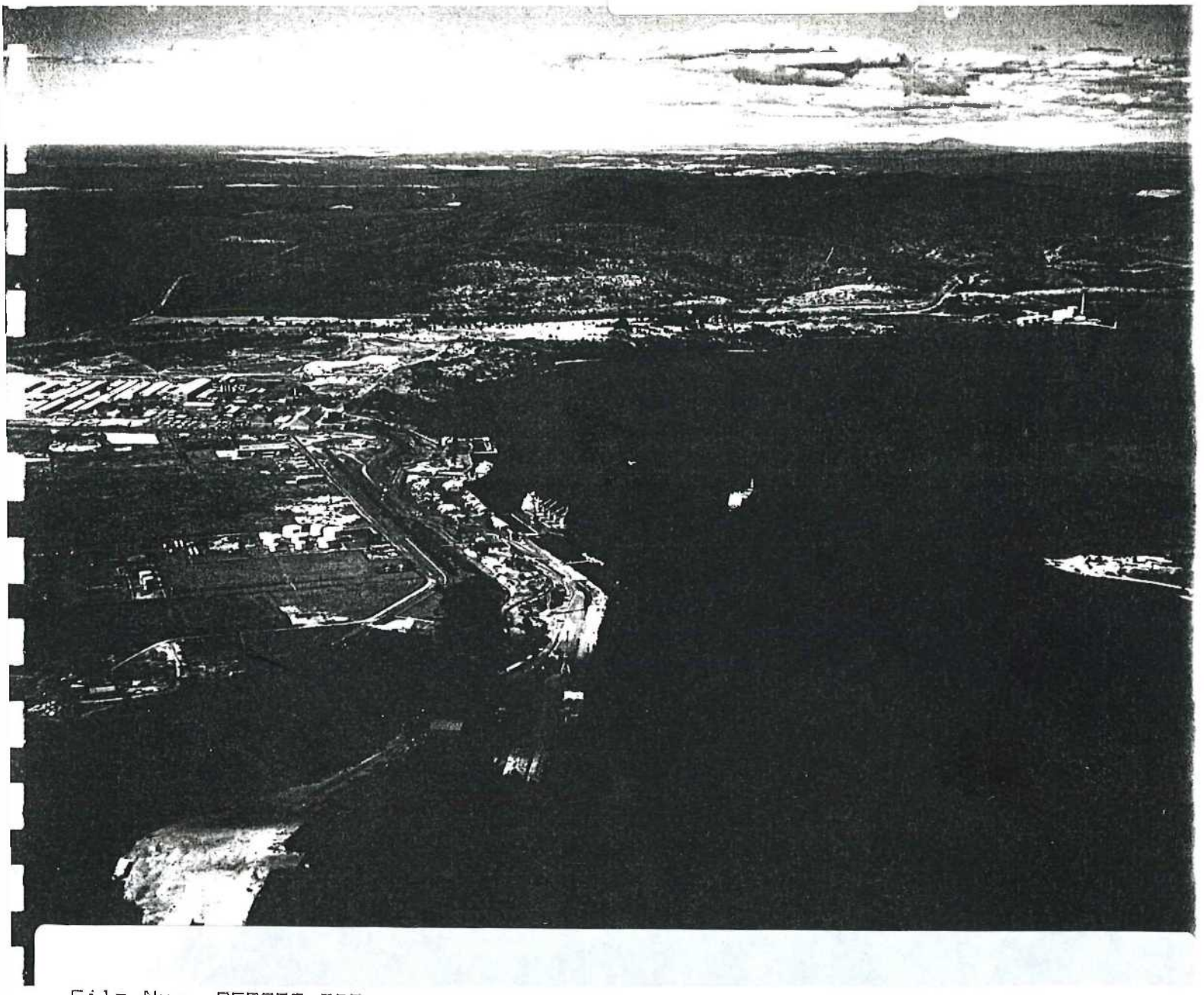
Pacific Quarries
Bell Bay Tasmania



KPMG Peat Marwick

Chartered Accountants

PACIFIC QUARRIES

BELL BAY

TASMANIA

INFORMATION MEMORANDUM

KPMG Peat Marwick

April 1993

PACIFIC QUARRIES

INFORMATION MEMORANDUM

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ACCOUNTANTS' REPORT
DISCLAIMER

Tasmanian Hardrock Pty Ltd

We have prepared the accompanying Information Memorandum set out on pages 1 to 35 from information supplied by Tasmanian Hardrock Pty Ltd and other information provided by the Directors and at the request of and exclusively for the use and benefit of Tasmanian Hardrock Pty Ltd and its Directors.

Under the terms of our engagement, we have not audited or otherwise investigated the records and have relied on the information provided to us. Accordingly, we express no opinion on whether the Information Memorandum presents a true and fair view of the matters contained in the Information Memorandum and no warranty of accuracy or reliability is given.

In accordance with our firm policy, we advise that neither the firm nor any member or employee of the firm undertakes responsibility arising in any way whatsoever to any person (other than the Tasmanian Hardrock Pty Ltd) in respect of the Information Memorandum including any errors or omissions therein, arising through negligence or otherwise however caused.

KPMG Peat Marwick

Launceston
8/4/1993.

KPMG Peat Marwick
Chartered Accountants

1. PACIFIC QUARRIES

Pacific Quarries is a business name registered and owned by Tasmanian Hardrock Pty Ltd whose registered office is situated at 33 George Street, Launceston 7250 Tasmania.

The company's directors are:

- Hilary James HARRINGTON
  16 Hobbs Street
  O'CONNOR 2601
  A C T

- Shirley Anne HARRINGTON
  16 Hobbs Street
  O'CONNOR 2601
  A C T

2. THE NEED FOR HIGH QUALITY AGGREGATES

A reliable source of high quality aggregates is as necessary to our society as food and water.

The aggregates industry is the largest volume industry in the western world. In the U K it has about three times the volume of the domestic coal industry.

Traditionally aggregates are supplied to major population centres by land transport, usually in trucks, from nearby quarries.

Environmental and land planning pressure is now creating a dilemma as the increasing demand for aggregates conflicts with

- extraction in ever more sensitive areas.
- more pressures being placed on the traditional methods of land transport used in the industry.

In addition it is now a common feature of the aggregates industry supplying major population centres in the world that

- The sources of the aggregate are being worked out.
- The cities they supply are expanding past existing quarry sites and over potential quarry sites.

The traditional approach to this problem is to seek a resource a little further out. This search is typically resulting in a new resource a considerable distance from the market, not to mention the environmental and transport issues associated with commencing a major extractive industry in a new area.

3. A NEW CONCEPT IN SUPPLYING HIGH QUALITY AGGREGATES

In Europe this dilemma of how to provide a reliable source of high quality aggregates at a competitive price whilst operating within environmental and other social constraints has been overcome by a completely new concept - that of establishing large scale quarries (super quarries) away from population centres at remote locations near a coastline. Aggregates are quarried and transported by sea at competitive prices to the markets.

Three super quarries are now operating in Europe and North America.

The first of these quarries is the Glensanda Quarry established by Foster Yeoman Ltd on the west coast of Scotland near Fort William. Glensanda came on stream in 1988 at an annual capacity of one million tonnes per annum (mtpa) with, interestingly, its first major market being in Houston, Texas, USA. Current capacity is 5 mtpa. Ultimate planned capacity is 15 mtpa. Glensanda's reserves within its present planning permission are some 450 million tonnes.

The second is Explaura in Newfoundland. Explaura commenced with a production of 1 mtpa in 1990 which was planned to rise to 4 mtpa in 1992 supplying the U S Atlantic and Gulf ports.

The third is a joint venture between John Fleming Constructions and Wimpey Minerals Division of the Wimpey Group and is situated at Bantry Bay in southern Ireland. This project came on stream in 1992 with a planned production of approximately 5-600,000 tonnes per annum (tpa) rising to 800,000 tpa in 1993 and 1.2 mtpa by 1995. The owners plan to further increase production to 2 mtpa, or above, by the end of the decade.

4. THE OPPORTUNITY

The Pacific Region

Our client believes the opportunity exists to establish super quarries producing high grade aggregates to service the Pacific region as the dilemma that has seen the North Atlantic super quarries established becomes reality in the Pacific region.

In the past 2 years our client has researched the markets presently existing for high quality aggregates in Australia and the Pacific region generally, investigating in particular the feasibility of these markets being supplied with aggregates from their traditional sources in future years.

Our client has reached the conclusion that the European dilemma regarding the future supply of hardrock aggregates will shortly exist in the Pacific region.

Our client's research shows that potential markets exist for the delivery of high quality aggregates by sea to the Australian cities of Sydney, Adelaide and Perth, to Auckland in New Zealand, to the west coast of the United States, especially The Bay Region, and to the Asian markets.

Japan is believed to be the single largest consumer of aggregates in the region with domestic production of approximately 1,000 mtpa. Our client has been advised that MITI estimates domestic supplies will last for approximately 5 - 10 years from 1991. Whilst Japan appears to be importing a very small quantity of rock from Taiwan, our client's conclusion is that Japan will have to consider the concept of importing aggregates in large quantities in the near future.

Niche Markets

Markets consume aggregates for a variety of purposes, the two largest uses being in making concrete and building roads.

Different qualities of aggregates can be used for some purposes, in particular, inferior qualities may be used for base coarses in road making.

Our client believes that with a greater understanding on the part of engineers

- of chemical reactions causing concrete cancer in high rise buildings
- that different qualities of aggregates are available in the market

there is a market for high quality aggregates for uses such as building construction and surfacing high traffic volume roads eg. central business districts, bridges and major arterial roads, such that premium prices may be sought.

Our client believes there is the opportunity to establish a number of super quarries to service the Pacific region, in particular as the industrialisation of South East Asian countries continues, requiring large quantities of concrete.

Our client believes the potential market is such that another or other competing super quarries in the region would not pose a threat to its own site as the market is large enough to consume the production from many such quarries. Rather, the dilemma will be whether a sufficient volume of suitable quality resource is available in the region. We note that our client's research has failed to locate any resources that meet all its criteria except the resource at Bell Bay.

Bell Bay

Our client has carried out extensive research in the Pacific region to locate an appropriate resource from which to supply these markets.

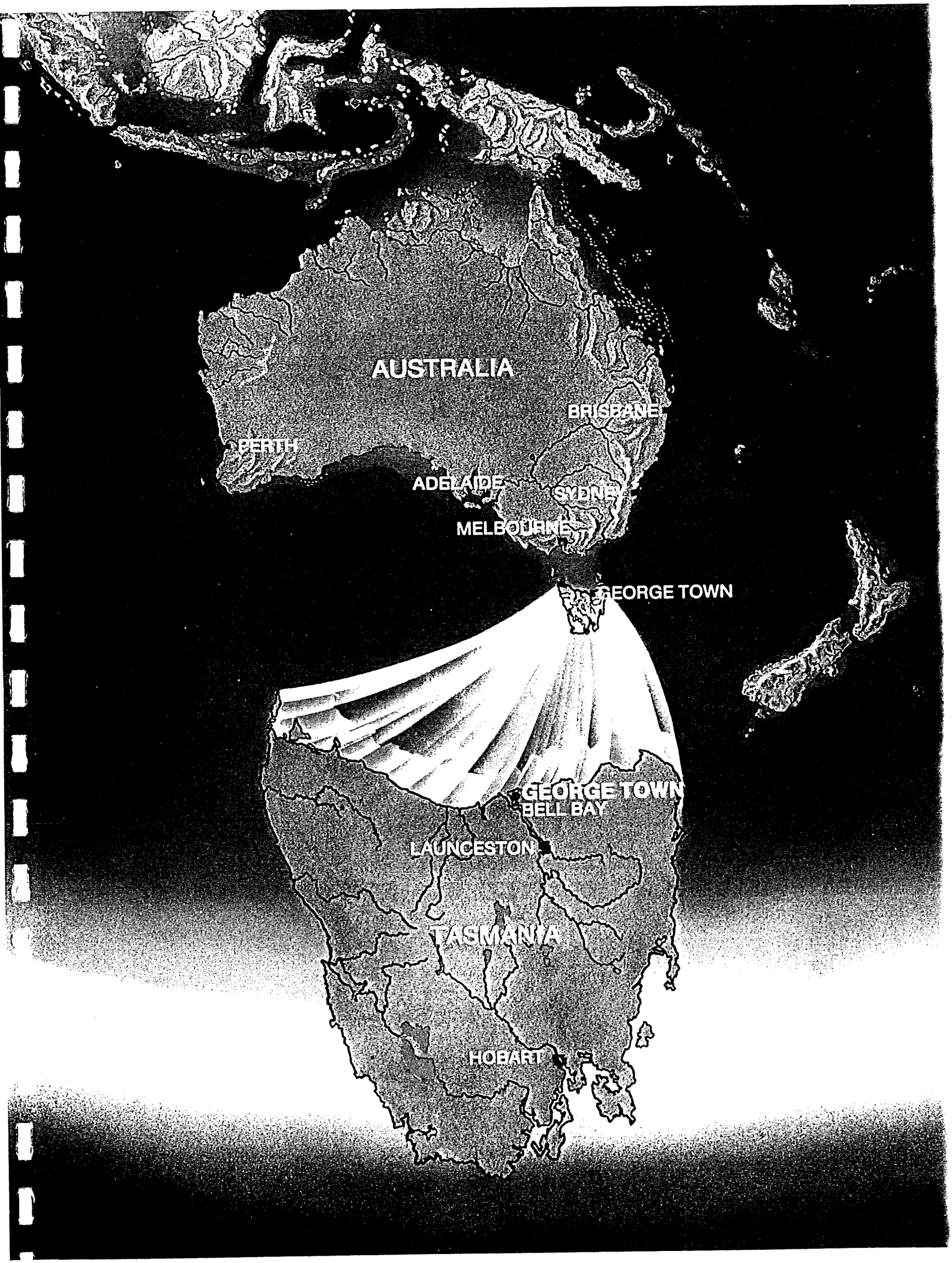
Three sites were short listed, two being rejected because the chemical composition of the rock at those sites had the potential to react chemically with cement.

Bell Bay in Northern Tasmania alone met all the criteria.

Illustrations on pages 6, 7 & 8 show the location of Bell Bay.

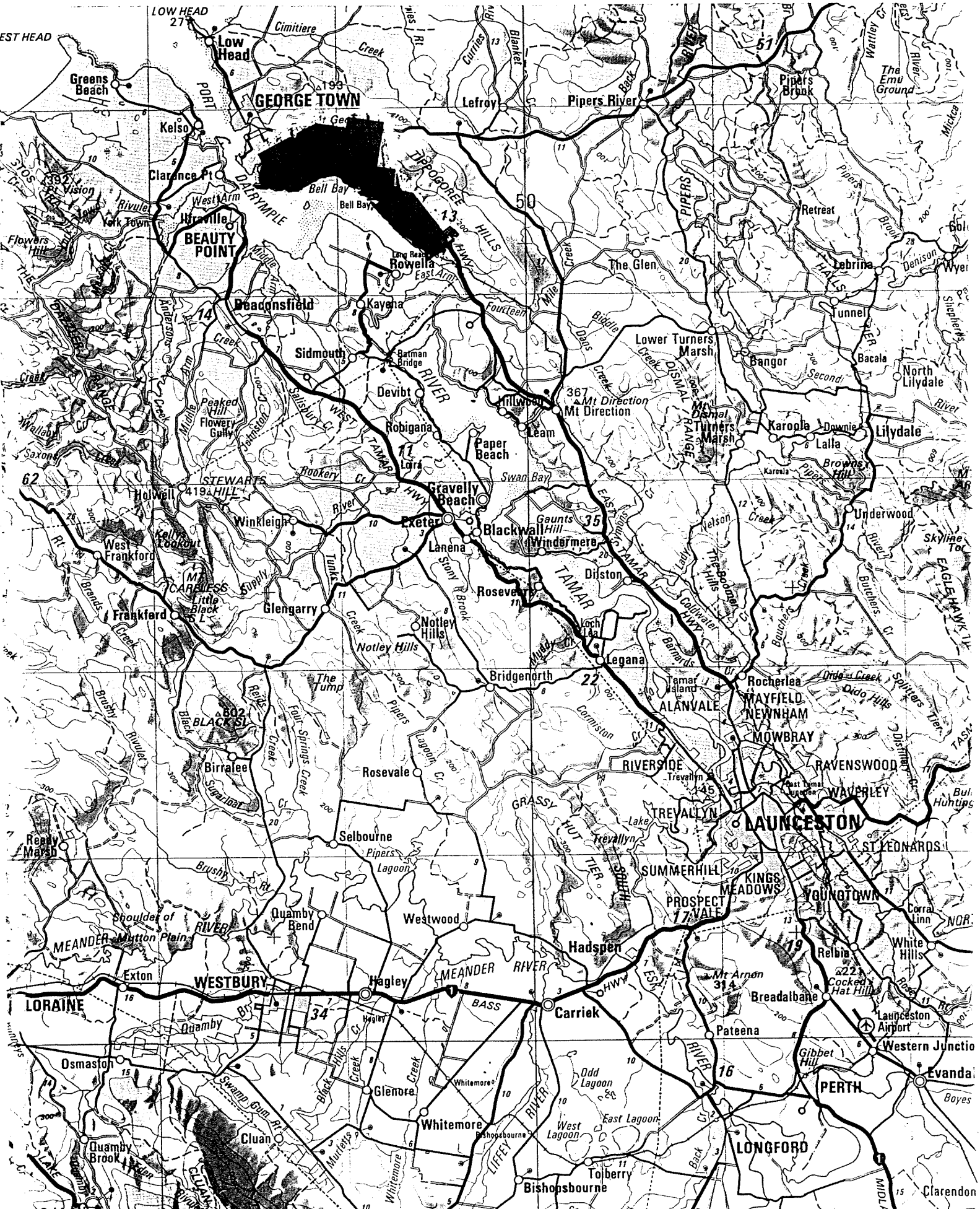
Our client believes it is not just that there is an opportunity for a super quarry to be established at Bell Bay in Tasmania but that the quality of the resource is such that it can be marketed as a premium product into niche markets.

The site and existing infrastructure also offer an opportunity to manufacture at Bell Bay high quality concrete products such as spun concrete pipes, concrete poles and concrete railway sleepers for shipping direct into export markets.

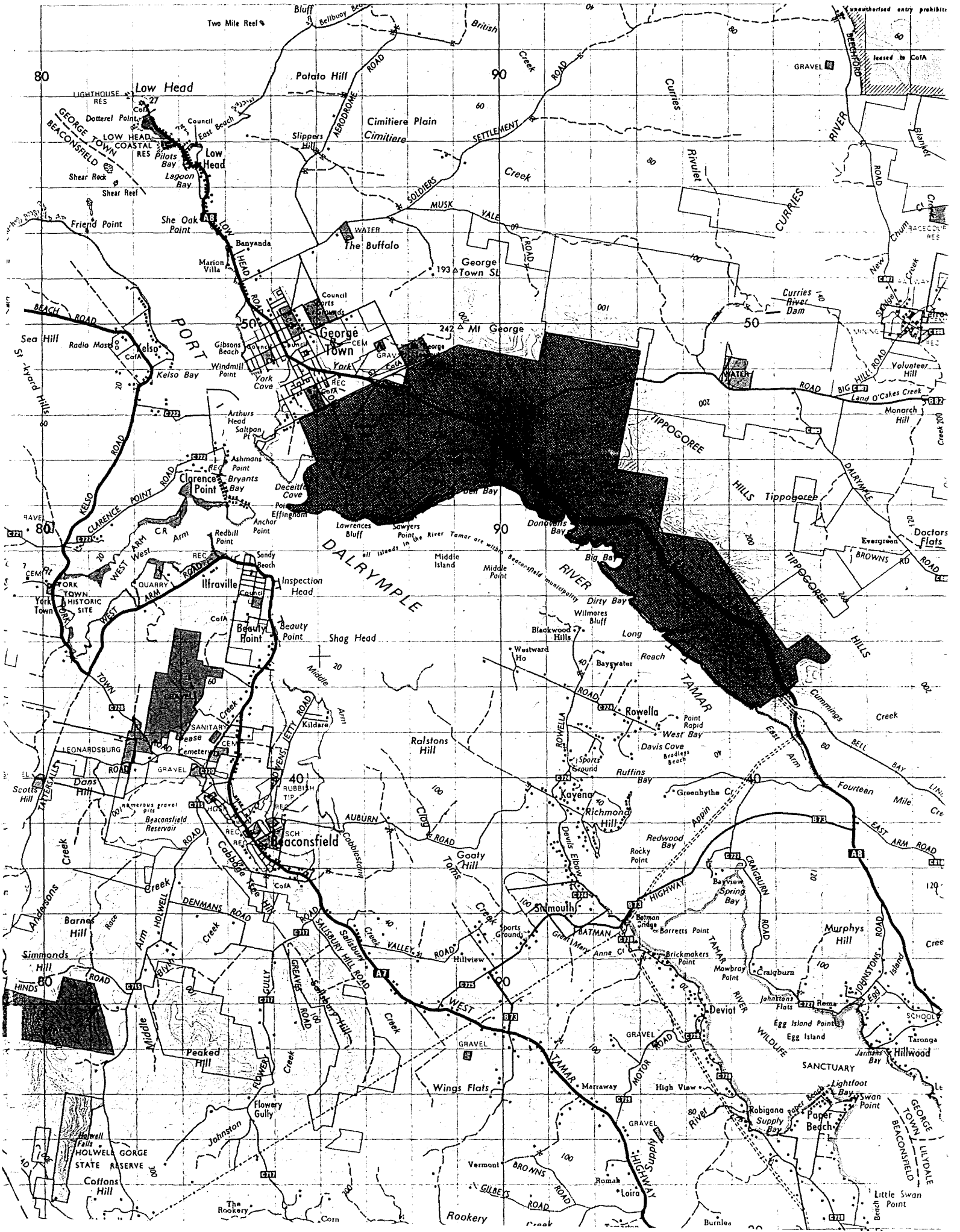


Tasmania is a self governing State within the Australian Commonwealth. It is a large island located to the south-east of the Australian continent and has an area of 68,300 square kilometres with a population of 430,000. The State's climate is classified as temperate maritime.

Bell Bay Tasmania
Location Map



BELL BAY
Site Map



5. BELL BAY, TASMANIA

Resource Assessment

Our client is the holder of an Exploration Licence (EL 10/90) issued under the Tasmanian Mining Act, 1929. The licence covers an area of 70 square kilometres on the eastern side of the lower Tamar River. The location plan showing EL 10/90 is on page 11. A geological map of the northern end of the licence area is shown on page 12.

Our client's exploration target has been to define the extent of dolerite deposits within the licence area and to assess their economic potential.

Dolerite is a relatively coarse-grained igneous rock which occurs over half of Tasmania. It is quarried extensively to meet local demands for crushed stone for concrete aggregates and road construction. It is a proven high quality product for these purposes. The physical properties of Tasmanian dolerite are outlined in the Division of Mines Report 1991/22 which is appended.

A Table containing a list of aggregates in order of quality prepared by E J Munty Petrology in relation to road materials published in the Royal Society of New South Wales journal 97 p. 47 is also appended. This shows dolerite has the highest percentage compliance with specifications of all the materials considered.

Within the licence area the dolerite is up to 300 metres thick and rises eastward from the Tamar River to form Mount George and the Tippogoree Hills. Exploration to date has consisted primarily of extensive geological mapping which has outlined an inferred resource of at least 1000 million tonnes of dolerite. From this work three potential quarry sites have been selected on the basis of:

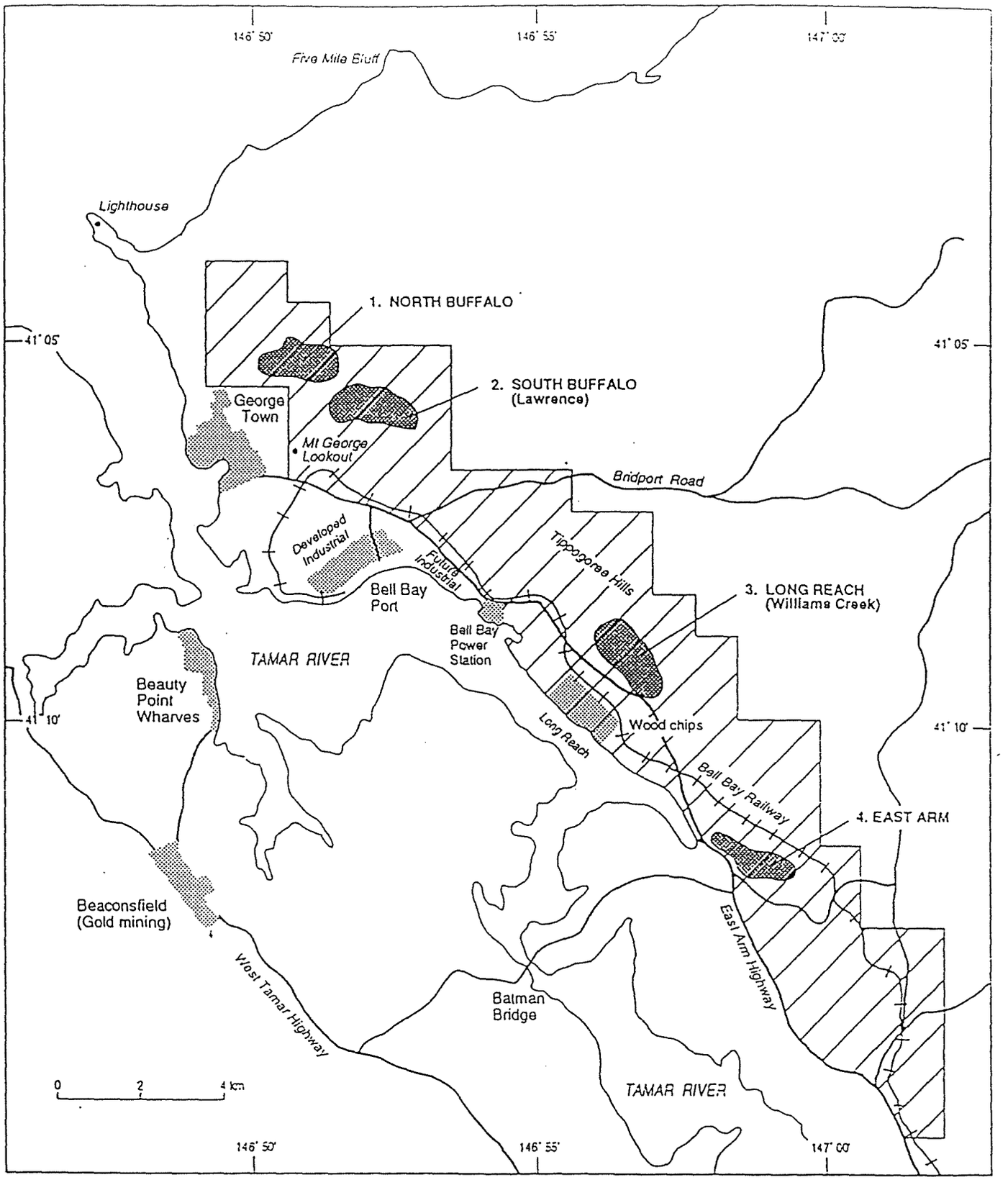
- the close-jointed or platy nature of the dolerite which is suitable for crushed stone production
- proximity to existing infrastructure

A fourth site at East Arm is in a different rock type - alkali basalt - which is not chemically suitable for concrete aggregate but whose wide joint spacing makes it a good source of armour stone for sea-walls, embankments etc.

Our client's preferred site for initial production is at Williams Creek because it is within 1.5-2.0 km of ship loading facilities at Long Reach. A map of the Williams Creek site is on page 13.

The Williams Creek site has an inferred resource of 500 million tonnes of dolerite if excavated to creek level. Further exploratory work is necessary to confirm the continuity and quality of the deposit and to upgrade the resource estimate to the status of a "measured reserve". Testing

of both drill cores and a bulk sample of rock will be required to determine its physical properties, and crushing/screening plant design parameters. These factors will be a necessary part of the economic assessment required to establish a "mineable reserves" estimate.



Location Map to show EL10/90 (broad cross-hatching), preferred quarry sites (dark dot screen, numbered and named), towns and industrial areas (fine dot screen), and principal roads, in relation to the Tamar River and the Port of Bell Bay

FIGURE 1

LOCATION PLAN

E.L 10/90

BELL BAY
Geological Map

Ts — Sand, clay and gravel: Tsc — carbonaceous silt. Tsg — dominantly rounded gravel.

Jdl — Boulder bed of dolerite (Jdl) with sand – clay matrix.

Tb — Interlayered basalt flows.

Qs — Sand, silt and clay, with occasional gravel probably derived from Tertiary deposits.

Qp — Silt with rounded clasts of granite, schist, quartzite, conglomerate, derived from Permian strata.

Qt — Talus: Qtb — basalt, Qtd — dolerite, Qtg — gravel

Tbr — Basalt in situ: Tbr — basalt rubble probably indicating Tb underneath.

Tbd — Basanitic dolerite.

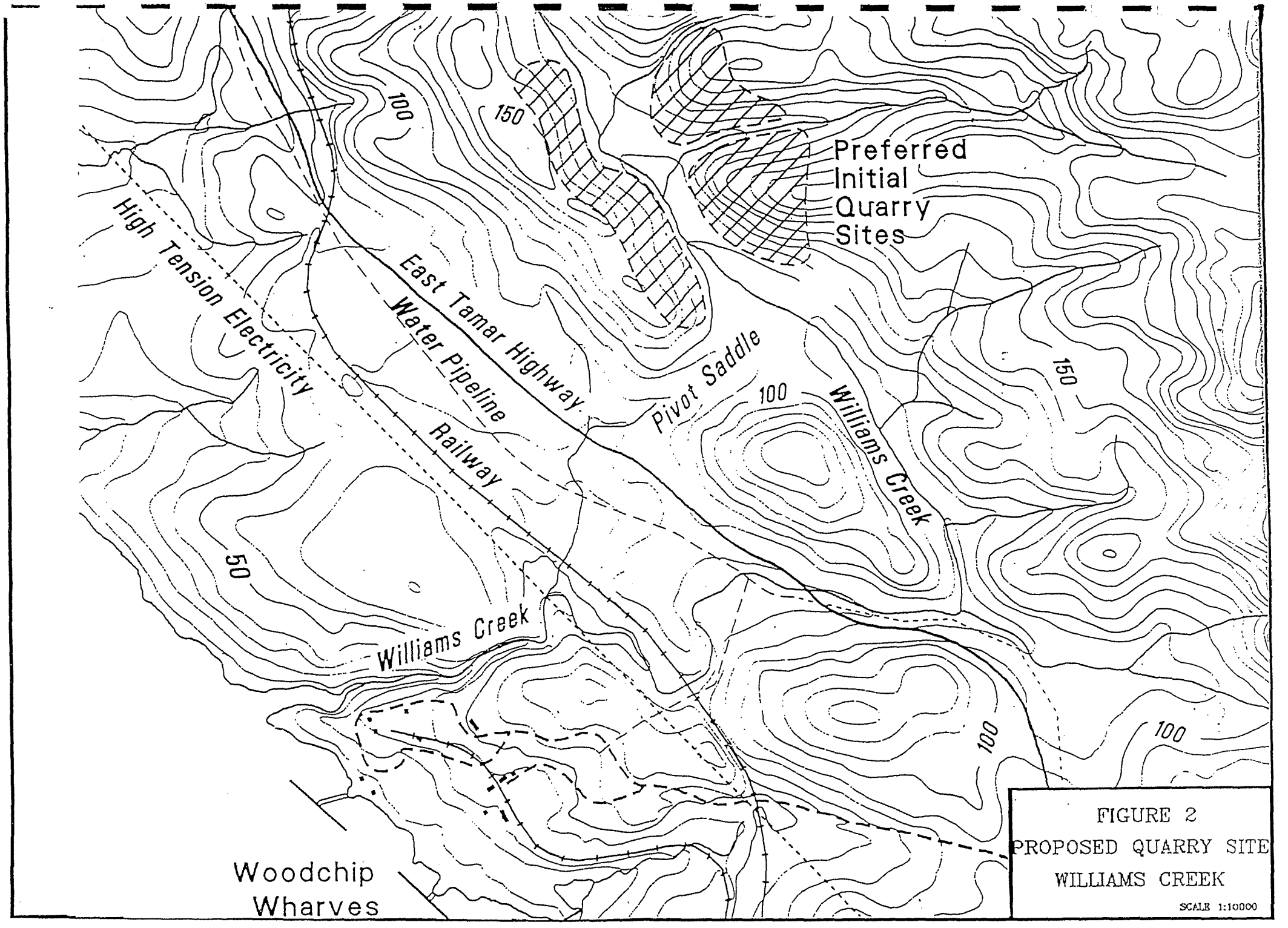


FIGURE 2
PROPOSED QUARRY SITE
WILLIAMS CREEK

SCALE 1:10000

Bell Bay as a Location for an Export Quarry

The proposed quarry is adjacent to a deep water port with established infrastructure.

A 2,300 ha Bell Bay Industrial Zone has recently been proclaimed. Part of the proposed quarry site is actually located within the boundaries of this zone. A map of the Bell Bay Industrial Park showing existing infrastructure is shown on page 16.

The existence of the Bell Bay Industrial Zone with its established export oriented industry including Comalco, Temco, Southern Aluminium, CAPCO, APPM and Boral provides a level of long term security for the quarry operation.

The Tasmanian Government through its development agency the Tasmanian Development Authority (TDA) supports the development of major projects through industry strategy plans. These plans are driven by Tasmanian commitment to facilitating international competitiveness and sustainable development.

The plans are designed to build on the strength and resources of the state, leading to economic expansion, improved quality of life and standard of living. The TDA acts in the role of facilitator to streamline the processes of government in relation to new industry development in the state. It ensures delays during project planning and approval stages are minimised. Evaluation is supported by the appointment of a TDA manager responsible for a specific project. Our client has received considerable assistance and support from the TDA which has appointed from its staff Mr Jon Everett as the manager responsible for this project.

A major portion of the strategy plan for the development of heavy industry in this state is based around the Bell Bay area and its significant infrastructure, existing industry, vacant land and deep water facilities. (See Bell Bay infrastructure map.)

The Bell Bay Industrial Zone is zoned "Heavy Industrial" and is well buffered from residential areas.

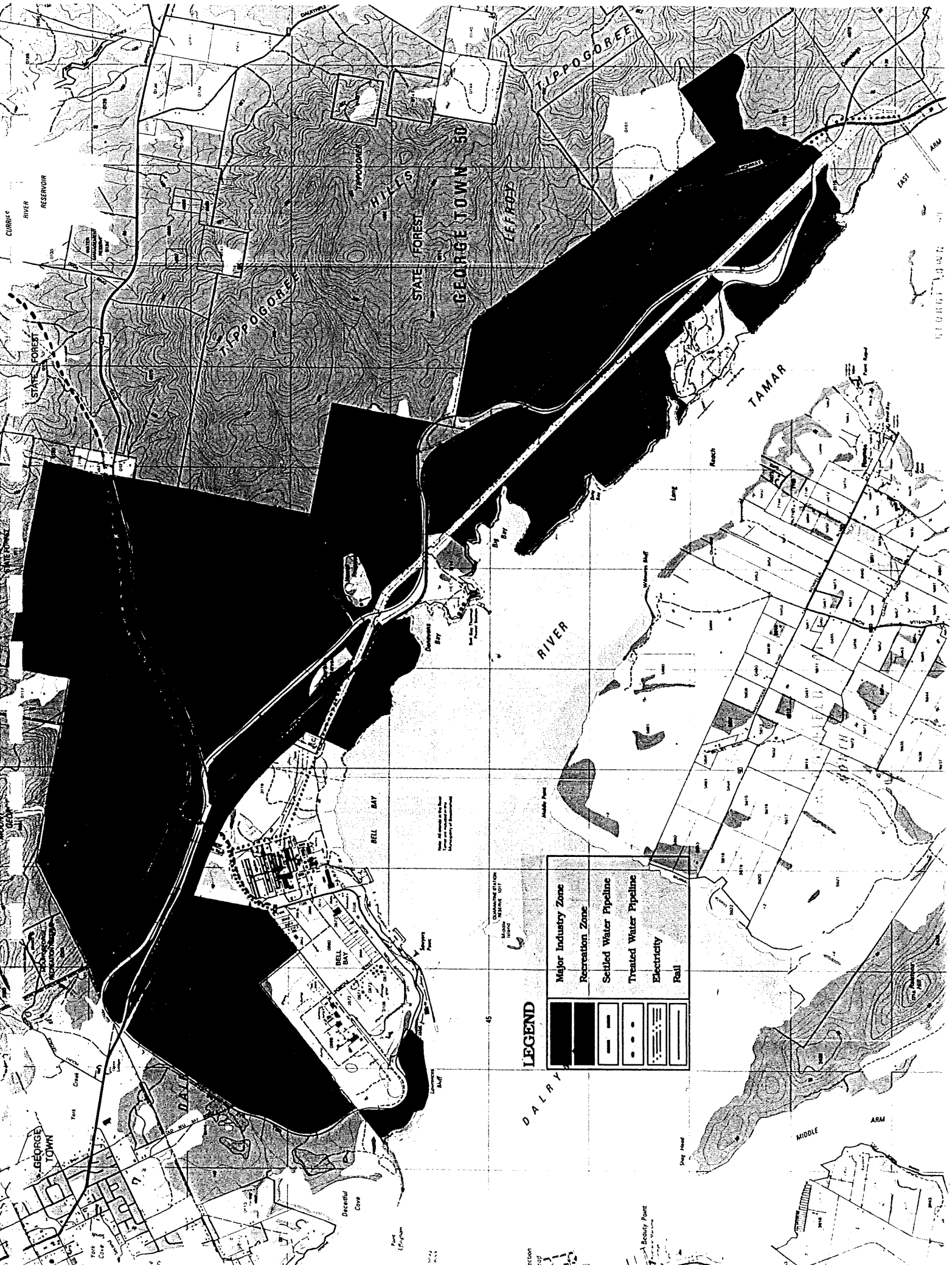
The guidelines for the zone were developed to preserve its long term economic viability and integrity. The wider aim of the guidelines are to minimise risk for industry and its long term strategy planning. All relevant community and environmental groups were consulted as part of the process for rezoning the Bell Bay zone as "Heavy Industries".

Since the establishment of the Bell Bay Industrial Zone in June 1990, community debate about project site selection has been significantly reduced and the approval process for new industries has been simplified.

Base line environmental studies are under way and these, in conjunction with established guidelines, provide an information base to streamline the development of environmental impact studies for future projects.

Bell Bay's outstanding infrastructure includes a deep water port, a railway, a well developed highway structure and reliable supplies of water and power. Nearby major residential and business areas offer a ready supply of labour and support services. George Town is the nearest residential centre and has a population of approximately 6,000. There are approximately 3,000 people employed in the Bell Bay/George Town area with more than half employed in the major industries. Workers commute to Bell Bay from George Town and from other centres including Launceston, which has a population of 93,000. Many of the workforce are highly skilled. New industries are achieving single plant unions and multi skilling agreements.

BELL BAY INDUSTRIAL PARK
Infrastructure Map



6. PROPOSED OPERATION

General

The Williams Creek quarry site is easily accessed from the East Tamar Highway and is located approximately 2 km from the woodchip loading wharves. The site is bisected by Williams Creek which would allow quarry faces to be opened on both sides of a central access on the valley floor. Working the two hillsides simultaneously will provide greater flexibility in operations and simplify any potential expansion in production rate.

Production of 1 mtpa has been used by our client to consider the viability of establishing an export quarry at this site. This would give a mine life well beyond 50 years. Operations are normally planned for 15-20 years life, therefore production from this initial site could be expanded greatly before additional sites need to be opened up.

Quarry Layout

Quarry layout would follow standard practice with bench heights of 10-15 m. Dolerite is a very competent rock and the quarry could be designed with a steep final batter (+50°). Final environmental and rehabilitation considerations may dictate a shallower slope (-40°) to facilitate replanting and a more stable final shape.

Clearing and Overburden Removal

The area is covered by dry sclerophyll forest. There is little topsoil particularly on the hill sides where vegetation is growing within the joints in the rocks. Under environmental guidelines topsoil will be saved and stockpiled for progressive rehabilitation of mined out areas.

The rock is not significantly weathered so overburden removal is virtually nil. This represents a significant saving on operating costs (approx. AUD 2 per tonne) compared with many quarries and eliminates the need for maintenance and rehabilitation of waste dumps.

Drilling and Blasting

A nominal drilling pattern of 3.5 m (spacing) x 2.4 m (burden) inclined at 10-15° from vertical and hole diameter of 100 mm has been used for this assessment. This is a fairly standard blast hole pattern for quarries but will be subject to variation after fragmentation studies are completed.

Holes will be drilled with 1 m sub-depth to achieve clean breaking of bench toes.

This pattern represents 25-28 tonnes per metre drilled. For a production rate of 1 million tonnes/year two self propelled diesel-hydraulic drilling rigs would be required. These would be equipped for drilling holes up to 20 metres depth and 70-100 mm diameter. Quarry drilling is normally done dry and the rigs would be equipped with dust collection/suppression equipment.

Blast holes will be dry therefore the most likely explosive type will be ANFO initiated by primers and non electric millisecond delays. Explosive usage will be approximately 0.2 kg/tonne.

It is expected that a specialised contractor will be used for blasting since blasts will normally be only 1-2 times per week.

Loading and Trucking

Blasted rock will be loaded from the face by a wheel loader of 6-8m^3 bucket capacity (Caterpillar 988B or equivalent). Haulage to the crushing plant may initially be by loader. As haul distances increase the rock will be loaded into 50 tonne capacity dump trucks (Caterpillar 77B or equivalent) for transport to the crusher bin.

A second smaller loader (Caterpillar 980C or equivalent) will be used for stockpile movement and as back-up to the main production loader.

Crushing Plant

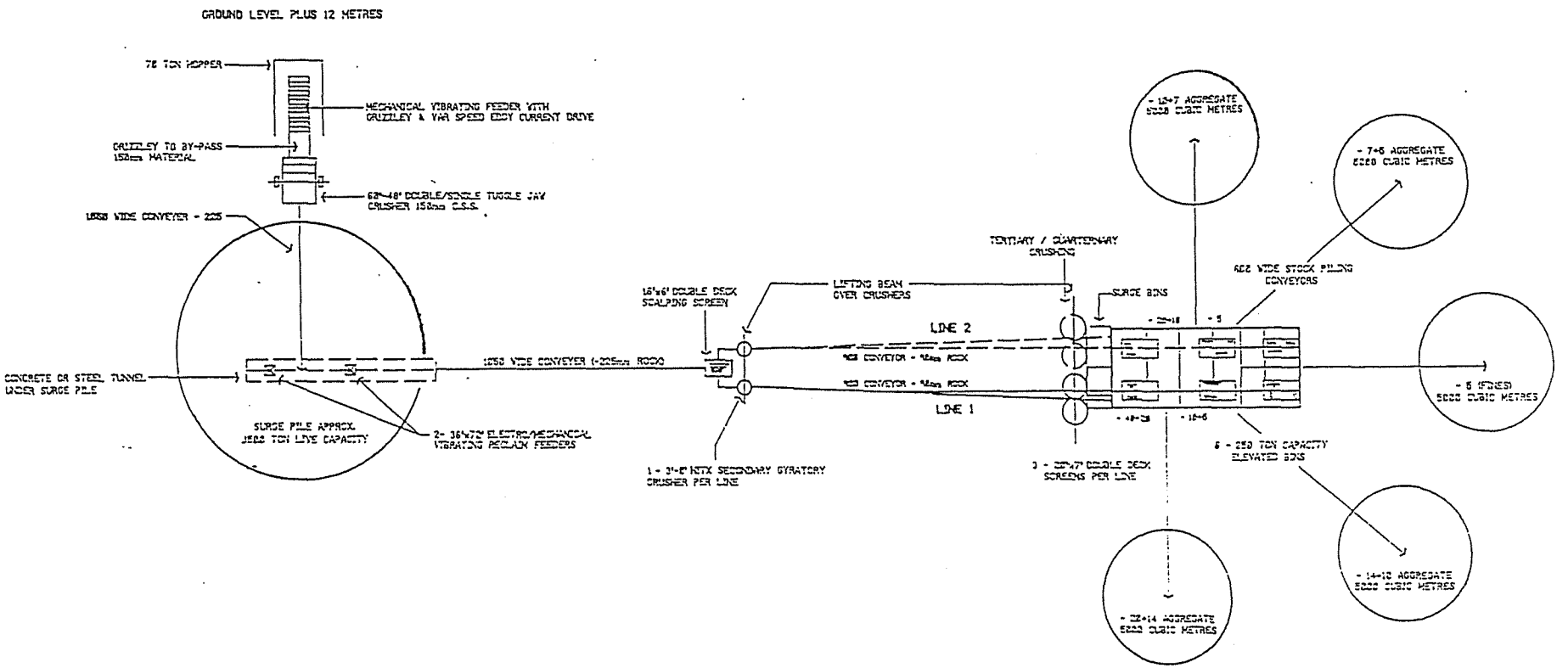
The crushing plant will be designed for production of 1 mtpa on a single shift basis. Plant layouts are typically three or four stage crushing with crushed rock conveyed to a screening plant for reparation to different aggregate product sizes. An indicative plant layout has been suggested by Jaques who are one of Australia's major suppliers of quarry crushing and screening equipment. This layout is shown on page 19.

Final crushing plant specification will be dependent on testing of rock samples and product specification.

Transport - Quarry to Port

There are two options for transport of crushed aggregate to the ship loading stockpiles, road haulage or conveyor.

SUGGESTED 250 TO 500 T.P.H. CRUSHING & SCREENING PLANTS
TYPICAL LAYOUT & GRADINGS



A) INITIAL PLANT DESIGN IS TO USE LINE 1 ONLY TO PROCESS APPROX. 250 TPH TO -20mm AGGREGATES.

PLANT COMPRISING		OR ALTERNATIVELY
60 x 48 JAW SURGE PILE	PRIMARY CRUSHER	62 x 48 JAW PRIMARY SURGE PILE
3' HITX GYRATORY	SECONDARY CRUSHER	3' HITX GYRATORY SECONDARY
No. 50 GYRACONE	TERTIARY CRUSHER	)
No. 35 GYRACONE	QUARTERNARY CRUSHER	)-CANICA 100
3 OFF 20 x 7 DOUBLE DECK SCREENS		3 OFF 20x7 DOUBLE DECK SCREENS

B) FOR EXPANSION TO 500 TPH IT IS PROPOSED TO DUPLICATE SEC. TERT/QUART CRUSHERS AND SCREENS AS LINE 2.

PRIMARY CRUSHER, CONVEYOR, SURGE AND RECLAIM SYSTEM, AND SCALPING SCREEN WILL BE DESIGNED TO HANDLE THE HIGHER CAPACITY.

APPROX. ANNUAL CAPACITY
9.5hrs/DAY x 5 DAYS x 50 WEEKS x 0.85 UTILISATION
= 2000hrs x 250T/hr = 500,000 TONNE/ANNUM
OR
= 2000hrs x 500T/hr = 1,000,000 TONNE/ANNUM

FIGURE 3
CRUSHING PLANT
SCHEMATIC LAYOUT

Road haulage is likely to be used in the initial stages of the project until firm long term contracts are established. Trucking would probably be by contractor(s). Contract trucking costs are estimated by our client at AUD 2 per tonne.

The plant site is approximately 1.5 km in a direct line from a deep water site and for handling large tonnages a conveyor would be the cheapest transportation method for production rates over 500,000 tonnes/year. Mr Don Reed, a partner in Sinclair Knight and Partners, Consulting Engineers, prepared a report for our client which estimated the cost of constructing a conveyor system to transport product from the quarry to the ship loading site at AUD 2 million with operating costs of approx. 30¢ per tonne.

Ship loading facilities would require the construction of aggregate stockpile areas/bins with reclaim feeders and conveyors feeding a main ship loading conveyor, three or four dolphins and catwalks. This work is estimated to cost approximately AUD 2 million.

Site Buildings

Building requirements on site will include:

- Main office block which would include accommodation for site administration, first aid room, change room and crib room for a workforce of up to 30 personnel.
- A workshop/store building designed for maintenance of heavy equipment.
- Magazine storage for explosives and detonators.

Services

Water Supply

Water can be obtained from the main George Town supply line which runs parallel to the East Tamar Highway.

A small storage dam for recycled water for the crushing/screening plant will be located near the quarry site.

Electric Power

A high voltage power line is located near the East Tamar Highway. A sub-station to provide power at 3000V and 415V will be established near the plant site. Estimated power requirement is approximately 1MW.

Waste Disposal

Disposal of solid wastes and drummed waste oil will be organised with appropriate local contractors.

It is assumed that sewerage and sullage will be handled by a septic system and manual soak drainage.

7. STATUTORY REQUIREMENTS AND APPROVALS

State Government

Mining Lease

The Exploration Licence area is located on a mixture of freehold, crown land and state forest. Part of the area is in a forestry RAP (Recommended Area for Protection). Agreement with the various parties has been obtained for initial exploration.

To be granted a mining lease over the Williams Creek quarry site the following steps will be taken :-

- Agreement with the private landowners(Comalco Ltd) on compensation and royalty payments.
- Agreement with the Forestry Commission to excise part of the RAP.
- Submission of a plan of proposed operations.
- Preparation of an Environmental Impact Statement and Rehabilitation Plan.

Licence To Operate Scheduled Premises

The granting of a mining lease only protects the lessee's right to mine the product. The actual operation of the quarry and plant will require a licence to operate a "scheduled premises" from the Department of Environment and Planning. To obtain this licence will require :-

- Submission of a development proposal outlining the proposed operation. Following discussion and consultation the Department will issue guidelines for the preparation of a Development Proposal and Environmental Management Plan (DPEMP).
- Preparation of an EMP would generally follow the guidelines as appended. The plan would normally cover :water supply, solid and liquid waste disposal, atmospheric emissions (including dust), visual impact and noise, impact on flora and fauna, archaeological and heritage study, monitoring and review programs, rehabilitation and abandonment.

The EMP's will be are open to comment and/or objection from the public and the process includes time for review of objections and modifications to the EMP.

Other Government Agencies

As well as Mines, Environment and Forestry, other Government agencies will need to be consulted and approval granted for specific aspects of the proposal.

In particular the construction of an overland conveyor would require consultation with the Department of Roads & Transport, Hydro Electric Commission and Australian National Railways.

Construction of the passing lane and junction of the Quarry access road and East Tamar Highway will be to DMR specifications.

Storage of hazardous substances and explosives will require approval and licencing by the dangerous goods branch of the Mines Department.

Operation of the quarry and plant will be subject to the Mines Inspection Act 1968 and Mines Inspection Regulations 1991.

Local Government

The Development plan will be submitted to the local (George Town) council for planning approval. This submission is also subject to public comment and objections.

Port Of Launceston Authority

All Shipping movements in the Tamar River are under the control of the PLA whose involvement will be necessary in the construction/use of ship loading facilities and finalisation of shipping arrangements.

Commonwealth Government

The Commonwealth Government will be required to approve the export of products to foreign destinations.

Our client has, during the past two years had extensive discussions with state and local government agencies including, in particular, officers from the TDA, Mines Department, George Town Council and the Port of Launceston Authority. The location, scale and operation of the proposed quarry has been discussed in detail with officers from these agencies who are supportive of the project. A letter dated 16 March 1993 from the Municipality of George Town is appended.

8. MARKET INFORMATION SUMMARY

The following is a brief summary of a limited survey of Pacific Rim port cities carried out by our client and Austrade representatives to determine prospective markets for a Bell Bay export quarry.

Consumption of rock is 2-7 tonnes per head of population per year based on official statistics for Japan, New Zealand and Australia.

North East Asia

Japanese consumption according to government statistics is 1,000 mtpa with the Tokyo/Yokahama region consuming 300 mtpa. Our client's research which is corroborated by information from Austrade indicates a selling price in Tokyo of about AUD 32-40 per tonne. MITI have advised Austrade that their estimate of domestic aggregate supplies is about 10 years, with a 5 year minimum.

Austrade representatives are also very keen on the market prospects in mainland China.

New Zealand

Auckland - usage in Auckland is 5-8 mtpa with the major existing near-city quarry's life limited to approximately 8 years. City expansion in Auckland has resulted in development over potential quarry sites. The north side of the harbour is without a local supply of high quality aggregates and could be an early potential market.

Australia

Sydney - usage is 7-8 mtpa supplied by three major companies. Current selling price in the Sydney CBD is $34.50-$35.50 per tonne. This cost is likely to increase with higher transport costs from new quarries being developed in the Mittagong/Berrima region. Our client considers that sea-transported products should be competitive in markets within 10-15 km of the CBD.

Adelaide - urban expansion has caused pressure to be applied to close the existing quarries. This would require new quarries to be established, possibly up to 100 kms distance from the city. Usage is believed to be 6 mtpa.

Perth/Fremantle - the situation in Perth/Fremantle is similar to Adelaide with quarries located in the Darling Escarpment distant from the central city area.

9. FINANCIAL

During the past two years our client has undertaken a detailed analysis of

- the cost of establishing a super quarry at Bell Bay
- the cost of operating a super quarry
- the cost of shipping bulk cargoes in the Pacific region

Establishment cost figures have been drawn from our client's general experience and from figures provided orally by the manager of a 1 mtpa quarry.

The cost estimate for the conveyor system to transport product from the quarry site to the ship loading site of $2 million was prepared by Mr Don Reed, a partner and quarry specialist in Sinclair Knight & Partners, a major firm of consulting engineers.

Quarry operating costs are as provided by a major Australian hardrock quarrying company.

Indicative shipping costs have been obtained by long investigation by our client, in particular direct enquiries of government and trade agencies involved in shipping, exporting mining companies, and industry publications.

Shipping costs form the largest cost component with a total cost used in the following projections of $18.70 per tonne for the shipment of product from Bell Bay to Tokyo. Our client believes bulk cargoes such as coal and iron ore on a piston (regular) run are now being shipped from Australia to Japan for a charter cost in the range USD 8-10 (AUD 11.40 to 14.30) per tonne. Shipping costs fluctuate within a band according to the economic cycle and other factors.

The following capital and operating cost estimates, sales projections and internal rate of return calculation "the projections" have been prepared by or for our client for its own use in evaluating the project. Whilst further more detailed information can be provided by our client these projections and any further information should not be relied upon by third parties who should make their own enquiries.

In preparing the projections the following assumptions have been made.

1. It will take up to two years

   - to investigate the project further and obtain the necessary approvals
   - to purchase and instal the necessary plant and prepare the site for commencement of operations

2. The first year's production and sales will be 500,000 tonnes, thereafter 1 mtpa.

3. Mobile plant is written off after 5 years at which time it is replaced with the replacement plant being written off over a further 5 years.

4. No allowance is made for inflation in capital costs, operating costs or sales revenue. The IRR is therefore a real IRR.

5. Sales are to Japan at a sale price of AUD 35 per tonne, free in hold Yokohama (Tokyo).

ESTABLISHMENT COSTS

STAGE 1

Prefeasibility

Site-testing and drilling	100,000	
Market study	100,000	
Preparation of development plan	100,000	
Admin./Financial/Legal	100,000	
		400,000

Project Planning & Approval

Engineering planning and design	250,000	
Environmental Management Plan	100,000	
Marketing	100,000	
Admin./Financial/Legal	150,000	
		600,000
		$1,000,000

STAGE 2

Site development

Slip lane to main road	
Access road to quarry site	
Drainage/dam construction	
Deforestation	
Earthworks/hard stand	
Plant & stockpile area	
Stripping of quarry area	
Fencing	
Quarry development planning	
Geological study	1,000,000

Mobile equipment

Drilling rigs	600,000	
Front end loader	600,000	
2 Dump trucks	1,400,000	
Smaller front end loader	400,000	
Road maintenance equipment	150,000	
		3,150,000

STAGE 2 Continued

Crushing and screening		
Primary crusher	400,000	
Scalper	50,000	
Conveyor system	250,000	
Secondary crusher	600,000	
Screens	250,000	
Weighbridge	130,000	
Other electrical and plant installations including tertiary crusher	2,000,000	
		3,680,000
Other including buildings		
Office	40,000	
Laboratory & equipment	200,000	
Workshop & tools	60,000	
Amenities	35,000	
		335,000
Conveyor		
1.5 - 2.0 kms of conveyor belt with infrastructure to include loading bins, bridge section, elevated section at stockpiles		2,000,000
Shiploading facility		
To include stockpile areas/bins, reclaim feeders and conveyors feeding a main shiploading conveyor, dolphins and catwalks		2,000,000
Contingency		1,000,000
		$12,165,000
TOTAL ESTABLISHMENT COSTS for Stages 1 & 2		$13,165,000
WORKING CAPITAL - estimate		$3,825,000

10. TASMANIA'S STRATEGIC ADVANTAGE

Local Government - George Town Council

George Town Council is highly supportive of industrial development and is probably one of the most efficient in processing development approvals in Australia.

Council may provide office space and facilities (telephone etc) in Council Chambers for Company project staff during the project construction period, and would commit its already established pro-industry record to reducing any costs or administrative delays within its influence to a minimum.

Community Infrastructure and Lifestyle

Bell Bay offers an outstanding place to work and to enjoy recreational opportunities with many hours saved in commuting time. Management and employees could look forward to a pleasant and rewarding lifestyle in the historical George Town/Launceston area

Statistics show that workers in the North of Tasmania tend to remain with one employer for long periods, often for their entire working life. Having established themselves in the area, most are reluctant to move. This is largely a reflection of the amenities and quality of life offered by the area, particularly for families.

Regional Facilities

George Town is in the immediate proximity of the industrial zone. Across the river is the Municipality of Beaconsfield and 40km upstream is the City of Launceston. The population distribution is as follows:

George Town	6,010
Beaconsfield	15,632
Launceston	93,347

These centres offer a full range of community facilities to support a wide mix of urban, rural or seaside lifestyles.

Launceston is one of Australia's major regional centres. It offers the very broadest range of services and facilities, both in terms of supplying industry with its needs and catering for the needs of the community.

The city offers entertainment and cultural facilities ranging from symphony concerts, one of the best museums in Australia (The Queen Victoria), a major convention and entertainment centre, cinema, concerts and cabaret, a University campus and the Australian Maritime College.

George Town and Beaconsfield municipalities have numerous beaches, boat ramps, golf courses and other facilities, and are a major tourist and holiday area of the State.

Above all, the George Town area offers room to grow. The Municipality covers 640 square kilometres and, apart from the proposed plant site, there is abundant, inexpensive and fully serviced industrial and residential land.

Housing

Quality housing is available at moderate cost on the private market. Average housing costs in Tasmania are the lowest in Australia. The median house price in Launceston is $80,500. George Town is even lower.

Emergency Services

All major industries in the Bell Bay area including the Port of Launceston Authority (PLA), HEC Thermal Power Station, TEMCO, Comalco, Boral and Super Vinyl (Plastics) have grouped to form an organisation known as the Bell Bay Industrial Mutual Aid Group (BIMAG). BIMAG members are coordinated by the Tasmanian State Emergency Service and provide reactive emergency services to industries in Bell Bay. Funding for BIMAG is via the membership and State Government. BIMAG conducts regular training exercises and is supported by regular equipment upgrades to support the industrial growth in the area.

Pacific Quarries will be invited to join and participate in BIMAG.

Resource Sector Employment

Sectors based on Tasmania's extractive and resource processing sectors account directly for approximately 41,100 employees or 21.5% of the employed labour force.

Population

Tasmania is the Southern-most State of Australia with a population of 452,847, representing 2.6% of the Australian population.

While Tasmania is the most decentralised Australian State with 60 per cent of the population living outside the capital city, there is a large skilled labour pool near industrial development sites.

The major population centres are:

		%
Hobart	181,838	40
Launceston	93,347	21
Burnie - Devonport	75,617	17

There were approximately 190,000 people in Tasmania's workforce at the beginning of 1992.

Employment Stability

On average, Tasmanians are more stable in their employment and hold their jobs for longer periods than people in other States. 58% of Tasmanians have occupied their current job for over 3 years compared to 54% for Australia as a whole. Nearly 26% of Tasmanian employees occupy their job for over 10 years.

The average time spent by Tasmanians in their occupation is 6.4 years compared to 6.0 years for the national average.

Labour force stability creates significant indirect cost savings for Tasmanian industry due to the reduction in costs associated with staff training and workforce reliability.

Industrial Disputation

Tasmania has by far the lowest level of industrial disputation of all the Australian states.

The number of working days lost in Tasmania for the 12 months ending September 1991 was 7,400. This is the lowest level of industrial disputation seen in Tasmania since 1969.

For the 12 months to September 1991, Tasmania lost 48 working days per thousand employees compared to 254 days lost in Australia as a whole.

Industrial Disputation and Stability

Average Weekly Earnings

Average weekly earnings for full-time adult employees by State are listed below. This gives a general indication of labour costs for each State.

Average Weekly (Ordinary Time) Earnings

	August 1991
NSW	613.70
VIC	593.20
QLD	561.60
SA	576.90
WA	608.20
TAS	570.80
Australia	596.80

Source: Australian Bureau of Statistics

Indicative Wage Rates

Wage rates under Tasmanian Awards are similar to the rates applying under Federal Awards throughout Australia. Generally, employees are entitled to payment for statutory public holidays, four weeks annual leave, two weeks sick leave and 3 months long service leave after 10 years of continuous service. A 17.5% annual leave loading is payable on annual leave pay under most awards.

Labour On-Costs

The States' labour on-costs published by the Australian Bureau of Statistics, show that Tasmania has significant advantages in labour on costs compared to other Australian states.

Labour on-costs include wage related costs for time not worked such as annual leave, long service leave, sick leave, public holidays and other bonuses and additional costs such as payroll tax, superannuation and workers compensation .

Employers are required to take out Workers' Compensation Insurance to cover liability, including loss of earnings, arising out of the injury and incapacitation of their employees.

During the 1989/90 financial year Tasmania's private sector had the second lowest labour cost per employee, while NSW had the highest. Tasmania's total labour costs per employee for the private sector are estimated to be 5.8% below the national average.

Gross earnings which include gross wages and salaries and severance, termination and redundancy payments average $22,472 per employee in Tasmania compared to $23,508 for average Australian.

	1989/90	
	Tasmania $	Australia $
Payroll Tax	938	901
Superannuation	704	881
Workers Compensation	332	575
Fringe Benefit Tax	103	194
Total On-Costs	2,076	2,551
Total Labour Costs	24,548	26,059

Source: Australian Bureau of Statistics

Labour on-costs in Tasmania are 19% below the national average. Labour on-costs as a percentage of total labour costs are significantly lower in Tasmania (8.5%) and Queensland (8.2%), compared to NSW (9.8%), South Australia (9.8%), Western Australia (10.00%) and Victoria (10.7%), with the Australian average at 9.8%.

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Tasmania Department of Resources and Energy

Division of Mines and Mineral Resources — Report 1991/22

Some physical properties of dolerite

by D. J. Sloane

Abstract

Dolerite, an igneous rock, is exposed over half of Tasmania. The good physical and chemical properties of the rock make it suitable for a wide variety of uses. Crushed rock is used as aggregate in concrete, as road sub-base and in flush seals, as facing stone in building construction, and as armour stone and rip-rap.

INTRODUCTION

Following a request for information concerning the physical properties of dolerite, a brief attempt was made to collate such information. Fresh dolerite rock is considered to be very strong and is not greatly affected by weathering. The uses for this rock are widely accepted and its physical properties are suitable for most purposes. This appears to account for the difficulty in obtaining test information, a reason confirmed by some of the information sources contacted.

Information concerning the strength properties was sought from: Rivers and Water Supply Division; University of Tasmania; Hydro-Electric Commission; major quarry companies; consultant engineers; Division of Mines and Mineral Resources; Concrete Association; and the Department of Roads and Transport.

GEOLOGY

Dolerite is an igneous rock, that is, rock initially molten and injected as a fluid into older sedimentary rocks. The magma, of quartz tholeiite composition, was emplaced as a liquid which rose upwards through the basement rocks into older sedimentary rocks of the Parmeener Supergroup. Emplacement probably occurred over an interval of 20 million years, and the average age of the rock is middle Jurassic, approximately 175 Ma (Hergt *et al.*, 1989).

Approximately half the area of Tasmania is underlain by Jurassic dolerite. The estimated volume of dolerite is of the order of 15 000 km^3 (Hergt *et al.*, 1989).

Dolerite is composed of two essential and several accessory minerals. The essential minerals are plagioclase feldspar and pyroxene, which together constitute between about 60% and 80% of the total rock composition. The accessory minerals are quartz, orthoclase, chlorite and magnetite. Quartz, orthoclase and chlorite may comprise 20% to 40% of the rock while the magnetite composition may be 2% to 3% (Leaman, 1973).

Numerous quarries occur throughout the State, with preferable sites close to contacts where jointing is platy. Decomposed, usually coarse-grained granophyric dolerite is used for surfacing unsealed roads.

PHYSICAL PROPERTIES

The physical and chemical properties of dolerite make it highly suitable for a variety of purposes. It is used mainly as crushed aggregate in concrete production, as road sub-base and in flush seals, facing stone in building construction, and as armour stone and rip-rap.

The physical properties of dolerite are given below for various localities. There is, however, no rock description for some sites. It can only be assumed that the tests were conducted on the best representative samples for each site. The physical properties of dolerite will vary depending on the grainsize, composition, degree of weathering and physical defects.

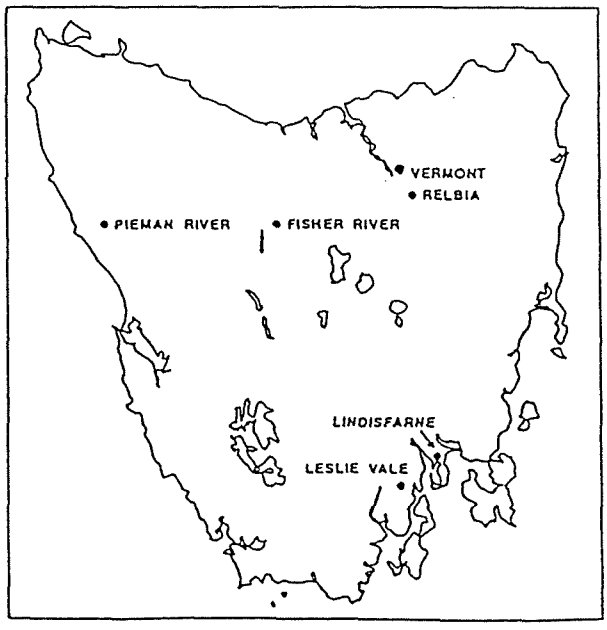


Figure 1. Location of sites of tested materials

Leaman (1972) provided a general summary of the physical properties of dolerite for the Hobart area. The source of this information is not known but the information may be useful as a general guide.

Density:	2.80–3.10 t/m^3 (average 2.9–2.95 t/m^3)
Poissons ratio:	0.02–0.1 (weathered) 0.3–0.4 (unweathered)
Youngs modulus:	10–40 GPa (weathered) 90–110 GPa (unweathered)
Bulk modulus:	5–30 GPa (weathered) 90–100 GPa (unweathered)
Rigidity modulus:	10–50 GPa (unweathered)
Uniaxial compressive strength:	40 MPa (unweathered)
Porosity:	Approximately 1%

The physical property results from tests obtained at various specific sites (fig. 1) are presented below.

Density

Apparent Density

Lindisfarne:	2.91 t/m^3 (date ?) 2.905 t/m^3 (June 1989) 2.88 t/m^3 (20 mm screenings) 2.73 t/m^3 (37 mm crusher run)

Bulk Density — Saturated surface dry

Relbia:	2.89 t/m^3
Lindisfarne:	2.865 t/m^3 2.85 t/m^3 (20 mm screenings) 2.68 t/m^3 (37 mm crusher run)
Fisher:	3.01 t/m^3 (figure quoted as 'density', samples air dried and saturated prior to testing)

Bulk Density — Oven Dry

Relbia:	2.87 t/m^3
Lindisfarne:	2.84 t/m^3 2.83 t/m^3 (20 mm screenings) 2.65 t/m^3 (37 mm crusher run)
*Pieman (1978):	2.96 t/m^3 (mean of 18 samples) 2.95–3.004 t/m^3 (range for good quality rock)
*Pieman (1983):	2.971 t/m^3 ('Hard' rock — mean of 9 samples) 2.935 t/m^3 ('Soft' rock — mean of 10 samples)

*N.B. Results quoted as 'Dry Density'. The Pieman (1983) results subdivided samples into 'hard' and 'soft' categories, depending on the ease of percussion drilling.

Water Absorption

Relbia:	0.6%	
Lindisfarne:	0.9%	
Lindisfarne:	1.09% 0.56%	(37 mm crusher run) (20 mm screenings)
Pieman (1978):	0.7% 0.3–0.6%	(mean of 20 samples) (range of values — good quality rock)
Pieman (1983):	0.28% 0.35%	('Hard' rock — mean of 9 samples) ('Soft' rock — mean of 10 samples)

Unconfined Compressive Strength

Relbia:	Core 1 — 90 MPa Core 2 — 125 MPa Mean — 108 MPa (50 mm diameter core approximately 200 mm in length)
Pieman (1978):	171 MPa (mean of 18 samples) 91–282 MPa (general range for good quality rock, although one sample gave 369 MPa)
Pieman (1983):	253 MPa ('Hard' rock — mean of 9 samples) 173 MPa ('Soft' rock — mean of 10 samples)
Fisher:	Mean 91 MPa (range of results was 30–155 MPa)

Schmidt Hardness

Pieman (1983):	43–44 for good quality fresh rock

Wet/Dry Strength

Lindisfarne:	Dry strength = 282 kN Wet strength = 197 kN Wet/Dry variation = 30%

Los Angeles Test Values

Lindisfarne:	Los Angeles Test 'A' grading 1985 — 16.5% (37 mm crusher run)
Lindisfarne:	March 1989 — 15.0% August 1990 — 15.0% April 1991 — 14.5%
Pieman (1978):	Los Angeles Test 'B' grading

Sample	*% loss*	*Quality*	*RQD (%)*	*Weathering*
1	13.7	Good	95	Fresh
2	9.7	Good	95–100	Fresh
3	14.5	Poor	0–75	Partly weathered
4	16.5	Poor	0–50	Partly weathered
5	6.3	Good	100	Fresh

Vermont: Los Angeles Test 'B' grading 14% (16 mm aggregate)

Polished Aggregate Friction Values

Lindisfarne: 52 (RCA Victoria Method 374.01)

Leslie Vale: 51 (AS1141-41/42)

Vermont: 46 (AS1141-41/42) (14 mm aggregate) 45 (10 mm aggregate)

California Bearing Ratio

Vermont: 220 (37 mm crusher run)

Point Load Strength

Pieman (1978): Is (50) MPa for 20 specimens. Refers to above samples.

Sample	*Median*	*Mean*	*Standard Deviation*	*Weathering*
1	15.4	14.5	3.1	Fresh
2	13.4	11.6	5.6	Fresh
3	6.5	7.2	4.5	Partly weathered
4	4.2	4.6	3.1	Partly weathered
5	17.0	16.6	1.4	Fresh

Pieman (1983): Is (50) MPa for 20 specimens:

For 'Hard' rock: Mean — 18.1 (range 3.4 to 21.6)
For 'Soft' rock: Mean — 10.7 (range 2.6 to 20.7)

Young's Modulus

Pieman (1978)

Dynamic: 93 GPa (mean of 18 samples) 87–102 GPa (range for good quality rock)

Static: 96 GPa (mean of 5 samples) 101–110 GPa (range for good quality rock)

Pieman (1983)

Dynamic: 102 GPa ('Hard' rock – mean of 9 samples); 97 GPa ('Soft' rock – mean of 10 samples)

Poisson's Ratio

Pieman: 0.22 (mean of 5 samples) 0.217–0.240 (range for good quality rock)

Petrographic Descriptions

Lindisfarne

Rock species – diabase
Plagioclase – 63%
Augite – 37%
Texture – no orientation, even-grained, dominant grain size 0.5 mm. No weathering.
Vickers hardness – 740
Drillability Index – PNI = 32
Drilling rate index = 31
Friability index (S_{20}') = 31
PROTO 20 = 23, s = 1.1
Sievers J value (SJ') = 10, s = 3.8

Relbia — Sample 1

Dolerite. Fine grained, ophitic texture.

Primary minerals — plagioclase, pyroxene, hornblende and quartz. Acicular and lath-like plagioclase, equant grains of pyroxene — some alteration to chlorite along cleavage and fissures. Secondary minerals (10%) include chlorite. Quartz content 10%.

Relbia — Sample 2

Dolerite. Fine grained, ophitic texture.

Primary minerals — plagioclase, pyroxene, amphibole. Plagioclase crystals acicular, pyroxene grains subhedral with chloritised outlines. Secondary minerals (13.5%) include chlorite and quartz (8.8%).

Pavement Skid Resistance

Information source: *Relative Performance of Basalt and Dolerite Flush Seals* (DRT Report 85/93)

Summary

Test programme included a range of seal ages, traffic densities and curve radii. Skid resistance properties measured using the British Pendulum Tester. Testing generally done during winter months.

Test result trends are shown in Figure 2, where BPN skid resistance values vs. total vehicles (from AADI counts and years in service) are shown for curve radii greater than 500 m, between 500 m and 100 m, and less than or equal to 100 m. The results showed no positive indication of BPN values being a function of aggregate size (10–16 mm).

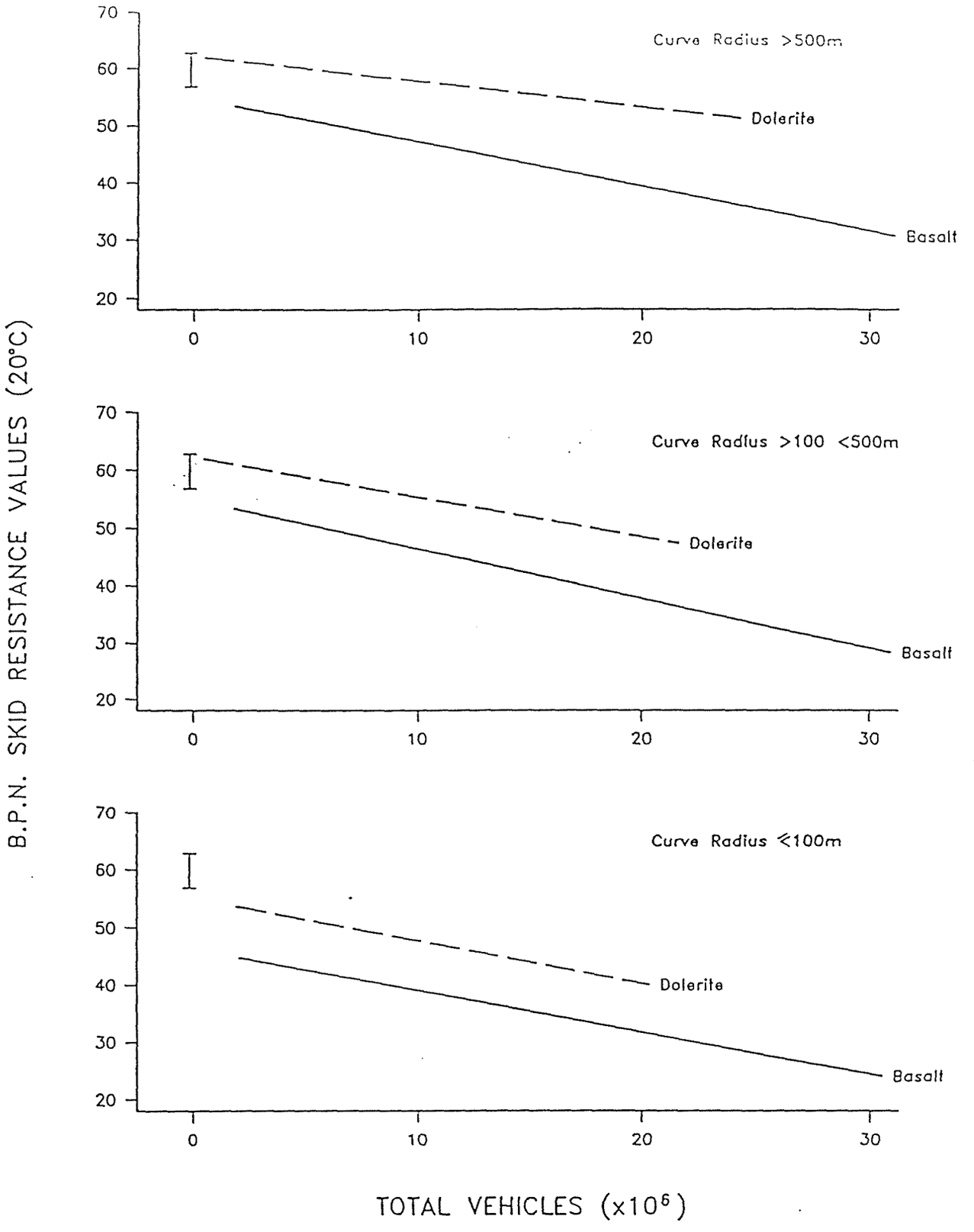
Results summary

Curve radii >100 m — Steady decline in BPN value from initial 60–65.

Curve radii <100 m — More rapid decline than above for the first 2.5×10^6 vehicles, but less than for basalt, followed by steady decline in BPN with continued traffic.

Lowest BPN value — 45 at 17.5×10^6 vehicles for curve radius less than 100 metres.

The results show that dolerites maintained higher levels of skid resistance, considered significant in the high traffic stress situations.



(I – Typical range of B.P.N. values on new, unfrafficked surface.)

(From DRT Report 85/93)

Figure 2

Physical properties of dolerite — BPN skid resistance versus total vehicles

CONCLUSIONS

The results reported in the body of this report indicate a range of physical properties for dolerite rock. The results were obtained from five locations. Variations in the properties of dolerite appear to be largely related to the degree of weathering and rock defects. Other factors, such as composition and grainsize, probably play a less important role in determining rock properties.

The Pieman (1983) results indicate differences in properties of good quality 'fresh' rock within the quarry. The results are interesting but no petrographic information was reported. The only reported differences were that the 'soft' rocks had slightly discoloured joints, evident in the broken uniaxial and point load specimens. Defects, and possibly slight weathering, appear to produce the difference in properties.

Comparative testing of basalt and dolerite indicates that dolerite has better properties for road seals. Dolerite has better polished stone values and skid resistance properties.

The results are considered to be representative of the general quality of dolerite currently quarried. However, not all results provided a description of the rock tested or the method of testing. Therefore they are only considered to be indicative of each site and cannot be assumed to apply elsewhere. The results provide an overview of physical properties but do not replace specific site testing.

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[31 October 1991]

LIST OF AGGREGATE TYPES IN ORDER OF QUALITY

(The Order is that of Average Test Results)

Rock Types	Per Cent Compliance with Specifications
Dolerite	83%
Quartzite, basalt	76
Microdiorite	75
Slag, limestone, microgranite	70
Granite, slate	67
Crushed river gravel	64
Volcanic breccia	52
Hornfels	48
Quartz	40

Source: Minty, E.J., Petrology in relation to road materials.
Journal and Proceedings, Royal Society of New South Wales, 97, p. 47.