Slabs subject to traffic abrasion, bridge decks, floors, sidewalks, pavements: 5% 2N – All other classes of concrete: 10%	n/a	ASTM requirement used to determine an approximation of clay lumps and friable particles in aggregates
Polished Aggregate Friction Value (PAFV)	≥44	n/a	≥44	A friction test that determines the susceptibility to polishing
Chlorides	Reported if >0.01%	n/a	No defined limit; at request	Chloride ion content
Sulphates	Reported if >0.01%	n/a	No defined limit; at request	Sulphate ion content

Appendix B – Aggregate Cost (Market Analysis)

Market Analysis - International

Country	Product	Cost per Tonne	Exchange Rate	Cost AUD	Reference
Thailand (Bangkok)	0-25mm and 50mm road base	190 - THB	0.039	7.4	http://www.aggbusiness.com/sections/quarry-profiles-reports/features/thai-construction-boom-drives-quarry-quality/
	Course Aggregate; 20mm	270 - THB	0.039	10.5	http://www.kpkqs.com/download/annual/unit_rates/material_labour_prices80_86.pdf
Malaysia (Kuala Lumpur)	Aggregate 3/4"	12.3 - RM	0.330	4.1	https://www.cidb.gov.my/web_backup/cidbv4_280815/images/pdf/n3c/BMP2013/publication%20bahagian%201_bahan%20_kuala%20lumpur_-2.pdf
	Course Aggregate; 20mm	37 - RM	0.330	12.2	http://www.kpkqs.com/download/annual/unit_rates/material_labour_prices80_86.pdf
Indonesia (Jakarta)					
Philippines (Manilla)	Subbase	225 - php	0.029	6.5	GHD Source
	for Base course	275 - php	0.029	8.0	GHD Source
	Fine Aggregates	325 - php	0.029	9.4	GHD Source
	Crushed Aggregates ¾"	325 - php	0.029	9.4	GHD Source
	Crushed Aggregates 3/8”	325 - php	0.029	9.4	GHD Source
	Crushed Aggregates G-1	325 - php	0.029	9.4	GHD Source

Appendix C – Supply chain operations and cost

GHD

Extraction – Fixed Cost Estimates & Amortized Cost per tonne

Planning and Approval	2.5 MTPA Single shift	5.0 MTPA Double shift	5.0 MTPA Single shift	10 MTPA Double shift
Quarry development and closure plan	130,000	182,000	182,000	260,000
Development Proposal and Environmental Management Plan (DPEMP)	650,000	910,000	910,000	1,300,000
Total	**780,000**	**1,092,000**	**1,092,000**	**1,560,000**
Quarry Development				
Clearing	0	0	0	0
Stripping, stockpiling and build bund	697,388	1,220,429	1,220,429	2,353,684
Access Road	780,000	780,000	780,000	780,000
Haul roads	780,000	1,014,000	1,014,000	1,404,000
Hard stand stockpile areas	2,600,000	3,412,500	3,412,500	4,129,412
Site facilities	3,250,000	3,900,000	3,900,000	5,200,000
Power Supply and lighting	1,105,000	1,560,000	1,560,000	1,950,000
Water Supply	1,092,000	1,092,000	1,092,000	1,092,000
Dam	3,900,000	5,850,000	5,850,000	7,800,000
Quarry closure	1,394,776	2,440,858	2,440,858	4,707,368
Total	**15,599,164**	**21,269,787**	**21,269,787**	**29,416,464**
Plant Capital				
Mobile Plant	12,665,900	12,665,900	23,193,300	23,193,300
Primary	6,968,000	6,968,000	13,936,000	13,936,000
Secondary	6,968,000	6,968,000	12,831,000	12,831,000
Tertiary	3,445,000	3,445,000	6,890,000	6,890,000
Screening	8,450,000	8,450,000	16,900,000	16,900,000
Stockpiling	3,250,000	3,250,000	4,680,000	4,680,000
Civils, Electrical,	26,000,000	26,000,000	52,000,000	52,000,000
Transfer to port	11,245,000	11,245,000	18,525,000	18,525,000
Total	**78,991,900**	**78,991,900**	**148,955,300**	**148,955,300**
Grand Total	**95,371,064**	**101,353,687**	**193,678,873**	**210,908,229**

Source: GHD based on industry sources

Production Volume per Scenarios - Mtpa

Scenario	Total Volume 10 Years	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
2.5 Mtpa	23	1	2	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
5.0 Mtpa	44.5	1.5	3	5	5	5	5	5	5	5	5
10.0 Mtpa	84	2	4.5	7.5	10	10	10	10	10	10	10

GHD

Amortized CAPEX cost per tonne - 10 years @ 6%

Calculation - charter Rate for Supramax

Bareboat Costs and Assumptions

Bareboat Cost	Values	
Capital Cost	35,500,000	USD
Exchange Rate	1.40	AUD/USD
Capital Cost	49,700,000	AUD
Period	20	years
Margin	15%	
Annual Rate	7,940,145	AUD
Daily Rate (Bareboat)	**22,366.61**	**AUD**

Source: GHD calculations based on industry sources

Note: The Australian charter rate assumes an uplift of AUD5,733 to represent an increase for Australian crew coastal vessel

International Operating Assumptions

Manning and Opex assumptions	USD	AUD
Manning	2,950	4,130
H&M Insurance	717	1,003
P&I Insurance	385	539
Repairs & Maintenance	878	1,230
Stores / Supplies / Spares	960	1,344
Mgt. & Admin	853	1,195
Total	**6,743**	**9,441**

Source: GHD calculations; Various industry sources

Domestic Operating Assumptions

Manning and Opex assumptions	AUD
Manning	9,863
H&M Insurance	1,003
P&I Insurance	539
Repairs & Maintenance	1,230
Stores / Supplies / Spares	1,344
Mgt. & Admin	1,195
Total	**15,174**

Source: GHD calculations; Various industry sources

Independent Charter Rates

Charter Rate	AUD
International	31,807
Domestic	37,540

Source: GHD calculations; Various industry sources

Vessel Sailing and Cycle Times

Supramax parameters

Ship Parameters		
Vessel DWT	52,000	tonnes
Cargo Tonnes	47,465	tonnes
GRT	30,000	tonnes
Service speed	14	knots
Average Consumption Sea	29.8	t/day
Average Consumption Port	4	t/day

Source: Clarksons SIN

Vessel Loading and Unloading Assumptions

Ship loading		
Ship load and Unload rates	2000	tph
Pre and Post, and Changeover	10.5	hours
Total Time at Bell Bay	1.43	Days
Total Time at Destination Port	1.43	days
Fuel consumption	11.4	tonnes

Source: GHD assumptions and calculations

Vessel Sailing Time

Port Location	Nautical Mile (one way)	Return Journey Duration (Days)	Fuel Consumption (t)
Bangkok	4,186	29	866
Kuala Lumpur	4,318	30	893
Jakarta	3,456	24	714
Manilla	4,386	30.4	908
Sydney Region	512	3.6	107
Brisbane	985	6.8	202
Melbourne	238	1.6	51

Source: Calculated using Netpas

Bell Bay Port Charges

Schedule of Charges

Charge Types	Rate (AUD)	
Bulk Cargo (Wet or Dry)	2.67	Per tonne
Pilotage		
Fixed Charge	1750	per Pilotage
GRT charge	0.11	per pilotage per GRT
Tonnage		
First Day	0.55	per GRT
Each Subsequent day	0.14	per GRT
Lay-up Charges	0.14	per GRT per day
Tug		
Base Rate	1200	fixed
GRT	0.4	GRT

Source: Tasports tariffs

Port Charges for Supramax

Port Charge Summary	AUD
Bulk Cargo (Wet or Dry)	126,731
Pilotage	10,102
Tonnage	18,295
Lay-up Charges	5,992
Tug	13,203
Total	**174,322**
Cost per tonne	**3.70**

Source: GHD calculations

New Ship loading Facility and berth Structure

Preliminary estimates for a new berth and material handling (ship loading) infrastructure to replace WC1 has been estimated as $60M to $90M. Assuming a mine life of 10 years and index rate of 7.5% the estimated cost per tonnes have been calculated, and are shown below:

Berth and Loading Facility Cost ($ per tonne)

		2.5 Mtpa	5 Mtpa	10 Mtpa
Low Estimate	$60 M	3.50	1.75	0.87
High Estimate	$90 M	5.24	2.62	1.31

Source: GHD estimates and calculations

New Ship loading Facility and berth Structure

Preliminary estimates for a new berth and material handling (ship loading) infrastructure to replace WC1 has been estimated as $60M to $90M. Assuming a mine life of 10 years and index rate of 10% the estimated cost per tonnes have been calculated, and are shown below:

Table: Berth and Loading Facility Cost (AUD per tonne)

	CAPEX	2.5 Mtpa	5 Mtpa	10 Mtpa
Low Estimate	$60 M	3.91	1.95	0.98
High Estimate	$90 M	5.86	2.93	1.46

Source: GHD estimates and calculations

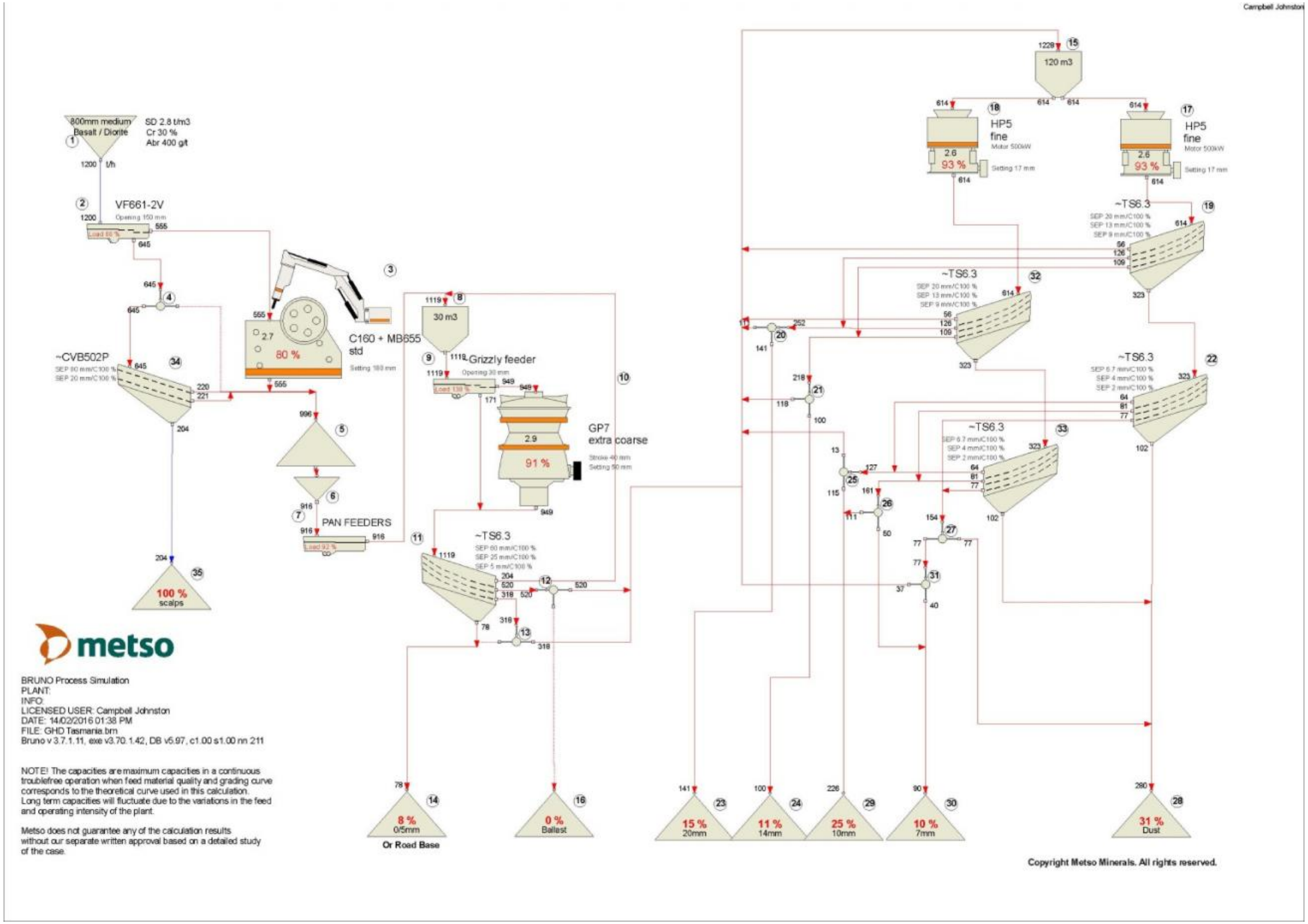
Table: Operating Cost

	2.5 Mtpa	5 Mtpa	10 Mtpa
Maintenance	$ 1,800,000	$ 1,800,000	$ 1,800,000
Workforce	$ 3,437,230	$ 5,474,108	$ 8,784,033
Power	$ 132,475	$ 264,950	$ 529,900
Other Overheads	$ 356,971	$ 573,906	$ 931,393
Total	$ 5,726,676	$ 8,112,963	$ 12,045,327
Cost per tonne	$ 2.29	$ 1.62	$ 1.20

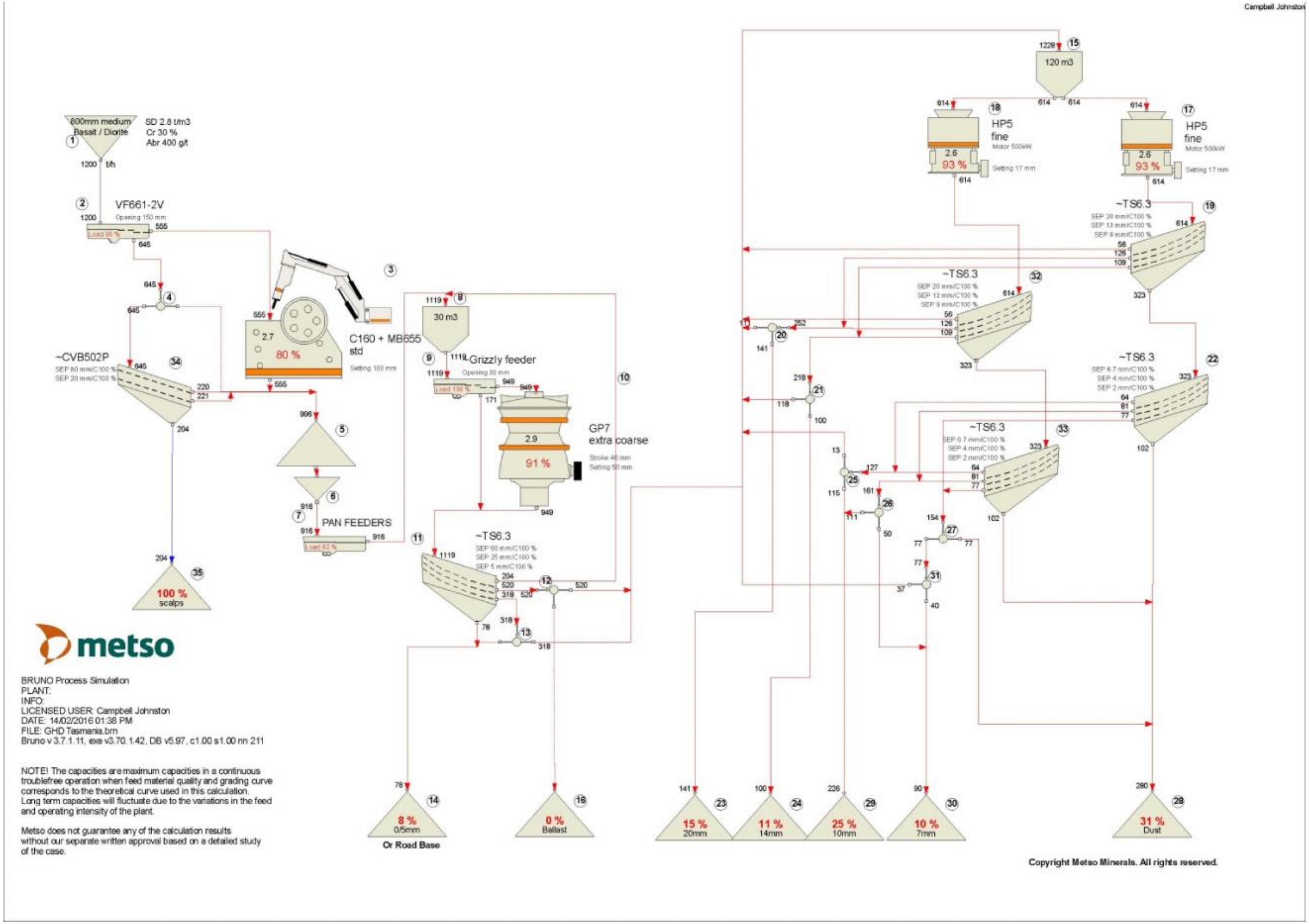
Source: GHD estimates and calculations

Appendix D – Crushing and Screening Plant Schematic

1,200 TPH Crushing and Screening Plant Schematic Capacity of 2.5 Mtpa or 5Mtpa (double shift)



2,400 TPH Crushing and Screening Plant Schematic Capacity of 5 Mtpa or 10Mtpa (double shift)



Appendix E – Assessment of Asian Market Competitiveness

GHD

Sailing time to the international market will be approximately 12 to 15 days and sailing to domestic markets will be less than 3.5 days

Distances and Duration

The sailing distance from Bell Bay to the various potential markets will have a direct impact to the delivery cost of the product, and the potential ability to sell to the market.

Sailing distances have been sourced using Netpas*. An example of the routes used in the analysis are shown in Figure 9 and Figure 10.

The sailing time has been calculated for each destination, and are provided in Table 6. The sailing time to the international destination ranges from 10 to 13 days. The longest journey time is to Manilla which is estimated at 13.05 days, which on a return journey, would limit each vessel to one cycle per month.

Sailing time and distance to product destinations

Markey Location	Nautical Mile (one way)	Trip Time - days (@ 14 knots)
Thailand (Bangkok)	4,186	12.45
Malaysia (Kuala Lumpur)	4,318	12.85
Indonesia (Jakarta)	3,456	10.3
Philippines (Manilla)	4,386	13.05

Source: Calculated using Netpas

Shipping Route - Manila

Source: Calculated using Netpas

The volatility of the vessel charter rate will have a greater impact to the overall cost to deliver quarry products to market

Shipping Cost

Based on the charter rate and fuel cost assumptions described, and the distance between Bell Bay and destination ports, shipping costs have been estimated (inclusive of Tasports port charges). The outcomes are summarised in Table 7 below, where it can be seen that the there is a large disparity between current shipping rates, and that which is considered an appropriate market independent rate, based on a commercial return basis over the life of the vessel. As such, consideration must be given in any future financial analysis in the viability of the project on what impact a recovery in the shipping market may have on the project

Shipping Cost per tonne

		Market Independent			Current Market		
Port Location	Port (Bell Bay)	Fuel (Ship)	Charter Rate	Total	Fuel (Ship)	Charter Rate	Total
Bangkok	3.7	13.3	18.6	35.6	3.4	2.3	9.5
Kuala Lumpur	3.7	13.7	19.1	36.5	3.5	2.4	9.6
Jakarta	3.7	11.0	15.7	30.4	2.9	2.0	8.5
Manilla	3.7	14.0	19.4	37.0	3.6	2.4	9.7

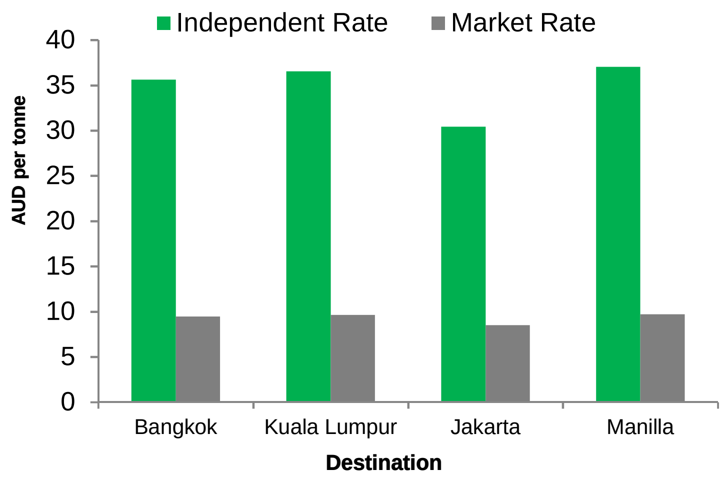
Source: GHD calculations

Charter Rate Influence to total Ship cost

The influence of the charter rate can have to the total cost is evident in Table 7. The direct comparison the different charter rates show a significant difference between estimated cost. The variation between cost is greater for the international haul.

For example the Bangkok shipping cost is estimated to be $8.9/t based on the current market, and is increased to $36/t when considering the long term rate (a variation of $27/t).

Long Term Estimate Shipping Cost



Source: GHD calculations

The study has combined the FOB and the maritime costs to demonstrate a representative CFR rate to destination markets

Extraction Cost (AUD per tonne)

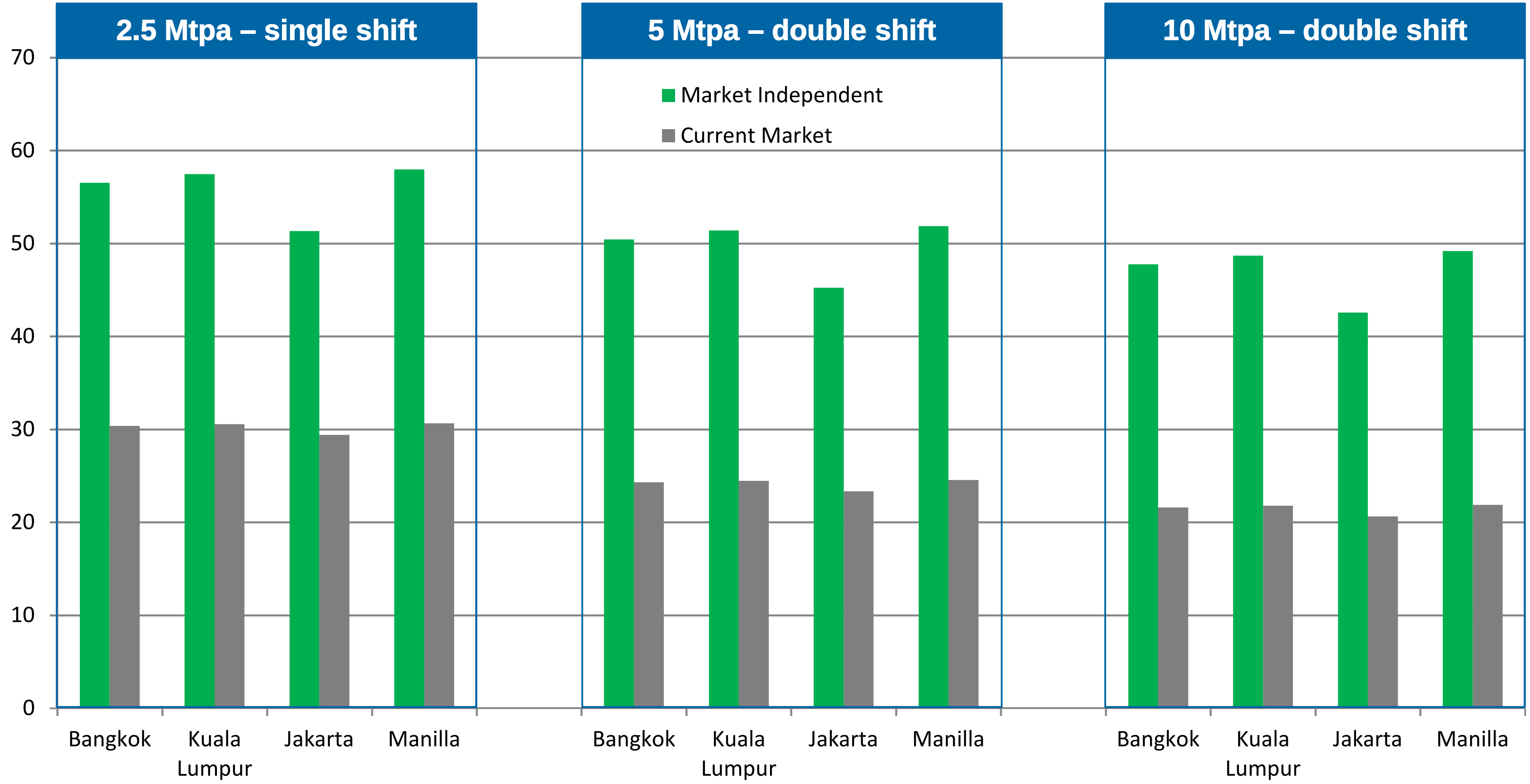
Destination	Extraction	Berth and Ship loader	Market Independent Shipping	Market Independent Total	Market Dependant Shipping	Market Dependant Total
2.5 Mtpa - Single Shift						
Bangkok	12.8	8.1	35.6	56.5	9.5	30.4
Kuala Lumpur	12.8	8.1	36.5	57.5	9.6	30.5
Jakarta	12.8	8.1	30.4	51.3	8.5	29.4
Manilla	12.8	8.1	37.0	58.0	9.7	30.6
5.0 Mtpa – Double Shift						
Bangkok	10.3	4.6	35.6	50.4	9.5	24.3
Kuala Lumpur	10.3	4.6	36.5	51.4	9.6	24.5
Jakarta	10.3	4.6	30.4	45.2	8.5	23.3
Manilla	10.3	4.6	37.0	51.9	9.7	24.6
10.0 Mtpa – Double Shift						
Bangkok	9.5	2.7	35.6	47.8	9.5	21.6
Kuala Lumpur	9.5	2.7	36.5	48.7	9.6	21.8
Jakarta	9.5	2.7	30.4	42.6	8.5	20.6
Manilla	9.5	2.7	37.0	49.2	9.7	21.9

Source: GHD calculations

*cost is based on the $90M indicative capital estimate

Comparing the cost between the market independent and the current market scenarios demonstrate a large variation between the international logistics costs

Total Cost per tonne – Extraction to Destination



Source: GHD calculations

Research identified the cost of aggregates in potential international markets with prices ranging from $5 to $12 per tonne

International Markets

The desktop analysis found that most production companies do not readily publish the cost of their products, and as such available information was limited. The study therefore has relied on internal international GHD resources, as well as the available information published in the public domain. The references used are provided in Appendix B.

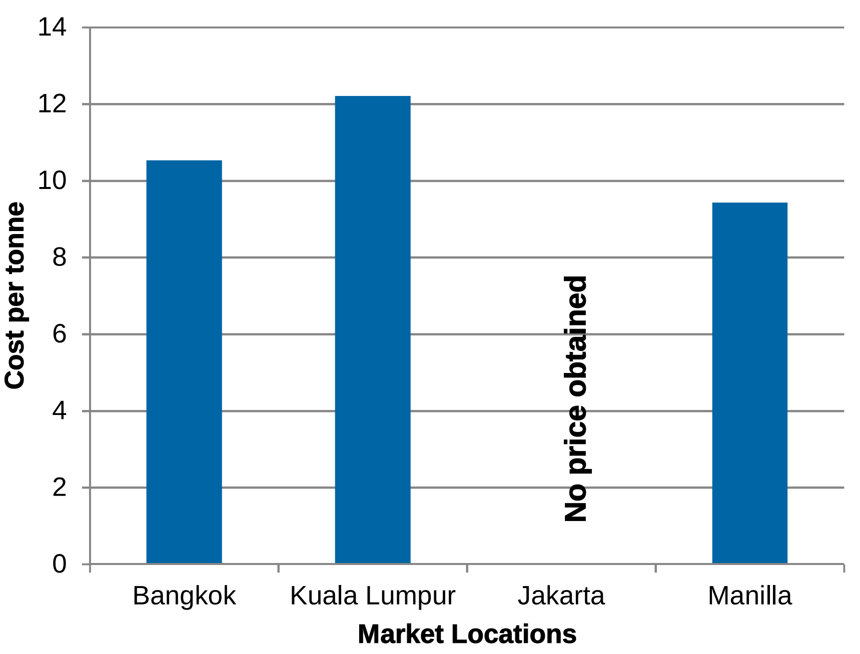
As shown in Table 11, prices in Asian target markets are low, with higher value 20mm aggregates ranging from AUD9-12 per tonne.

Price of aggregate in target markets

Country	Product	Cost AUD per tonne
Thailand (Bangkok)		
	5mm to 25mm and 50mm road base	7.41
	Granite; Course Aggregate; 20mm	10.53
Malaysia (Kuala Lumpur)		
	Granite Aggregate 3/4"	4.06
	Granite; Course Aggregate; 20mm	12.21
Indonesia (Jakarta)		
	No pricing obtained	
Philippines (Manilla)		
	Aggregate for subbase	6.53
	Aggregate for Base course	7.98
	Fine Aggregates	9.43
	Crushed Aggregates ¾"	9.43
	Crushed Aggregates 3/8"	9.43
	Crushed Aggregates G-1	9.43

Source: Various industry sources

Price of 20mm aggregate in target markets



Source: Various industry sources

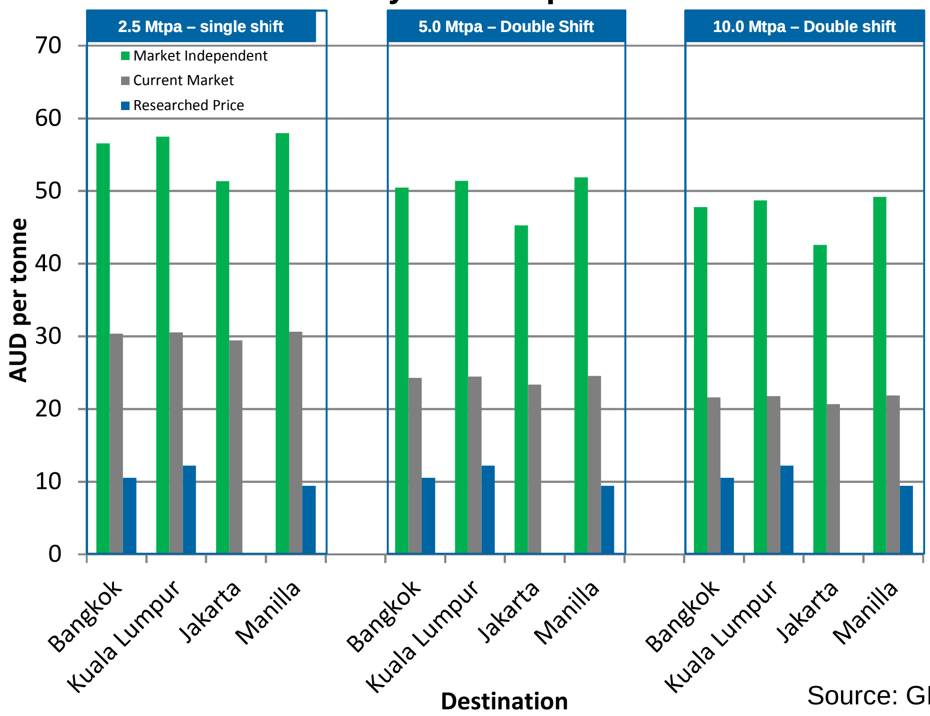
Based on the estimated supply cost of product from Bell Bay, there appears to be little potential for international markets in Asia due to the very low cost of supply within the region

International Price Competition

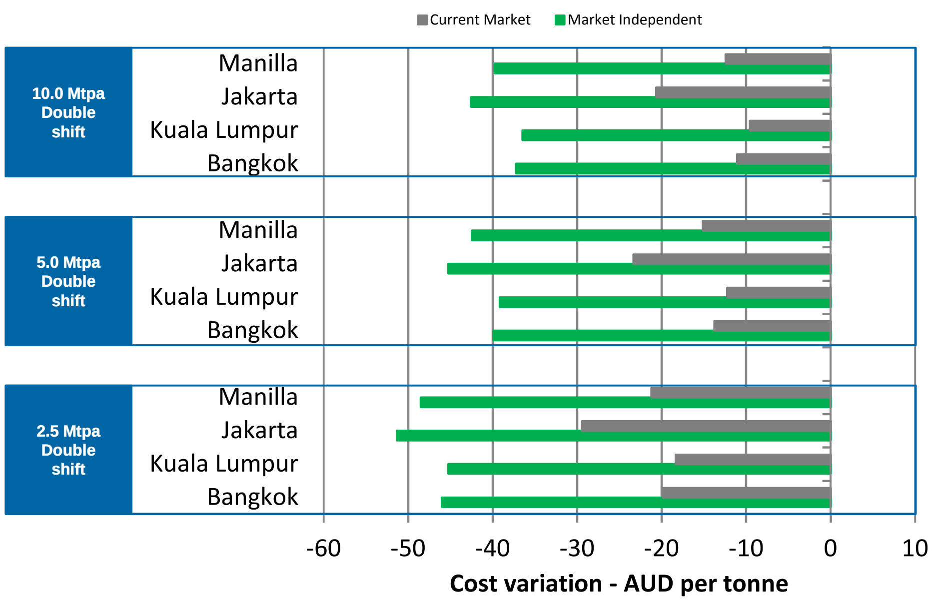
Comparing the identified regional Asian market prices with the estimated supply cost, Bell Bay product does not appear competitive (as per Figure 17). The variation of price between the researched prices and estimated supply cost is provided in Figure 18. This shows that the Bell Bay product is current $15 to $20 per tonne (100% to 200%) higher than local supply, with the potential to be $35 to $50 per tonne more expensive, if shipping markets correct.

Despite the significant cost disadvantage for Bell Bay product supplied into regional Asian markets, potential may exist for one off supply contracts for specific construction projects, where the nature of the project is conducive with the quality and specifications of the Bell Bay product, and the purchaser is prepared to the price premium. The nature of this ad-hoc market is likely to be sporadic and opportunistic, rather than a secured supply arrangement with steady revenue streams.

Asian market Side-by-side Comparison



Variation between Sourced prices and Bell Bay Estimates



Source: GHD calculations; various industry sources

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Pacific Basin Bluestone Pty Ltd

Processing and export of aggregates from Northern Tasmania – Phase 1 Additional Task Analysis

Final Report

July 2016

Table of contents

Appendices

1. Introduction and key conclusions

1.1 Purpose of this report

The purpose of this report is to address 'Phase 1 Next Steps' identified in the "Preliminary Analysis Options for the potential processing and export of aggregates from Northern Tasmania" prepared by GHD, which for the purposes of this report is referred to as 'The Initial Study'.

The Initial Study assessed the potential cost for extracting and exporting Dolerite aggregates from Bell Bay and distributing to mainland Australian and, to a limited extent, potential Asian markets. This report, as an extension to the initial work, provides extended consideration of additional target markets, alternative product options, and key changes in plant assumptions, and, as such, must be read in conjunction with The Initial Study.

The level of analysis undertaken in this study is intended to provide some insight into the potential for additional markets, alternate products, and value-add processing/manufacturing that were not considered in The Initial Study. As such, the level of analysis undertaken is limited, incorporating the following tasks:

- A brief investigation into the market, pricing and competitive position for both Auckland, NZ, and Adelaide, SA
- A brief investigation into the market, pricing and competitive position for Armour Rock and Gabion Stones. This includes defining and estimating costs for changed infrastructure, materials handling and transport logistics
- A brief investigation into the market, pricing and competitive position for pre-casting coastal defence blocks and/or concrete slabs. This includes defining and estimating costs for additional plant, additional inputs, changed infrastructure, materials handling and transport logistics
- A high level cost assessment for the change from owned plant to leased mobile crushing equipment (limited to 5mtpa)
- A high level description and assessment of the potential for, and resulting cost savings from, reconfiguration of the berth to a single loader operation
- Brief discussion on the potential gains and challenges associated with sourcing and installing a second hand transfer conveyor from the quarry to the ship loading terminal

In addressing the above tasks, the report is structured to consolidate the tasks into three main sections, namely: **Alternate products and Initial Project Focus**, where production and resulting costs for different target rock products and pre-casting concrete are addressed; **Additional market locations**, which investigates aggregate potential for Adelaide and Auckland; and **Reducing capital**, which assess the potential for leasing plant, and reducing capital. This report concludes with a **summary of capital and operating costs by quarry operation type**, and **key findings and suggested next steps**, to be included with the Phase 2 actions identified in The Initial Study.

1.2 Limitations

This report has been prepared by GHD for Pacific Basin Bluestone Pty. Ltd. and may only be used and relied on by Pacific Basin Bluestone Pty. Ltd. for the purpose agreed between GHD and Pacific Basin Bluestone Pty. Ltd. as set out in GHD's proposal dated 4 April 2016.

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The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out. The opinions and conclusions in this report are based on conditions encountered and information reviewed at the date of preparation of the report.

GHD disclaims liability arising from any of the assumptions being incorrect. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared. GHD has prepared this report on the basis of information provided by Pacific Basin Bluestone Pty. Ltd. and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

GHD has prepared indicative order of magnitude only transport costs in this report ("Cost Estimate") using information reasonably available to the GHD employee(s) who prepared this report; and based on assumptions and judgements. The Cost Estimates (in Australian Dollars) have been prepared for the purpose of preliminary analysis of cost competitiveness and must not be used for any other purpose. The Cost Estimates are an indicative estimate only. Actual prices, costs and other variables may be different to those used to prepare the Cost Estimate and may change. Unless as otherwise specified in this report, no detailed quotation has been obtained for actions identified in this report. GHD does not represent, warrant or guarantee that the transport costs can or will be undertaken at a cost similar to the Cost Estimate.

1.3 Summary of key conclusions

Based on consideration and assessment of both The Initial Study and the Phase 1 actions (addressed in this report), a number of key conclusions have been drawn on the potential for a quarry development located at Bell Bay in Northern Tasmania. In order to exploit natural competitive advantage (the unique position of being a coastal quarry with nearby access to existing port facilities), and provide the ability to meet market demand in a highly integrated industry, the quarry development, and subsequent studies should consider:

- A flexible plant operation and diversified product range, with a start-up focus on alternate rock products (armour rock and gabion stone) in addition to aggregate
- The use of leased plant in the initial operations to minimise upfront capital and time to commence operations
- Undertake a phased development approach to the project, with an initial small volume Phase 1 operation, growing through expanded Phase 2 and Phase 3, with commercially defined trigger points based on market size and realisation of product demand for quarry products
- Exploit the advantages of a small start-up volume with a low up-front capital cost requirement (through leased plant and use of existing berthing facilities) to establish a market presence, generate initial project cash flow, as well as minimise commercial risk exposure
- New identified aggregate markets in NZ, in addition to Melbourne and Sydney
- Target key strategic positioning opportunities for the supply of quarry products (and potentially value-add concrete products) for coastal protection and rehabilitation projects (for armour rock, coastal protection blocks, and gabion stones) on the Australian east coast – particularly after recent events in Collaroy.

In addition to the above points, the findings of this report (which must be read in conjunction with The Initial Study), and recommended actions for next steps in evaluating the feasibility of the quarry project are outlined in Section 6.

2. Alternate Products and Initial Project Focus

It was identified in The Initial Study that one of the key challenges for penetrating the aggregates market was the high level of vertical integration in the aggregate value chain, particularly, where quarry operators internally supply aggregates for downstream value-add processes, such as concrete production.

Despite the challenges this may present with respect to market penetration for aggregates, and the likely inability to disrupt these operations or supply lines, there are potential market opportunities that may present due to other operators limited production flexibility. This is largely due to the largely locked internal supply arrangements, which are committed during periods of peak demand for value-add products, and the difficulty/lost time resulting from plant reconfiguration – especially non-standard products. As such, market potential may exist for[1]:

- **Armour rock** – as a primary blast product that achieves high production rates for the level of processing required.
- **Gabion stones** – as a primary crushed product, which has minimum processing requirements, and therefore lower costs
- **Pre-cast products** – as an on-site value-add process to produce coastal defence blocks, slabs, and/or any other desired form of cast concrete, such as railway sleepers, bridge sections and the like.

While there are some common elements in the quarry operations, the materials handling system, storage requirements, and ship loading operation will be different for these products. In particular:

- **Armour rock** – large rocks are not suitable for conveyor transfer, and cannot be transferred across a specialised dry bulk berthing arrangement. Therefore, the transport system for Armour rock would involve the use of Front End Loaders, cranes and barges across a general wharf or similar, and handled at a much reduced rate. It would be expected that armour rock would therefore be transferred to Bell Bay port facilities by road and loaded upon sea-going barges or Multi-Purpose Vessels.
- **Gabion stones**[2] – 150-200mm rocks can be transferred by conveyor (beyond the plant), but are not typically transported longer distances by conveyor due to the lower throughput volume. Therefore, the transport system for Gabion stones at Bell Bay would involve the use of Front End Loaders, cranes with grabs or similar, and loaded upon MPVs across a general wharf. It would be expected that gabion stone would therefore be transferred to Bell Bay port facilities by road.
- **Pre-cast products** – large objects of various shapes, sizes and mass, that are not suitable for conveyor transfer, and cannot be transferred across a specialised dry bulk berthing arrangement. Therefore, the transport system for pre-cast products would involve the use of cranes and MPVs across a general wharf, and handled as a breakbulk product. It would be expected that pre-cast products would therefore be transferred to Bell Bay port facilities by road and loaded upon sea-going barges or Multi-Purpose Vessels by crane depending on product, consignment size and destination

[1] The potential to produce manufactured sand is not included within the scope of this study.
[2] Clean stone washed and used with baskets to create retaining walls and also used in river embankments.

With the focus on alternate products, which are more suited to general wharf operations, it is likely that redevelopment of a bulk handling facility (approximately $90M) is not required, substantially reducing the upfront capital commitment for the project. However, a batching plant and additional land for curing will be required, as the volume of aggregate exports is likely to be lower.

To enable the export of aggregates a range of non-permanent materials handling options are available, including the use of ships gear, a wharf crane with grabs, both of which are most likely available at the Bell Bay terminal, or alternatively a mobile radial loader, such as a Telestacker, are likely to be suitable, and with low capital outlay.

2.1 Indicative cost assessment of alternative operations

2.1.1 Operational assumptions – rock products

A defined 'potential' quarry operation has been developed for costing and subsequent analysis with a focus on extraction and production of alternative products (Armour Rock and Gabion stones). The different nature of this type of operation, when compared to an operation that targets aggregate production (as done in The Initial Study), has both different handling requirements, and different plant due to lower production volumes (assumed to be mobile plant). For the purposes of the analysis, a maximum capacity of 2.5mtpa is assumed, comprising:

- 6 days per week operation;
- 2 shifts per day;
- 2 x primary crushers;
- 1 x secondary crusher;
- 2 x double deck intermediate screens;
- 2 x tertiary crushers; and
- 1 x triple deck final product screen

The plant configuration is based on the schematic of operation provided in Appendix A.

2.1.2 Production levels

For the purposes of estimating a likely cost of production to target alternative products, three production levels have been considered. These include:

- **2.5mtpa** – High plant utilisation with 24 hour operations (As per Section 3.1.1)
- **1.25mtpa** – High plant utilisation with 12 hour operations (As per Section 3.1.1)
- **0.25mtpa** – Small scale operation with 12 hour operations (Scaled to single units only)

2.1.3 Cost of production

The Cost of Production (COP) has been developed for each scenario based on several key assumptions, particularly with respect to the life of plant and write-down value. For the purposes of the analysis, the COP assumes that the plant is written off completely over the analysis time frame (5 years and 10 years). However, there is likely to be a residual value of plant, which would reasonably be:

- **2.5mtpa** - full replacement each 5 years
- **1.25mtpa** - largely written down at 5 years with 15,000 hrs of operation (still has value with load and haul plant)

- **0.25mtpa** - less than 5,000 hrs of operation in 5 years (fully maintained value approximately 50%)

Other assumptions

- Financing rates as per the assumptions stated in The Initial Study
- Operating costs as provided by Metso
- The COP is based on the average cost per tonne (assumes all products saleable). The COP will vary depending on the target product. Additional analysis of cost per product tonne based on yield targets is required to estimate market price by product

Table 1 Nominal cost of production

	0.25mtpa	1.25mtpa	2.5mtpa
Planning	$380,000	$600,000	$840,000
Quarry Development	$2,150,000	$7,124,678	$10,149,357
Plant and equipment capital (CAPEX)	$10,000,000	$15,100,000	$15,100,000
Operational Costs (OPEX)	$2,414,815	$7,200,100	$14,799,000
COP 5 yr write off with 30% contingency	$29.46	$13.66	$11.27
COP 10 yr write off with 30% contingency	$21.01	$12.12	$11.27

Source: GHD calculations

2.1.4 Road transport

The alternate operation has assumed that the products from the quarry will be exported via Bell Bay port facilities (potentially Berth No. 6, Berth No. 3, or Berth No. 5), and therefore the direct feed conveyor option to the Woodchip berth (as per The Initial Study) is no longer required. All quarry product will therefore be transferred via road.

The road transport is estimated for Gabion Rock and Aggregates to be $3.50 per tonne and $5.5 per tonne for Armour Rock (Table 2). The increased transport cost for Armour rock was largely a result of the increased handling difficulty and reduced payload utilisation of the haul truck.

Table 2 Estimated road transport costs – Quarry to Bell Bay

Road transport to Port ($ per tonne) incl. 30% contingency	All Scenarios (per tonne)
Armour Rock	$5.50
Gabion Rock	$3.50
Aggregates	$3.50

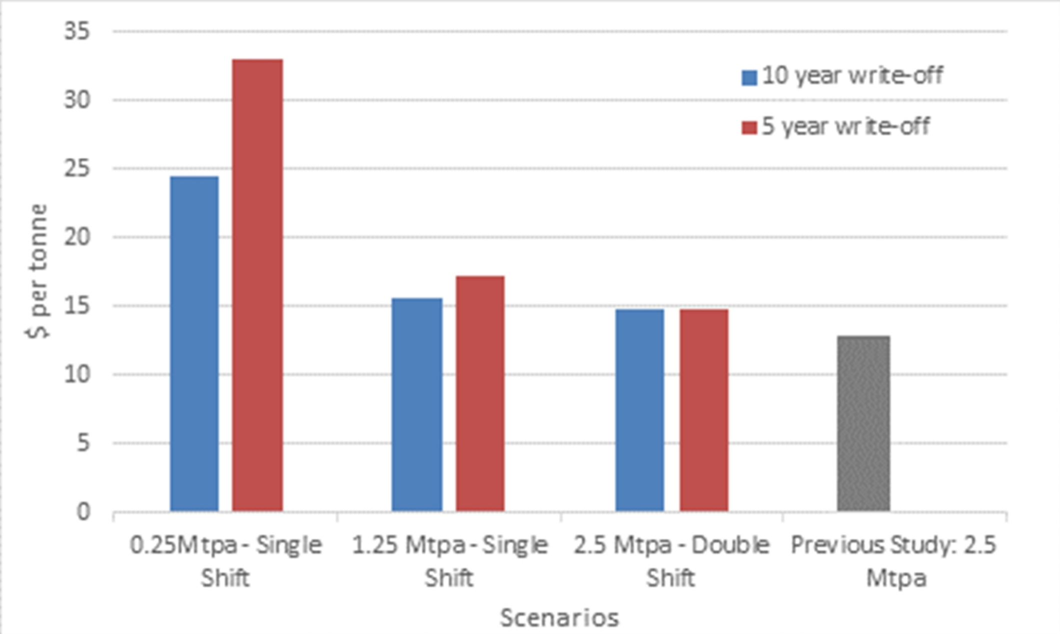
Source: GHD calculations

2.1.5 Extraction and land transport comparison

The Initial Study estimated the cost of extraction for a range of scenarios, which utilised fixed equipment for the extraction of aggregate. The smallest volume scenario from the previous study was 2.5mtpa. The cost to transport the aggregate from the extraction site to the port via a conveyor system was also included in the cost of extraction. A comparison of the mobile and fixed equipment, including the land transfer[3] costs, is provided in Figure 1.

[3] Assumes a road transport cost of 3.50 per tonne (as per Section2.1.4)

Figure 1 – Comparison FOB Costs (assumes $3.50/t transport)



Source: GHD calculations

As can be seen in Figure 1, there is a marginal increase in the cost of operations resulting from the switch between fixed plant (as indicated by the 'Previous Study') and a mobile plant at 2.5mtpa, with little difference in the write down period, as the typical life of mobile plant at high utilisation is approximately 5 years – therefore, the plant will need to be replaced. However, of significant note, is the increasing cost per tonne with a drop in utilisation from lower throughput – particularly at levels around 0.25mtpa (which is based on single units).

Despite the marginal increase in cost for a mobile plant, there are significant benefits with respect to a much shorter time to operations, as a plant does not need to be constructed, and the ability to lease equipment, which is not typical for fixed plant operations. The commercial flexibility of a mobile plant operation, also provides an easier transition to care and maintenance if the market is unfavourable, thereby reducing commercial exposure; however, the scale of operation is largely limited to approximately 5mtpa (based on equipment capacity), whereas a fixed plant can more easily accommodate a throughput in the order of 10mtpa, without the need for duplication (which would be required for a mobile plant)

2.1.6 Alternate rock product pricing

An initial scan of pricing for alternate products on the East Coast of Australia (Table 3) showed that Armour Rock is priced at between $65 to $75 per tonne, and Gabion Stones between $28 and $46 per tonne. Based on an FOB cost of approximately $15 per tonne, Bell Bay alternate rock products have the potential to be competitive on the East Coast of Australia, depending on the cost of maritime transport – which will be higher than rates in The Initial Study, due to a lower logistics system efficiency and volume. Additionally, depending on the alignment in the operation to throughput volume, low throughput volumes will have a significant influence on viability. Further assessment on the shipping costs (tug and barge or similar) will need to be considered in future studies.

Table 3 Alternate rock product prices

Product Description	Per m^3	$ Per Tonne
Supply of rock armour (3.9 - 6.6 t)	---	68
	---	75
	---	75
	---	68
Amour Rock Spalls	80	54
Gabion	83	46
Gabions	56	39
Gabion Rock	50	28

Source: Based on http://www.taree.cc/assets/Main-Site/Files/FP-Strategic-Planning/Appendix-G-8A0271gpb-Old-Bar-Design-Investigation.pdf; http://www.winstoneaggregates.co.nz/wp-content/uploads/2016/04/All-sites-pricelist-1-June-2015-LATEST.pdf; https://www.brisbane.qld.gov.au/sites/default/files/etuc_secta5_product_and_construction_unit_rates.pdf

2.1.7 Precast concrete

An option available for the quarry operation is the commercial recovery of surplus and waste material through the installation of a concrete batching plant and casting facility. The casting facility has the potential to exploit:

- Low cost aggregates and crusher dust generated by the quarry operations
- A favourable (cool) casting environment
- Nearby vacant land – the proposed Gunns Mill site
- Nearby water sources
- Nearby cement facilities (Cement Australia – Railton)
- Close to port facilities (short transfer distance) for the shipping of irregular shaped and heavy products

Analysis on the cost of pre casting options was limited to information sourced from anecdotal benchmarks and discussions with suppliers. Additionally, for the purposes of this report, the analysis is limited to concrete production only, as there is large variation depending on many aspects of a batch plant and casting operation, including mould license cost, formwork, throughput and labour costs (particularly finishing). This is demonstrated through precast units selling for as low as a few hundred dollars per cubic metre (such as mass block wall units), and over $1000 per cubic meter for detailed panels.

Based on such variability, there are a number of options available for the value-add processing of Bell Bay aggregates and crusher dust. These include:

- Build and operate a batch plant and casting facility
- Build and operate a batch plant and casting facility for standard products, and lease surplus capacity to a 3rd party to cast their own/project products under licence
- Build and operate a batch plant, and lease the casting facilities to a 3rd party
- Build a batch plant, and lease the operation of the batch plant and casting facilities to a 3rd party – with the requirement to source quarry products from the quarry operation

Based on standard specifications for 40MPa concrete pre casting (for basic casts), a cubic metre of concrete will require approximately:

- 1.5 tonnes of aggregates
- 0.4 tonne of cement
- 0.5 t of sands

The cost to produce 1 cu.m of 40MPa concreate is estimated to be approximate $130 in material[1], excluding capex and labour. Anecdotally labour cost been indicated to be low for a batching plant (but significantly higher for casting due to higher labour intensity); however further analysis is required to identify the labour costs.

Cost of setting up a 60 cu.m per hour batch plant (ex China) is understood to be at least $2.5M with the potential to increase significantly depending on the level of automation technology included. A locally built batch plant is likely to be 1.5-2 times the cost of the imported plant.

Based on other known eastern sea board concrete costs, the cost of production at Bell Bay will likely be competitive, thereby reducing the distance disadvantage exporting from Tasmania. However, depending on the size of market, and the potential ability to secure 3rd party leases for either or both the batching plant and casting facilities, the cost of providing enabling infrastructure may be limiting. Further investigations into the sizing of the cast products market will be required in future studies.

[1] Cost of concrete, based on ratio inputs - aggregates at approximately $25, cement $92 ($230/t supplied and delivered) and sand $13 ($26/t supplied and delivered).

3. Additional Market Locations

Work to date has focussed on understanding aggregate marketability from a proposed export quarry operation in Northern Tasmania to selected mainland Australian locations and, to a limited extent, potential Asian markets. As an extension, this report considers the marketability for export aggregate to Adelaide (South Australia), and Auckland (New Zealand).

The inclusion of these additional markets is based on:

- **Adelaide** – initial analysis indicated that aggregates from Bell Bay are competitive to southern and south eastern markets (Melbourne and Sydney). As such, Adelaide, as the other major population and industrial centre in the southern Australian region, may present opportunities, depending on product price
- **Auckland** – with the relative low freight unit cost of maritime transport to road transport, the New Zealand market may be achievable. As the cost of transport, on a distance basis, is lower for maritime transport, Tasmanian exports may be competitive with the domestic land transport in New Zealand, which is further assisted by little to no road transport at the Bell Bay site. In addition, anecdotal information suggests that the limited life of existing quarries, the longer road transport need, and the arguably lower quality of rock available within the Auckland area, presents opportunities to penetrate the NZ market, depending on product price

3.1 Market delivered costs

For the purposes of this analysis the FOB costs (extraction, transfer, storage and terminal charges) and volume scenarios developed in The Initial Study are assumed to be the same, for comparative purposes. Shipping costs, however, have been calculated for the new markets, due to the different distances, but with the same assumptions as The Initial Study.

3.1.1 Shipping cost

Port to port distances for Adelaide and Auckland have been calculated using Netpas software, which indicates that for bulk carriers, Adelaide sailing time is approximately 2 days from Bell Bay, while, Auckland is 4-5 days (Table 4). The most likely sailing route to Auckland is shown in Figure 2.

Table 4 Sailing distances and time

Markey Location	Nautical Mile (one way)	Trip Time – days (@ 14 knots)
Adelaide, South Australia	589	1.78
Auckland, New Zealand	1,524	4.54

Source: Calculated using Netpas software

Figure 2 Sailing route – Bell Bay to Auckland

Source: Calculated using Netpas software

As identified in The Initial Study, volatility of the vessel charter rate will have an impact on the overall cost to deliver quarry products to market. Based on the charter rate and fuel cost assumptions The Initial Study, and the calculated distance between Bell Bay and destination ports, the shipping costs have been estimated (inclusive of port charges).

The analysis summarised in Table 5 below shows there is a large disparity in maritime transport cost, as observed in The Initial Study, between current shipping rates and that which is considered an appropriate market independent rate (based on a commercial return basis over the life of the vessel). The analysis shows that the cost of shipping to Adelaide is approximately the same as Sydney; however, the cost of shipping to Auckland is approximately $8-10 per tonne higher than the most competitive domestic markets based on a reasonable vessel rate of return, but only $2-3 per tonne higher in current market conditions.

Table 5 Shipping costs

Port Location	Market Independent $ per tonne	Current Market $ per tonne
Adelaide	10.8	5.7
Auckland	18.1	7.8
Sydney	10.1	5.5
Brisbane	13.9	6.6
Melbourne	8.0	4.9

Source: GHD analysis; Braemar ACM

Direct comparison of shipping costs shows a significant difference between estimated cost between Australian and New Zealand markets over the longer term, where shipping to New Zealand will form a significant proportion of the delivered costs. The higher cost is directly correlated with the long sailing time, and additional fuel costs for vessels.

3.1.2 Delivered costs

In order to calculate an indicative delivered cost (for competitiveness purposes), the previously calculated FOB cost and the maritime transport costs have been combined to demonstrate a representative CFR rate to destination markets[4][5]. Based on the calculations performed and presented in Table 6, the cost of supply to Adelaide ranges from $18-32 per tonne (which is heavily influenced by the level of production) and the estimated shipping rate, while supply to Auckland, range from $20-39 per tonne – excluding any additional taxes and import duties.

Table 6 Estimated CFR costs

Destination/Production	Market Independent $ per tonne	Current Market $ per tonne
2.5 Mtpa – Single Shift		
Adelaide	31.7	26.6
New Zealand	39.0	28.7
Sydney	31.1	26.5
Brisbane	34.8	27.5
Melbourne	28.9	25.9
5 Mtpa – Double Shift		
Adelaide	25.6	20.6
New Zealand	32.9	22.6
Sydney	25.0	20.4
Brisbane	28.7	21.4
Melbourne	22.8	19.8
10 Mtpa – Double Shift		
Adelaide	22.9	17.9
New Zealand	30.2	20.0
Sydney	22.3	17.7
Brisbane	26.0	18.8
Melbourne	20.1	17.1

Source: GHD analysis

3.2 Assessment of competitiveness

Research for aggregates in The Initial Study indicated that Australian domestic price ranged from $30 to $50 per tonne for 20mm aggregates (as the premium product) on the East and South-East of Australia. Research for the new market locations of Adelaide and Auckland indicated that pricing in Adelaide is approximately $15 per tonne (20mm aggregates); much less than identified in The Initial Study at other domestic market locations. Specifications of aggregate product at that price are not known, and appear unusually low when compared with other locations, and arguably more in line with a natural screened product, as opposed to a crushed stone aggregate – which appears to be typically above $30 per tonne.

Initial pricing research for Adelaide suggests that if the price of crushed aggregates in Adelaide is truly $15 per tonne (most likely as a result of low demand and oversupply), then it is unlikely that the Bell Bay product would be competitive; however, at $30 per tonne, supply to Adelaide

[4] Extraction Rates: 2.5 Mtpa – $12.80/t; 5mtpa - $10.30/t; 10mtpa – $9.50/t
[5] Berth & Ship loader rates: 2.5mtpa – $8.10/t; 5mtpa - $4.60/t; 10mtpa – $2.70/t

may be competitive, but only where Bell Bay production levels are above 5mtpa to achieve a small margin.

Enquiries on 20-25 mm aggregate in Auckland indicated pricing of $16 to $37 Australian Dollars per tonne. [6] At these pricing levels (which have the same specification constraints as observed for Adelaide) product from Bell Bay over the longer term would be competitive (at the higher pricing levels) at production rates at and above 5mtpa (with a small margin), or where a price premium can be achieved for superior product specifications.

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[6] http://www.winstoneaggregates.co.nz/wp-content/uploads/2016/04/All-sites-pricelist-1-June-2015-LATEST.pdf

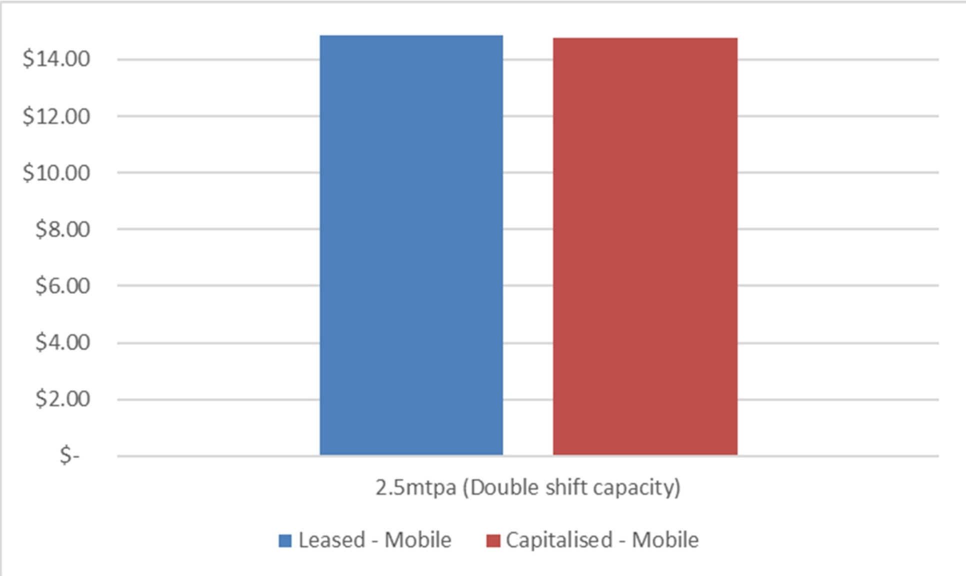
4. Reducing Capital

4.1 Crushing plant cost assessment: owned versus leased

A potential option for reducing the start-up costs of the quarry operation, assuming a mobile plant, is to lease equipment, rather than to own outright. Typically, with the transfer of financing to the equipment vendor, with margin, a higher operating cost is expected.

A comparison between owned versus leased plant (Figure 3) showed little difference, with both at around $15 per tonne. The primary driver for the similar outcome is likely to be that the vendor may be prepared to forego the margin on asset or margin at sale, instead focussing on the maintenance and consumables contract over the longer term. Additionally, if the commercial terms are favourable, with lower barriers to entry in a competitive market, then vendors will be more likely to seek rates that are comparable to owned plant.

Figure 3 – Comparison of owned versus leased plant costs



Source: GHD calculations; Metso

Despite comparable costs, and the benefits of minimising start-up capital, at output close to capacity, the lease rates (which may be paid by operating hour) will be highly sensitive to both the throughput rate (where lower rates increase the per tonne cost substantially), and the lease period (due to the remaining life of plant, and ability to redeploy plant if asset costs are not fully recovered

4.2 Single loader berth operation

The loading of vessels in The Initial Study was based on dual head loading with luffing and slewing telescopic loaders. There are numerous operational benefits generated by dual head loading, in particular, reducing ship hours at berth (reflected through the shipping costs), and achieving high capacity per berth – which is critical when high target throughput for bulk products in small vessels is a focus (in the order of 10mtpa).

As a result of targeting high throughputs and minimising ship time, there is an additional capital requirement, in particular the 2nd ship loader. However, if the operation is reduced to a single loader operation, there are a range of additional factors that need to be considered. In particular:

- The luffing and slewing loader will not be able to achieve full coverage of the vessel hatches, therefore:
  - The proposed loader will need to be substituted by a rail mounted travelling telescopic luffing ship loader with significantly higher civil (rail track and higher loads) berth costs and higher ship loader costs
  - The vessel will need to warp at berth (repositioned on its ropes) under the loader, which is a more hazardous operation, especially in high flow currents, increases wear on the berth and fenders, and increases wear on the vessel. Additionally, due to the high cargo density, the ship will be required to move up and down the berth multiple times in order to achieve an acceptable load plan, which further reduces the ship loading rate. Due to the movement of the vessel under the loader, further capital reductions (a shorter berth) can be achieved, but must be considered with potential interaction of vessels at WC2
- The lower ship loading rate:
  - Reduces the capacity of the bulk loading facilities, limiting the scalability of the terminal, and constrains the ability to socialise fixed costs through greater economies of scale.
  - The additional time at berth will add to vessel cycle times and therefore the ship cost per tonne. Additionally, with potential recovery of shipping charter rates, the increased time at berth will further impact the cost of shipping

4.3 Second hand transfer conveyor

A major piece of materials handling infrastructure is the transfer conveyor from the crushing plant to the storage facilities at the ship loading operations. Potential exists for a reduction in capital costs from the installation of a second hand conveyor as a result of a number of mine closures in Australia. Despite the potential cost savings that may present from the purchase of a second hand transfer conveyor, there are a number of limiting factors, including:

- The conveyor cost is a relatively small proportion of the overall capital costs, therefore the levels of savings generated from sourcing a second hand conveyor are minimal
- Sourcing a conveyor of suitable specification (belt width and design speed) may be challenging
- The remaining life of a second hand conveyor may be less than the proposed Bell Bay operation, therefore require replacement in the future (and a disruption to operations)
- The conveyor may be located remotely, which may have high transport costs to transfer to a port for on-carriage to Bell Bay, particularly when new equipment can be sourced internationally near port locations
- The savings would only be attributable to the conveyor gallery, belt and idlers, requiring the same civil works requirements and installation, modification or retrofitting of trestles

5. Summary of capital and operating costs by quarry operation type

There are numerous target product, plant operation, throughput, capacity, and commercial options available to the quarry development, as discussed in the Initial Study, and in previous sections of this report. The combination of which will need to considered in future studies and the subsequent business plan.

In order to assist with comparison of the various operational and commercial options available, and demonstrate the cost structure differences (capital and cost of production) resulting from the nature, type and scale of operation, a summary has been provided in Table 7.

As shown in Table 7, there is a high infrastructure capital cost associated with fixed plant for high throughput volume. The level of capital can be reduced with the use of leased plant, which, with the lower capacity would need to use existing port facilities, as the cost of private berth facilities would be cost prohibitive. As also shown in Table 7, limiting production to small volume niche markets provides the opportunity commence operations with a small capital outlay, and low cost of production (due to low processing costs), but with lower yield (higher proportion of waste product).

Table 7 Summary of costs by operation type – excluding road transport, shipping, port and terminal charges

Target products	Plant type	Port facilities	Throughput	Capacity	Capital Cost ($M)	Cost of Production ($/t)[7]
Armour rock only	Nil	Existing	To contract (0.25 max)	Variable	<$2M Pending operational scale (1)	$4.50 (25% yield)
Armour and gabion	Grizzly only	Existing	To contract (0.25 max)	Variable	<$2M Pending operational scale (1)	$5.50 (35% yield)
Armour and gabion	Mobile primary crusher only	Existing	0.25	0.25mtpa	<$2M Pending operational scale (1)	$7.50 (50% yield)
Full product range	Mobile plant	Existing	0.25	1.25mtpa Single units	$2M (2)	$29.50
Full product range	Mobile plant	Existing	1.25	1.25mtpa	$3.5M(3)	$13.50
Full product range	Mobile plant	Existing	2.5	1.25mtpa (Double shift)	$5M (4)	$11.50
Aggregate only	Fixed	New private	2.5	2.5mtpa	$101M Quarry capital only (5) +$90M Berth(6)	$12.80
Aggregate only	Fixed	New private	5	2.5mtpa (Double shift)	$101M Quarry capital only (5 +$90M Berth(6))	$10.30
Aggregate only	Fixed	New private	5	5mtpa	$171M Quarry capital only(5) +$90M Berth(6)	$12.40
Aggregate only	Fixed	New private	10	5mtpa (Double Shift)	$180M Quarry capital only (5) +$90M Berth(6)	$9.50

Source: GHD analysis

(1) Assumes minimum initial upfront planning and development cost. Drill & blast, sorting, load-out and primary crushing for additional gabion rock if required all by contractor.
(2) As for above note (1) with mobile plant leased or provided by contractor.
(3) Higher production volumes will require additional development capital. Progressive development as production ramps up and leasing or contract mobile plant operation will minimise up front capital
(4) As per note (3) above. Additional start-up capital required to facilitate higher production capacity.
(5) Fixed quarry plant cannot be contractor supplied and leasing would not be feasible
(6) Cost of production excludes road transport, shipping and terminal charges

[7] Inclusive of operational costs and capital costs amortised at 6% over 10 years

6. Finding and Recommendations

Consideration and assessment from the Phase 1 actions from The Initial Study has identified a number of key findings for the potential quarry development located at Bell Bay in Northern Tasmania. The findings in this report must be read in conjunction with The Initial Study.

Additional Market Locations

- Based on the calculations the cost of supply to Adelaide ranges from $18-32 per tonne (which is heavily influenced by the level of production) and the estimated shipping rate, while supply to Auckland, range from $20-39 per tonne – excluding any additional taxes and import duties
- Research of aggregate markets in Adelaide and Auckland indicated that pricing in Adelaide is approximately $15 per tonne (20mm aggregates); much less than identified in The Initial Study at other domestic market locations. Specifications of aggregate product at that price are not known, and appear unusually low when compared with other locations, and arguably more in line with a natural screened product, as opposed to a crushed stone aggregate – which appears to be typically above $30 per tonne
- If the price of crushed aggregates in Adelaide is truly $15 per tonne (most likely as a result of low demand and oversupply), then it is unlikely that the Bell Bay product would be competitive; however, at $30 per tonne, supply to Adelaide may be competitive, but only where Bell Bay production levels are above 5mtpa to achieve a small margin
- Enquiries on 20-25 mm aggregate in Auckland indicated pricing of $16 to $37 Australian Dollars per tonne. At these pricing levels (which have the same specification constraints as observed for Adelaide) product from Bell Bay over the longer term would be competitive (at the higher pricing levels) at production rates at and above 5mtpa (with a small margin), or where a price premium can be achieved for superior product specifications

Alternate Products

- If the focus of quarry operations is on alternate (non-aggregate) products, which are more suited to general wharf operations, it is likely that redevelopment of a bulk handling facility (approximately $90M) is not required. However, to enable the export of aggregates (as a secondary product) a range of non-permanent materials handling options are available, including the use of ships gear, a wharf crane with grabs, or alternatively a mobile radial loader, which have low capital outlay
- The alternate product focus of operations has the potential to export via existing Bell Bay port facilities (potentially Berth No. 6, Berth No. 3, or Berth No. 5), which will need to be transported by road. Road transport is estimated for Gabion Rock and Aggregates to be $3.50 per tonnes and $5.50 per tonne for Armour Rock. The increased transport cost for Armour rock is largely a result of the increased handling difficulty and reduced payload utilisation of the haul truck
- Analysis of the difference between fixed and mobile plant showed that there is a marginal increase in the cost of operations at the reduced throughput of 2.5mtpa. There are significant benefits for a mobile plant, in particular, a much shorter time to operations and the ability to lease equipment, which is not typical for fixed plant operations
- Assuming full recovery of quarry material (ability to sell all products) the average price across all products delivered to the wharf (excluding stevedoring) is estimated to be approximately $15 per tonne at 2.5mtpa using mobile plant operating on double shift

- An initial scan of pricing for alternate products on the East Coast of Australia showed that Armour Rock is priced at between $65 to $75 per tonne, and Gabion Stones between $28 and $46 per tonne. Based on an FOB cost of approximately $15 per tonne, Bell Bay alternate rock products have the potential to be competitive on the East Coast of Australia, depending on the cost of maritime transport and alignment of the operation to throughput volume. Further assessment on the shipping costs (tug and barge or similar) will need to be considered in future studies
- The scale of operation for a mobile plant is limited to approximately 5mtpa, whereas a fixed plant can more easily accommodate a throughput in the order of 10mtpa, without the need for duplication (which would be required for a mobile plant)
- Commercial recovery of surplus and waste material through the installation of a concrete batching plant and casting facility has the potential to exploit low cost aggregates and crusher dust, a favourable (cool) casting environment, nearby vacant land – the proposed Gunns Mill site, nearby water sources, nearby cement facilities (Cement Australia – Railton), and close proximity to port facilities (short transfer distance) for the shipping of irregular shaped and heavy products
- There is large variation on production costs for a batch plant and casting operation due to many cost influences related to licencing, labour and throughput. This is demonstrated through precast units selling for as low as a few hundred dollars per cubic metre (such as mass block wall units), and over $1,000 per cubic meter for detailed panels
- Analysis showed that the cost to produce 1 cu.m of 40MPa concrete is approximately $130 in material[1], excluding capex and labour. Anecdotally labour cost has been indicated to be low for a batching plant (but significantly higher for casting due to higher labour intensity)
- There are a number of options available for the value-add processing, including building and operating a batch plant and casting facility. However, there is the potential to lease or partially lease (on a time period or project basis) its operation to reduce commercial exposure
- Based on anecdotal eastern sea board concrete costs, the cost of production at Bell Bay will likely be competitive, thereby reducing the distance disadvantage exporting from Tasmania. The success of this value-add offering will depend on the size of the market, and ability to penetrate it. One strategy to minimise production cost is through securing 3rd part leases for either or both the batching plant and casting facility, which will assist in generating economies of scale to socialise fixed costs and off-set licensing and formwork costs to users of the facilities

Reducing capital

Leased plant

- Comparison between owned versus leased plant showed little difference, likely a result of the vendor being prepared to forego the margin on asset or margin at sale, instead focussing on the maintenance and consumables contract over the longer term. Additionally, if the commercial terms are favourable, with lower barriers to entry in a competitive market, then vendors will be more likely to seek rates that are comparable to owned plant
- Leased equipment rates (which may be paid by operating hour) will be highly sensitive to both the throughput rate (where lower rates increase the per tonne cost substantially),

[1] Cost of aggregates is approximately $25, cement $92 ($230/t S&D) and sand $13 ($26/t S&D).

and the lease period (due to the remaining life of plant, and ability to redeploy plant if asset costs are not fully recovered

Single ship loader

- Reducing capital through limiting operations to a single ship loader, will require substitution of the proposed system with a rail mounted travelling telescopic luffing ship loader. This will require a significantly higher civil (rail track and higher loads) berth and ship loader costs, limiting the levels of capital savings. Alternatively, the vessel will need to warp at berth (repositioned on its ropes) under the loader, which is a more hazardous operation, especially in high flow currents, increases wear on the berth and fenders, and increases wear on the vessel
- With the movement of a vessel under a single ship loader, further capital reductions (a shorter berth) can be achieved, but must be considered with potential interaction of vessels at the adjacent WC2 berth. However, the lower ship loading rate through a single loader reduces the capacity of the bulk loading facilities, limiting the scalability of the terminal, and constrains the ability to socialise fixed costs through greater economies of scale, and the additional time at berth will add to vessel cycle times and therefore the ship cost per tonne

Second hand transfer conveyor

- Despite the potential cost savings that may present from the purchase of a second hand transfer conveyor are likely to be offset by sourcing a conveyor of suitable specification (belt width and design speed) may be challenging, potential relocation costs may be prohibitive from remote locations, and the cost of modification or retrofitting of trestles may exceed the costs of a designed for purpose conveyor system

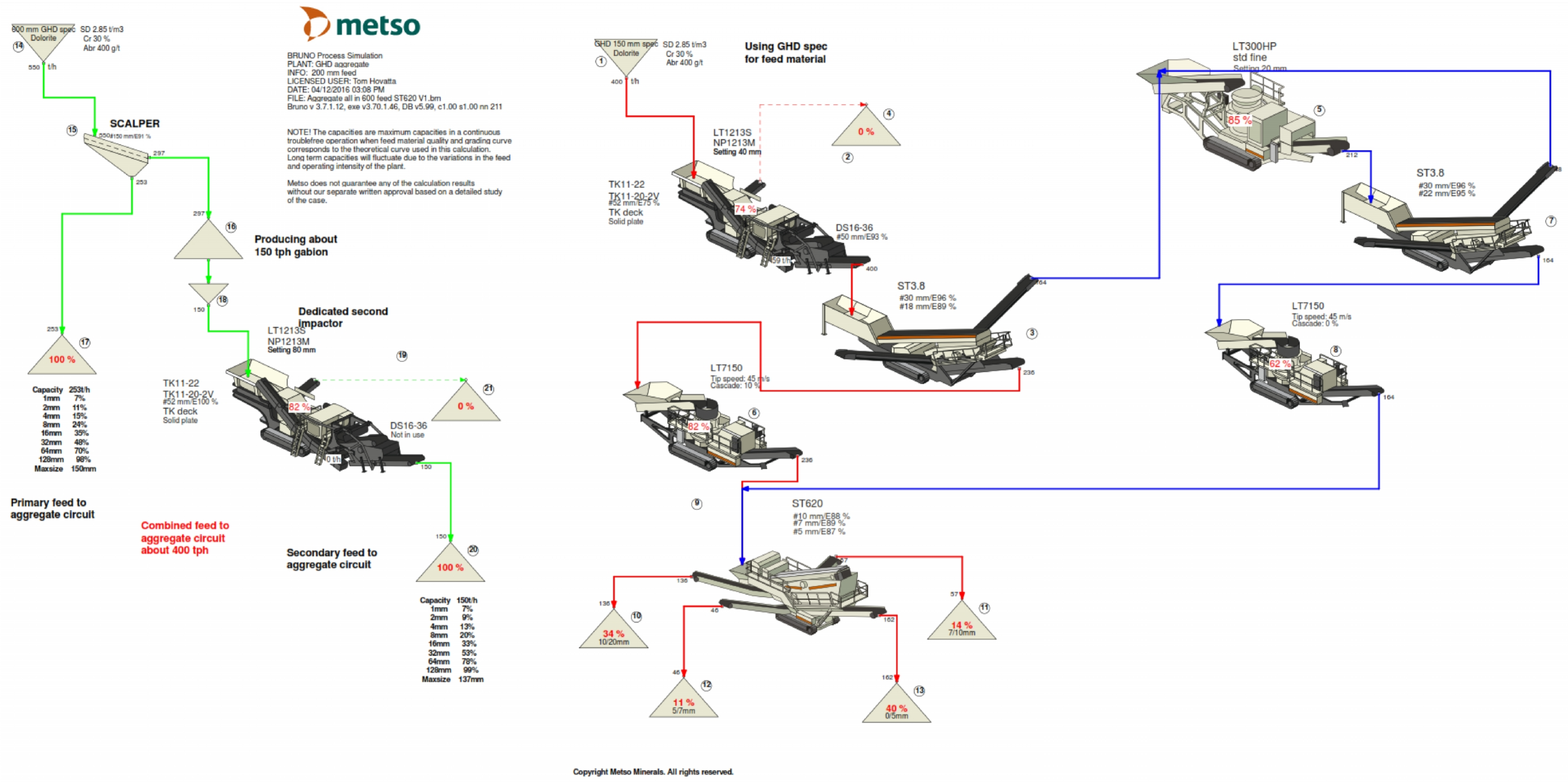
Next Steps

More detailed analysis on likely markets resulting from the analysis in this report and Phase 2 tasks identified in The Initial Study prior to undertaking a business case/pre-feasibility study:

- Further market sounding to increase the level of confidence in the current and likely future market prices, particularly:
  - Crushed aggregate prices in Sydney and Melbourne
  - Premium crushed aggregate potential and prices in Auckland
  - Armour rock prices on the Australian East Coast and Pacific Islands
  - Gabion stone prices in Tasmania an Australian East Coast
  - Standard pre-cast product (slab walls and similar) prices on the Australian East Coast
- Further market analysis is required, to:
  - Identify the level of volume discount that is typical of the industry for large purchases
  - Identification of potential customers for identified competitive products
  - Market sizing and an assessment/analysis of potential for downward price impacts from the injection of Bell Bay product into the market
  - Identification of potential lease operators of the batching plant and/or casting facilities for standard and licenced products (such as coastal protection blocks)
  - Further investigation on the potential for value-add process (batching and casting plant) and the potential for manufactured sand
- Engage with infrastructure owners and regulators to assess the potential and likely costs to secure access to berth and connected land infrastructure
- Engage with the Tasmanian Government to identify support programs may be available

Appendices

Appendix A – Potential mobile crushing plant



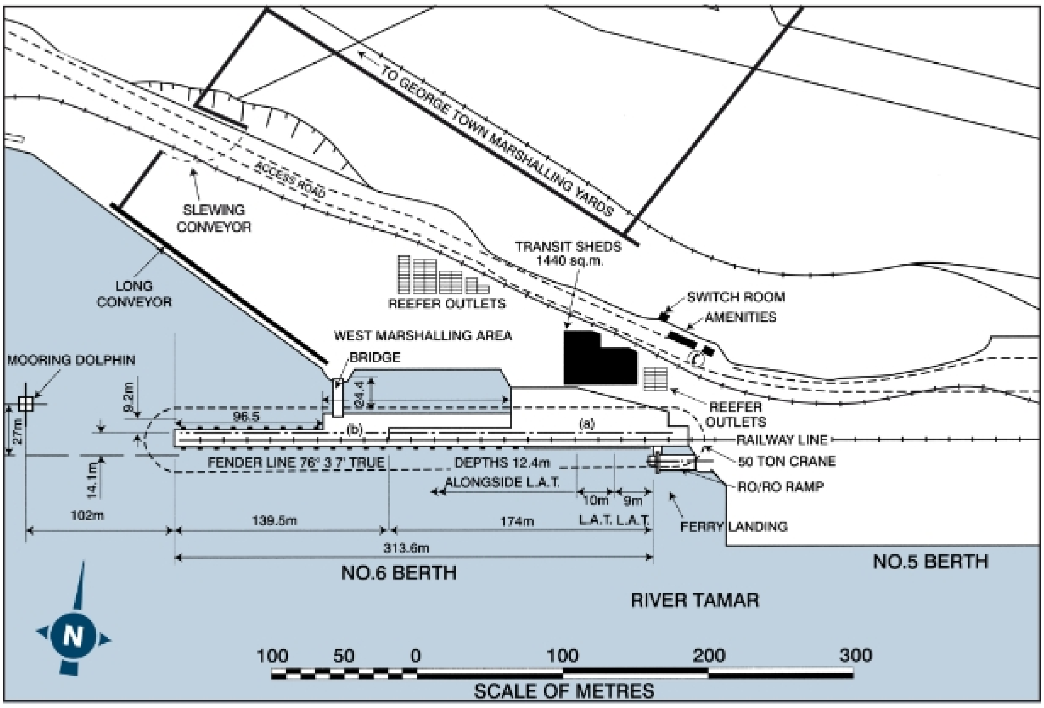
Appendix B – Potential berth options – Bell Bay[8]

TASPORTS PORT INFORMATION

TasPorts

Bell Bay

No.6 Multi-Purpose Berth – Ro/Ro, Container & General



Wharf Fenders-W To E:

(a) Bridgestone SUC1250H RE cell type fenders plus anti-friction frontal pads – 13 at 12m centres alternating with 12 tyre fenders; 7 at 14.7m centres alternating with 5 x 2 sets of tyre fenders.

(b) .30 x .15 .380 rubber cylinder backed waling plus 16 timber piles at 4.9m centres plus restraining chains.

(c) Timber fender piles x 9 along rear face of wharf.

Wharf Bollards-W To E:

(a) 50 tonne x 1 at 15m centres.

(b) 50 tonne x 8 at 18m centres.

(c) 50 tonne x 9 at 19.6m centres

(d) 50 tonne x 2 at 36m centres and 50 tonne x 2 at 52.5 centres along rear face of wharf.

(e) 100 tonne x 2 at rear corners of wharf.

Stern Mooring Bollards:

50 tonne x 2.

Mooring Dolphin:

3 x 50t QR Hooks, 1 x 100t Bollard

Public Telephone

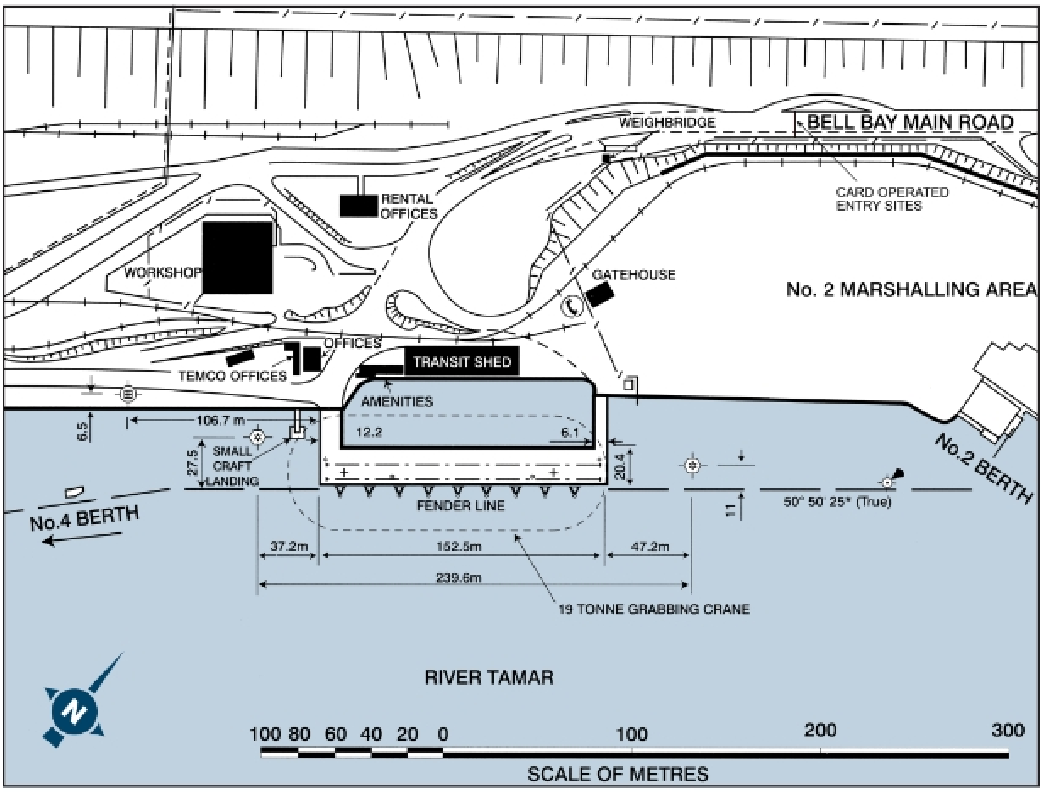
[8] Source: http://www.tasports.com.au/pdf/Tasports_Port_Info_All_Ports.pdf

TASPORTS PORT INFORMATION

TasPorts

Bell Bay

No. 3 Berth – Bulk and General



Wharf Fenders:

Each 2 x UE 500 x 1000 unit element fenders supporting timber fender piles at 6.1m centre.

Wharf Bollards:

7 x 25 tonne at 18.l3m centres.

2 x 25 tonne at 13.3m back from wharf face each end.

2 x 25 tonne at 73.2m centre.

Mooring Dolphins-W & E:

Cluster of 6 steel box piles *Bollard – 50 tonne.

Seebeck Double Quick Release Hook:

60 tonne.

Beacon:

3 red piles with light (F.R.)

Public Telephone

General Description

A concrete decked, steel piled wharf providing for handling of general and bulk cargoes.

Length Of Wharf:

152.5m; width 20.4m.

Mooring Dolphins:

236.9m apart.

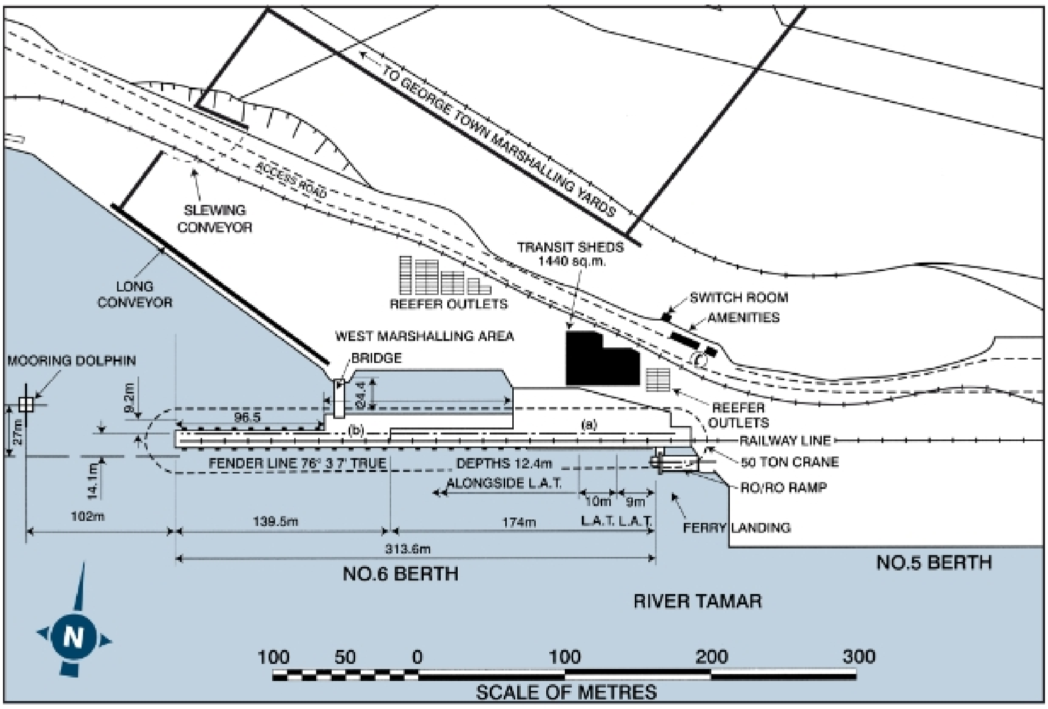
Depth Alongside:

11.8m at L.A.T.

TASPORTS PORT INFORMATION

Bell Bay

No.6 Multi-Purpose Berth – Ro/Ro, Container & General



Wharf Fenders-W To E:

(a) Bridgestone SUC1250H RE cell type fenders plus anti-friction frontal pads – 13 at 12m centres alternating with 12 tyre fenders; 7 at 14.7m centres alternating with 5 x 2 sets of tyre fenders.

(b) .30 x .15 .380 rubber cylinder backed waling plus 16 timber piles at 4.9m centres plus restraining chains.

(c) Timber fender piles x 9 along rear face of wharf.

Wharf Bollards-W To E:

(a) 50 tonne x 1 at 15m centres.

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(d) 50 tonne x 2 at 36m centres and 50 tonne x 2 at 52.5 centres along rear face of wharf.

(e) 100 tonne x 2 at rear corners of wharf.

Stern Mooring Bollards:

50 tonne x 2.

Mooring Dolphin:

3 x 50t QR Hooks, 1 x 100t Bollard

Public Telephone

DI 80572 – p16

Appendix C Materials handling options

Large stone handling

Source: http://www.mibau-stema.de/en/steinbrueche-larvik.html

Source: http://www.aggbusiness.com/categories/quarry-products/features/aggregate-for-welsh-coastal-protection/

Mobile telescopic Loader

Source: http://superior-ind.com/products/conveyor-equipment/passport-conveyor/

Appendix D Potential cement casting options

Coastal protection block form work and installation

Source: https://www.flickr.com/photos/okinawa-soba/sets/72157632369128663/

Source: http://www.constantinidis.org/images/MAR/10/Picture44.jpg

Pre-cast wall sections

Pre-cast bridge beam

Source: http://civmec.com.au/capabilities/precast-concrete/

Source: http://www.concretenetwork.com/photo-gallery/site_26/concretenetwork-com_12980/

Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
Rev0	G Denholm	G Edwards		G Denholm		15/7/2016

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