

Seashore Engineering



FISHERY BEACH MARINA BOAT RAMPS AND JETTY REFURBISHMENT



TECHNICAL SPECIFICATION

**by Seashore Engineering & Civil Structural Consulting.
for Shire of Jerramungup**

*May 2021
Rev B*

SE64-04-R02

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Acknowledgements

This report was co-authored by Tim Moore (CSC) who provided the structural engineering input to the design.

Limitations of this Report

This report and the work undertaken for its preparation, is presented for the use of the Client for the purposes of Tendering the Works. The report may not contain sufficient or appropriate information to meet the purpose of other potential users. Seashore Engineering does not accept any responsibility for the use of the information in the report by other parties.

Rev	Issue Description	By	Review	Date
A	Draft specification for review	HD, TM (CSC)	SB	04/05/2020
B	Issued for Tender	HD, TM (CSC)	SB	07/05/2020

1 PRELIMINARIES

1.1 Description of the Works

The Fisheries Beach Marina recreational boating facility is located in Bremer Bay within the Shire of Jerramungup. The facility is located within the Department of Transport's (DoT) boat harbour but is managed by the Shire of Jerramungup (the Shire). The Shire is the Principal for the Works.

The boating facility, including a 2-lane concrete ramp and narrow finger jetty, was constructed in 1996, and is nearing the end of its intended design life.

The Shire engaged Seashore Engineering in 2017 to investigate options for refurbishment and potential upgrading of the recreational boating facility. The preferred option was to replace the facility in its current location with 2 new boat ramps (comprising pre-cast concrete ramp units), and a new finger jetty of 37m length and 2m width.

The Scope of Works includes demolition of the existing facility, supply and fabrication of materials and the construction of the new boat ramps, jetty and associated works as outlined in the Specification and the Drawings. Completion of the Works is required in December 2021.

The Principal will supply required rock for reworking and protection of the existing ramp formation.

1.1.1. Design Options

The Drawings identify a number of options that the Principal is seeking to consider to ensure the new facility provides value-for-money to the community. These options are outlined in the Drawings and Price Schedule and are summarised in Table 1.1.

The intention of the Principal is to construct Option One. However, one or more alternate options for individual components will be considered by the Principal, in consultation with the preferred Tender, prior to Contract award and the issue of IFC Drawings.

Table 1.1 Design Options

Description	Option One	Option Two	Drawing Ref.
Jetty Piles	Steel piles	Concrete piles	SE064-04-10
Jetty Fenders	Steel C-Section with Rubber Fenders	Timber Chaffer with Rubber Fenders	SE064-04-10
Pre-Cast Concrete Boat Ramp Units - surface	Waffle pattern (below water) Chevron pattern (above water)	Waffle pattern only	SE064-04-05 SE064-04-06
Ladders	Stainless Steel	Mild Steel (painted)	SE064-04-09



1.1.2. Design Basis

The recreational boat launching facility has a design working life of 25 years as per AS4997 for small craft facilities. The boat ramp has been designed for the launching of recreational vessels, anticipated maximum vehicle weight 3.5 tonnes

The jetty is designed for berthing of up to 10 tonne vessels.

1.1.3. Drawings

All Drawings are to be read in conjunction with all other relevant Drawings and specifications and with such written instructions as may be issued during the course of the contract. Instructions on Drawings take precedence over these notes.

All discrepancies shall be referred to the Principal before proceeding with the work.

All dimensions relevant to the setting out and off site work shall be verified by the Contractor before construction and fabrication is commenced. These Drawings shall not be scaled.

Minimum design life of this structure is 25 years. All workmanship and materials shall be in accordance with the relevant Australian Standards and codes, in particular AS4997 "Guidelines for the Design of Maritime Structures", or equivalent including amendments and the local statutory authorities except where varied by the Contract.

No substitutions shall be made or sizes of structural members varied without obtaining the prior approval of the Principal.

All dimensions are in millimetres unless stated otherwise.

Any variation to the details shown on the Drawings must be authorised by the Principal prior to fabrication and construction.

1.2. Standards and Guidelines

The Contractor should undertake all works in accordance with relevant Australian Standards and guidelines.

1.3. Drawings

The following Drawings are directly relevant to the Works and all works shall be undertaken in accordance with them:

Table 1.2 Fishery Beach Marina Boat Ramps and Jetty Refurbishment - Drawings

Title	Drawing Number	Revision
Locality Plan and Drawing Index	SE064-04-01	1
Drawing Notes	SE064-04-02	1
Site Layout	SE064-04-03	1
Boat Ramp Details	SE064-04-04	1
Pre Cast Panel Sheet 1 of 2	SE064-04-05	1
Pre Cast Panel Sheet 2 of 2	SE064-04-06	1
Jetty Details Sheet 1	SE064-04-07	2
Jetty Details Sheet 2	SE064-04-08	2
Jetty Details Sheet 3	SE064-04-09	2
Pile Options	SE064-04-10	1
Chaffer Options	SE064-04-11	1

1.4. Survey and Datum

Unless stated otherwise on the Contract Drawings, the *horizontal datum* for the Works shall be the Map Grid of Australia, based on GDA94, Zone 50.

Unless stated otherwise on the Contract Drawings, the *vertical datum* for the Works shall be based on the *Australian Height Datum (AHD)*, which is 0.884m above Chart Datum (CD) and 4.683m below Tidal Benchmark DMH093.

The Contractor shall be entirely responsible for setting out and undertaking the Works in the position as shown in the documents or as directed by the Principal. This is likely to require machine based GPS system, however other equivalent methods will be considered. This includes all survey associated with the quality control documents outlined in Section 0.

Pre-Construction Feature Survey

The Contractors will be required to undertake a pre-construction feature survey of the site and adjacent seabed prior to commencement of Construction. This survey should include probes of rock depth along the existing jetty alignment to confirm assumed underlying rock levels. The survey should also include the location and elevation of the existing piles.

This survey should be provided to the Principal to allow for the development of Issued for Construction drawings.

1.5. The Site and Access

The site is located within the Department of Transport's Fishery Beach Marina at the end of Swarbrick Rd, Bremer Bay, in the Shire of Jerramungup.

All works are to be undertaken in accordance with the Site Plan. The Contractor is to be required to develop the Site Plan for review and approval by the Principal, and to supply, install and maintain required signage, fencing and barricading and temporary navigation markers and lights for the duration of the Works.

The boat ramps are to be closed for recreational launching for the duration of the Works, and the Principal will issue public notices in this regard. Temporary access will need to be provided to the local Sea Rescue during the works in consultation with the Shire.

Access will still need to be provided for the public and commercial operators to the adjacent wharf, breakwater, carparking and the public beach.

Marine works are located within the Bremer Bay Boat Harbour. However, the Site is exposed to strong currents associated with long period waves and occasional storms. Available metocean data is provided in Attachment 3.

The Site shall be secured and kept in a safe, clean and tidy condition during the Contract period. The Contractor shall liaise with the Principal to ensure that the Works are carried out with minimal interference to others.

On completion of the Works the Contractor shall remove all rubbish and other foreign material from the Sites and ensure of its appropriate disposal.

1.6. Traffic Management

The Contractor shall secure any required permits required for the mobilization of plant, equipment and materials to site, to allow trucks to deliver rock to Site. This should include a basic Traffic Management Plan for the site approved by the Principal.

The supply of rock armour to the Site will be undertaken by the Shire in accordance with existing Traffic Management procedures. Signage for the temporary closure of the access road to the boat ramp shall be clearly outlined in the Contractor's Site Plan.

1.7. Temporary Services

The Department of Transport have 'single phase and three phase power, water and lighting' at the Service Wharf and the Contractor should liaise with DoT in this regard. The Contractor shall install all required temporary services including but not limited to water and power required for the Works. All temporary services shall be removed to the satisfaction of the Principal on completion of the Works.

1.8. Environmental

The mitigation of environmental impacts associated with the works should be documented in the Safety Management Plan and Environmental Management Plan.

1.8.1. Noise

The Contractor shall arrange its operations and shall provide silencing equipment to its



plant and/or surrounding area at its own expense to whatever extent is necessary to satisfy the statutory requirements of the Shire of Jerramungup and the Environmental Protection (Noise) Regulations 1997 in relation to the sound level arising from the Contractor's operations. The control of noise practices shall at all times be in accordance with Australian Standard 2436-1981 "Guide to Noise Control on Construction, Maintenance and Demolition Sites".

In particular, the Piling methodology should seek to minimise noise impacts on marine mammals as far as practicable.

1.8.2. Vibration

The Contractor shall arrange its operations to ensure that the Works do not cause excessive vibrations that may have an adverse impact on adjacent structures or operations or marine mammals.

1.8.3. Dust and Wind-Blown Material Control

The Contractor shall be responsible throughout the period of the Contract for the effective control of all dust and windborne material emanating from the Site as a result of the Works. The Contractor shall implement all dust controls which are necessary to control dust on the Sites.

1.8.4. Protection of Vegetation

The Contractor shall minimise disturbance to the natural vegetation and shall keep to existing roads and paved surfaces as far as practicable.

1.8.5. Refuelling

Refuelling of construction plant should occur within the laydown areas identified in the Site Plan. The Contractor shall ensure that any accidental spillage of fuel or lubricants is thoroughly cleaned up prior to recommencement of Works and that the necessary materials for clean-up are available on Site.

1.8.6. Heritage

A search of the online Aboriginal Heritage Inquiry System has not identified any registered sites or other heritage places within the works area for this project.

1.8.7. Protection of Marine Environment

Works are within an existing Harbour Reserve with regular maritime activity and commercial operations. There are no adjacent Marine Parks.

However, the waters within the Harbour are clear during calm conditions with a seabed of fine white sand. The Contractor should ensure the contamination of the surrounding marine environment with materials imported to construct the new facility is minimised during the works. The Contractor should ensure their methodology adequately mitigates this risk and is monitored during the works and at completion. A diving survey of the seabed should be undertaken at the completion of these works in this regard.

Whale migrations occur in the vicinity of the Boat Harbour. As noted in Section 1.7.1 and 1.7.2, the piling methodology should seek to limit any impacts on marine mammals.



Rock in the existing ramp formation is required to be reused for the works. Additional rock will be imported to site by the Principal for installation by the Contractor. The Principal will seek to minimise the extent of clay, mud or gravel within rock delivered to site. However, the Contractor should monitor the imported rock to ensure it is suitable for placement prior to introducing this material to the marine environment.

1.9. Safety

The Contractor shall at all times comply with the Occupational Safety and Health Act 1984 and the Occupational Safety and Health Regulations 1996.

In accordance with OHS Reg 1996 part 3 div 12 the Works for this Contract are deemed to be “high-risk construction work” due to it being “construction work in, over or adjacent to water or other liquids if there is a risk of drowning”. Submission of a Safety Management Plan (SMP) to the Principal prior to commencement of construction is required by the Contractor.

The Contractor shall ensure that all workers on site have current safety awareness training and qualifications for the required works.

The Contractor shall ensure that the hazard risk assessment required under OHS Reg 1996 part 3 div 12 has been carried out prior to commencing construction. The Principals’ risk assessment is provided in Figure 1.1 which is based on the risk assessment matrix in Figure 1.2.

The Contractor shall ensure that Safe Work Method Statements have been prepared prior to commencing construction of each new stage of work.

The Safety Management Plan is to be submitted to the Principal within 2-weeks of Contract award. The Contractor’s workers need to have a record of a current Shire of Jerramungup OH&S induction, relevant current operator tickets and a current WA construction blue or white cards.

Technical Specification Fishery Beach Marina Boat Ramps and Jetty Refurbishment

RISK ASSESSMENT
Fisheries Beach Boat Ramp Refurbishment - Safety in Design
Client: Shire of Jeramungup

Rev: A
Date: 28/4/21
Description: Construction, operation maintenance and demolition of Fisheries Beach Boat Ramp Refurbishment

Risk Identification	Likelihood	Consequence	Risk Rating (Uncontrolled)	Action	Risk Rating (Controlled)
Construction, Maintenance and Decommissioning					
Demolition of load bearing structure	Unlikely	Major	Moderate	Administrative Controls: Contractor to demonstrate suitable methodology for demolition and provide SWMS for works. Elimination: Minimise requirement to demolish existing structure through reuse of existing structural elements where appropriate.	Low
Temporary load bearing support for structural alterations or repairs	Unlikely	Major	Moderate	Administrative Controls: Contractor to demonstrate suitable methodology for temporary support of load bearing structures as required and provide SWMS for works.	Low
Work near a shaft or trench deeper than 1.5m or a tunnel	Unlikely	Major	Moderate	Administrative Controls: Contractor to demonstrate suitable methodology for working near excavations and provide SWMS for works. Engineering Controls: Areas around excavations to be fenced off.	Low
Tilt-up or precast concrete elements	Unlikely	Extreme	High	Administrative Controls: Contractor to demonstrate suitable methodology for installation of pre-cast ramp units and provide SWMS for works. Engineering Controls: Ramp panels to be designed with appropriate lifting fixings to allow safe lift of panels. Substitution: Consider in-situ pour of ramps with formwork to achieve required ramp surface.	Moderate
Work on, in or adjacent to a road, railway, shipping lane or other traffic corridor in use by traffic other than pedestrians	Unlikely	Major	Moderate	Administrative Controls: Contractor to demonstrate suitable methodology for working near boats and road users and provide SWMS for works. Isolation: Fencing off works where feasible to provide separation between works and ramp users	Low
Work in an area with movement of powered mobile plant	Unlikely	Extreme	High	Administrative Controls: Contractor to demonstrate suitable methodology for working with mobile plant and provide SWMS for works.	Moderate
Work in or near water or other liquid that involves a risk of drowning	Unlikely	Major	Moderate	Administrative Controls: Contractor to demonstrate suitable methodology for working around water and provide SWMS for works. This is to consider appropriate working conditions with regard to waves and water levels.	Low
Diving work	Unlikely	Major	Moderate	Administrative Controls: Contractor to use suitably qualified divers and provide SWMS for works.	Low
Operation - Launching/Retrieval of vessels					
Slips/trips/falls	Unlikely	Major	Moderate	Administrative Controls: display appropriate signage warning of slip hazards Engineering Controls: use appropriate surface treatments to ramp to limit potential slip/trip and fall.	Moderate
Crush injury	Unlikely	Extreme	High	Administrative Controls: display appropriate signage warning of wave, current and surge risk Administrative Controls: display appropriate signage warning of potential for crushing between boat and holding structure/trailer. Engineering Controls: discourage ramp users from walking on ramps between boat and jetty, i.e. no path on ramp alongside holding structure. Elimination: eliminate moveable gaps within holding structure (between pontoon units) that could crush limbs etc.	Moderate
Operation - Embarkation/Disembarkation to and from vessels					
Slips/trips/falls	Unlikely	Major	Moderate	Administrative Controls: display appropriate signage warning of slip hazards Engineering Controls: use appropriate surface treatments to holding structure to limit potential slip/trip and fall. Engineering Controls: Use of appropriate holding structure to ensure stable surface when embarking/disebarking from vessels (use of jetty in more energetic wave climate)	Moderate
Crush injury	Unlikely	Major	Moderate	Engineering Controls: level of holding structure to be designed to ensure vertical distance between holding structure deck and vessel deck is minimised across the majority of water levels (pontoon is preferable). Administrative Controls: display appropriate signage warning of wave, current and surge risk	Moderate

Note: Risk Assessment Matrix sourced from Worksafe OHSE Subbypack.

Figure 1.1 Safety in Design Assessment

Risk assessment

**Use the risk rating table to assess the level of risk for each job step.

Consequence		Likelihood				
		1 Rare The event may occur in exceptional circumstances	2 Unlikely The event could occur sometimes	3 Moderate The event should occur sometimes	4 Likely The event will probably occur in most circumstances	5 Almost Certain The event is expected to occur in most circumstances
1	Insignificant No injuries or health issues	LOW	LOW	LOW	LOW	MODERATE
2	Minor First aid treatment	LOW	LOW	MODERATE	MODERATE	HIGH
3	Moderate Medical treatment, potential LTI	LOW	MODERATE	HIGH	HIGH	CRITICAL
4	Major Permanent disability or disease	LOW	MODERATE	HIGH	CRITICAL	CATASTROPHIC
5	Extreme Death	MODERATE	HIGH	CRITICAL	CATASTROPHIC	CATASTROPHIC

Risk rating:

- Low risk:** Acceptable risk and no further action required as long as risk has been minimised as possible. Risk needs to be reviewed periodically.
- Moderate risk:** Tolerable with further action required to minimise risk. Risk needs to be reviewed periodically.
- High risk:** Tolerable with further action required to minimise risk. Risk needs to be reviewed continuously.
- Critical risk:** Unacceptable risk and further action required immediately to minimise risk.
- Catastrophic:** Unacceptable risk and urgent action required to minimise risk.

Figure 1.2 Safety in Design Risk Matrix

1.10. Protection of Existing Utilities and Fixtures

Prior to commencing work, the Contractor shall prepare and forward to the Principal, a report on the condition of any Shire or DoT assets in the vicinity of the work site. The report shall list the location and extent of any existing damage to assets such as road pavement, kerb and channel, drains, drainage pits, footpaths, road signs etc. The Contractor will be responsible for repair/reinstatement of all assets damaged during the works to their existing condition prior to the Works, unless otherwise agreed with the Principal.

The Contractor shall be responsible for locating and protecting all existing service lines, pipes, cables and fixtures, whether or not such information is shown on any Drawings.

All damage caused by the Contractor to services shall be the responsibility of the Contractor who shall arrange for the responsible Authority to make good any damage so caused. The Contractor shall meet the total cost of all such repairs wholly. In the event of damage to services the Authority concerned shall be immediately informed, as shall the Principal.

1.11. Log Sheets

The Contractor shall submit daily log sheets to the Principal the following day outlining works completed, plant and personnel onsite, materials delivered, safety and environmental issues and any QA requirements. The log sheet template shall be submitted to the Principal for approval prior to commencement of Works.

Log sheets are to be submitted to the Principal daily by 12:00pm the following day.

1.12. Weekly Reports

The Contractor shall submit a weekly report to the Principal by the Monday of each week outlining works completed, works planned, materials delivered to site, quality control records (including any interim survey requirements), a revised construction program and a summary of all safety issues, environmental issues, complaints and corrective actions.

Weekly reports are to be submitted to the Principal weekly by COB Monday of the following week.

1.13. Construction Program

The Contractor shall submit a detailed Construction Program and Methodology to the Principal prior to commencing the Works. Revisions to the Construction Program are required weekly and shall not defer the date for Practical Completion except where extensions of time have been approved by the Principal.

The Principal is seeking to award a contract for the Works by July 2021, and for the Contractor to commence works onsite by **04th October 2021**.

The Date for Practical completion is **10th December 2021**. This would allow for recreational boating facility to be open to the public for the summer holiday and boating season.

1.14. Working Hours

Working days are Monday to Saturday, excluding public holidays, unless otherwise approved by the Principal. Work shall commence no earlier than 7:00 am and cease no later than 6:00 pm on any day, unless otherwise approved by the Principal.

1.15. Contractor to Maintain Access to Others

Adequate signage and fencing shall be erected at the Sites to ensure public access is restricted. Signage shall be in accordance with AS1742.

1.16. Contractors Offices, Sheds and Stores

The Contractor shall provide all such offices, sheds and stores as are necessary for the carrying out of the Contract, and identify their location in the Site Plan. The working area shall be kept clean and tidy during the Contract period and removed on completion of the Works. The Contractor shall ensure that dangerous or potentially harmful substances shall be kept secure in accordance with statutory requirements and so as to prevent access by unauthorised persons.

1.17. Quarrying

The Principal shall arrange for the operation and approvals for all quarries and rock sources required for the supply of rock for the completion of the works.

1.18. Samples and Testing of Material

Where tests are called for in this Specification, the Contractor shall have the specified tests carried out on representative samples of the material in a testing Laboratory to be approved by the Principal. The test results shall be certified by the Laboratory and

forwarded to the Principal. When the Principal has approved a particular sample of material no material shall be supplied of inferior quality or of significantly different grading to the sample tested, otherwise it may be rejected.

1.19. Documentation Required from Contractor prior to Commencement

The documents required by the Principal from the Contractor prior to commencing the Works are outlined above and summarised below:

- Traffic Management Plan (1.6)
- Site Specific Safety Management Plan (including hazard risk assessments and safe work method statements) (1.9)
- Asset inspection (1.10)
- Proposed log sheets and weekly reporting template (1.11)
- Detailed Construction Program, Methodology and Quality Control procedures (1.13)



2. MATERIALS – BOAT RAMPS

2.1. General

Materials required for the construction of the Boat Ramps include:

- *Rock* for reworking, refurbishment and scour protection of the underlying ramp formation (4 classes of rock), to be Principal supplied to site.
- *Geofabric* (marine grade) to contain fine material in the ramp formation.
- *Pre-cast concrete ramp units* (2 lanes).
- *Fibre Reinforced Plastic (FRP) kerbing*.
- *Concrete toe beam* at the base of the ramps.
- *Drain* at the crest of the ramps.
- *In situ concrete path*

2.2. Rock

Rocks required for the works will be supplied by the Principal and delivered to site for use by the Contractor.

All stone shall consist of individual, hard, dense, angular, clean quarried material. Individual stones shall be sufficiently strong to maintain their integrity from the quarry to the Sites and whilst being placed by tipping from a conventional tip truck. Stones shall be delivered free of adherent soil or organic matter.

The following rock classes required are required for the Works (F1, F2, F3 & A1).

Rock shall be sorted into classes as defined below, with each class being delivered in wholly separate truckloads or sorted from existing material on site. Each load shall be tipped where directed by the Principal.

2.2.1. Aggregate (F1)

A 26mm aggregate is required to provide a 300mm thick compacted base beneath the pre-cast concrete ramp units.

2.2.2. Crushed Rock (F1)

Crushed rock is required to be a well graded material consisting of course to fine aggregates to maximise compaction. This material is to be used for the ramp formation as required.

2.2.3. Rip Rap (F2)

Rip Rap (Class F2) shall comprise individual **granite** stones of between 0.1m and 0.3m diameter. The density of individual stones shall be no less than 2.6 tonnes per cubic meter.

All Rip Rap stone recoverable from the existing seawall will need to be sorted onsite and reused where practicable by the Contractor.

2.2.4. *Armour Stone (Class A1)*

Class A1 armour stone shall comprise individual **granite** stones of mass between 0.3 and 1.0 tonnes with at least 50% of the mass of any delivered truckload being of stones greater than **0.65 tonnes**. The density of individual stones shall be no less than 2.6 tonnes per cubic meter.

Granite is a ‘phaneritic igneous rock containing quartz and feldspar’. The material should have a ‘grey’ colour with visible quartz fragments. This material is specified for its aesthetic appearance, density and durability.

Armour stones (A1) shall be of regular shape with the ratio of greatest to least dimension of 90% of individual stones not exceeding 3.0:1.0.

All Armour Stone (A1) recoverable from the existing seawall will need to be sorted onsite and reused where practicable by the Contractor.

Table 2.1 –Rock Classes and Quantities

Class	Type	Median Size	Range	Assumed Quantity (T)
F1	Aggregate	23mm	14-32mm	200T
F2	Ramp formation	100mm	50-150mm	
F3	Rip Rap	200mm	100-300mm	300T
A1	Granite Armour	600mm (650kg)	500-700mm (300– 1000kg)	

2.2.5. *Measurement and Classification of Rock*

The Principal will provide the Contractor with dockets for rock materials supplied to site, identifying the rock class, quantity, source and time and date of delivery. The Contractor should collate dockets for inclusion in the daily and weekly reports as required.

The Contractor should ensure the rock supplied meets the requirements of the design prior to installation, and inform the Principal immediately if the supplied rock is not suitable.

2.3. **Geofabric**

The geotextile filter fabric (geofabric) required for the Works is a marine grade non-woven, needle punched, continuous filament, polyester geotextile (Texcel 900R). Equivalent materials will be considered if the supplier can demonstrate equivalent characteristics.

2.4. Concrete

All concrete and reinforcement shall be in accordance with the current edition of AS3600.

All concrete supplied shall have maximum nominal aggregate size of 20mm and a slump of 80mm immediately prior to placing concrete. No variations for these unless approved by the Principal.

Clear cover to all reinforcement and concrete grade shall be as outlined in Table 2.2 unless noted otherwise.

Table 2.2 Concrete Requirements

Element	Cover (mm)	Grade (min)
Abutment – Against Ground	70	N40
Abutment – Formed	65	S50
Pre-Cast Slabs	65	S50
Ramp Toe Beam - top	70	S50
Ramp Toe Beam – bottom and sides	50	S50

Blinding concrete compressive strength shall be $f'c = 15\text{mpa}$

All concrete shall be subject to project assessment of strength and slump.

Additives other than specified are not permitted without written approval from the Principal.

Free dropping of concrete from a height greater than 1200mm shall not be permitted.

Concrete shall be compacted with suitable vibrator during placement.

All concrete in each separate pour shall be placed and mechanically vibrated in one continuous operation.

Provide, and build-in bolts, pipes, etc. As required by the Principal. No holes or chases shall be made in any concrete without the written approval of the Principal.

Construction joints other than those shown on Drawings shall be located to the satisfaction of the Principal. The contractor shall allow for all necessary construction joints.

Concrete shall have a durability suitable for a minimum 25 year design life in accordance with AS4997 "guidelines for the design of maritime structures". The contractor is to supply a mix design to ensure compliance with this durability requirement given that the concrete is in the splash zone, and/or submerged.

2.4.1. Reinforcement

The contractor shall supply all necessary bar chairs, support and spacer bars to ensure reinforcing steel is placed in its correct position during construction.

All reinforcement to be *hot dip galvanized* unless otherwise noted.

Reinforcement is shown diagrammatically and not necessarily in true projection.

Set reinforcement out at equal centres where spacing is not specified.

2.4.2. Formwork

All formwork to be in accordance with AS3610.

Formwork shall not be stripped until the concrete strength is sufficient to support the loads without excessive distortion or cracking. Notwithstanding this requirement, the minimum stripping times shall be 7 days.

Provide all exposed edges and corners with 25mm chamfers unless nominated otherwise.

All formwork to conform to all "Worksafe" WA requirements. The contractor shall be responsible for the structural sufficiency of all formwork.

2.5. Pre Cast Concrete Slabs

Temporary lifting and storage of the precast slab panels is the responsibility of the contractor. This shall include handling procedure of the units throughout all stages including stripping, lifting, transportation and erection. Concrete stresses throughout handling shall not cause cracking. Contractor shall have design responsibility for all lifting procedures including sizing and location of all lifting inserts.

The contractor shall supply and fit lifting fixings as required. These shall take the form of proprietary cast-in cables or ferrules. No other holes, recesses or chases other than those shown on the structural Drawings shall be allowed without prior written approval of the Principal. All embedded lifting fixings shall be designed for a 25 year life span in a splash zone.

Mesh reinforcing shall be one continuous sheet per slab.

2.6. Toe Beam

The mass concrete Toe Beam shall be constructed to comply with concrete material requirements listed above in Section 2.4 and the Drawings.

2.7. Kerbs

Ramp Kerbs are to be APR recycled plastic kerbs or approved equivalent. Joints are to butt midspan on planks to lock ramps together. The kerbing is to have a suitable non-slip surface.



3. MATERIALS – JETTY

3.1. General

Materials required for the construction of the Jetty include:

- *Steel* for the jetty piles (Option One) and superstructure.
- Corrosion protection *painting systems* for all steelwork.
- *Micromesh decking units*, and associated fixtures, for the jetty decking.
- *Rubber fenders*.
- *Stainless steel ladders* (Option One).
- *Timber chafers* (Option Two).
- Navigation lighting

3.2. Steel

All workmanship and materials shall be in accordance with AS4100/AS1554. Steel shall be ordinary weldable grade to AS3678 and AS3679 unless noted otherwise.

Unless noted otherwise materials shall be as follows :

- Angle Sections and Plate: AS3678/3679 Grade 250
- UB, UC and PFC Sections: BHP SPEC Grade 300 Plus
- Hollow Sections: AS1163 Grade 350

All shop detail Drawings required for the works shall be prepared by the contractor. Two copies of shop detail Drawings shall be submitted to the Principal and approval of the same obtained before commencing fabrication. Approval will not cover dimensions or layout

Any damaged corrosion protection, nuts, bolts and washers shall be made good by the contractor. All welds to be carried out in shop, no site welding without prior approval

From the Principal. Welding shall be in accordance with AS1554. Welding shall be class SP E48XX unless noted otherwise. Bolts are designated on the Drawings by the number, diameter.

Grade and tightening procedure in accordance with AISC bolting procedures (standardized structural connections). 8.8/tb denotes grade 8.8 bolts to AS1252 tensioned bearing.

Bolts fully tensioned shall not be retightened once tightened, but shall be discarded. Load indicator washers or turn of nut method shall be adopted. No paint shall be applied to mating surfaces which shall be clean and free of scale. Bolts fully tensioned in accordance to AS1511.

Unless noted otherwise welds shall be 6 mm continuous fillet. Minimum of 2m20 8.8/tb bolts per connection unless noted otherwise. The Contractor shall be responsible for and leave in place until permanent bracing elements are constructed, such temporary bracing as is necessary to stabilize the structure during erection.



Galvanized members shall conform to AS1214 and AS1650., minimum 1000g/sm.

Preparation and pre-treatment of surfaces shall be in accordance with AS1627. Any damaged galvanized surface shall receive one site coat of approved zinc epoxy paint.

3.3. Corrosion Protection (Steelwork Surface Treatment)

All steelwork, including nuts, bolts and washers, is to be suitably treated for corrosion protection after fabrication, having regard for the highly corrosive marine environment. No work (drilling etc) should be carried out subsequent to treatment. Steelwork edges and corners are to be suitably bevelled to ensure paint adhesion and limit paint chipping.

All hot dip galvanizing, including surface preparation, is to comply with "after-fabrication hot dip galvanizing" by Galvanizers Association of Australia.

Bolts, nuts, washers and 200PFC fender supports to be hot dip galvanised to 1000gsm. 200pfc fender supports are to be additionally treated with a compatible two pack epoxy paint system (st4 below). All steelwork other than nuts, bolts and washers to be treated with a compatible two pack epoxy paint system (st4 below).

Proposed steelwork to be coated with a marine painting system as follows:

- abrasive blast clean to Class SA3 of AS1627.9.
- provide high build solids two pack epoxy coating in accordance with AS3750.14 (marine grade coating).

3.4. FRP Grating

Marine Grade FRP 'mini-mesh grating to be supplied in panels and fixed to Jetty substructure as per Drawings. The specified material is Treadwell barefoot grade 38mm thick mini-mesh. Individual sheets are required to span the 2m width of the jetty. The fixings are to be specified by the manufacturer.

3.5. Ladders

Ladders are to be fabricated to allow fixture to the Jetty as per Drawing SE064-04-09. There are 6 stainless steel ladders to be fabricated and installed on the jetty.

3.6. Fenders

The Fenders Specified are Trelleborg 150DD rubber fender to fix to 200PFC as per Manufacturers detail. (refer Drawing SE064-04-07). An alternate option (Option Two) for a timber chafer and rubber fender is also outlined in the Drawings.

3.7. Concrete Piles (Provisional Option Two)

Concrete Piles (Option Two) is outlined on the Drawings for the construction of insitu concrete piles instead of steel piles. Refer Drawing SE064-04-10 for detail

This option is provided due to the potential cost of installing steel piles. The design for the existing boat ramp finder jetty is based on concrete piles founded on the underlying bed rock, and these piles have been effective for more than 20 years.

Whilst the existing design provides rock levels from Piles 1 to 7, a pre-construction feature survey with rock probes is required to confirm existing rock levels, which are currently inferred from available geotechnical information.

The Contractor should confirm the requirement to demolish or reuse existing concrete piles with the Principal prior to demolition. The Principal will consider re-use of the existing concrete piles provided visual inspections and load testing provide sufficient confidence that they are able to achieve the required 25 year minimum design life.

3.8. Timber Fenders (Provisional Option Two)

Option Two of timber fenders and rubber chaffers fixed to a steel bracket has been included. Refer Drawing SE064-04-11 for detail.



4. Construction

4.1. Demolition of Existing Jetty and Ramp

The Contractor shall undertake all excavations in accordance with the WA Government 2005 Code of Practice for Excavation, the Safe Work Australia Code of Practice for Excavation Work and the Drawings.

The Contractor prior to commencement should undertake all necessary enquiries as to the location of services in the area of excavation as outlined in Section 1.9.

The excavation depths will require the contractor to schedule the construction program around tides and weather.

Contractor is required to demolish the existing boat ramps and jetty prior to commencement of the works, including concrete slabs, kerbing, paths, concrete abutment, jetty substructure, decking and fenders. Drawings are available of the existing structure. Details of the existing boating facility are provided in the site photos and Attachment 4.

Material may be disposed of at the Bremer Bay waste facility.

The existing ramp formation including crushed rock, rip rap and rock armour is to be left in place and reworked and refurbished as part of these works.

The Shire of Jerramungup may seek to reuse the jetty substructure, decking and fenders subject to their condition following removal.

Existing Boat Ramp

Excavation works will require progressive removal and sorting of stone from the existing Boat Ramp as per the Drawings. All stone recoverable from the existing Boat Ramp will need to be sorted onsite and reused by the Contractor. The balance of stone will need to be supplied by the Contractor.

Waste material in the existing structure (e.g. concrete) is to be stockpiled and carted from site by the Contractor.

4.2. Construction of Ramp

The Contractor shall be responsible for the dewatering of all trenches, or constructing works in the wet, where required

The Contractor shall dispose of excess spoil as directed by the Principal.

All assets modified or damaged by the proposed works shall be reinstated to the satisfaction of shire of Jerramungup.

The ramp formation and aggregate base is to be prepared in accordance with the Drawings. Each stage of preparation is to be documented and inspected in accordance with the ITP. Commencement of subsequent stages is not to proceed without the prior written approval of the previous stage, from the Principal.

Prior to the placement of any fill or pavement, the exposed sub-grade shall be compacted in accordance with AS 1289, to the approval of the Principal. Any soft spots shall be removed and replaced with approved fill and compacted.

Geofabric

Geofabric shall be placed on the compacted ramp formation as shown in the Drawings. The Contractor shall ensure there is sufficient length of geofabric at the toe of the layer and at the crest to allow for the required wrapping of fabric as shown on the Drawings, and allow for deformation during placement of filter rock. The geofabric shall be pulled tight and laid on a firm surface prior to the placement of filter rock. The overlap required between sheets of geofabric, where required, is 1.0m.

4.2.1. Toe Beam

The toe beam should be constructed as shown on the Drawings and in accordance with the ITP for insitu concrete.

4.2.2. Ramp slabs and kerbing

The insitu concrete ramp slabs should be progressively placed on the underlying ramp formation (below LAT) and the compacted aggregate base (above LAT). The lower ramp slabs required installation initially, and each subsequent slab shall be interlocked with the adjacent slab and secured with the kerbing.

The installation process should ensure an even grade to the boat ramp within the tolerances outlined in the Specification.

4.2.3. Filter Stone

Filter stone shall be placed on geotextile filter fabric as shown in the Drawings. The filter stone is required to prevent loss of the ramp formation and aggregate from beneath the ramp slabs for the design life of the structure. Damage to the fabric during placement of filter stone will require replacement or additional fabric to be overlaid.

4.2.4. Armour Stone

Armour stone shall be placed progressively beside and on top of the geofabric and filter stone as shown on the Drawings. Armour stone shall be placed to the grades and heights as shown on the Drawings.

Individual stones are placed and orientated to maximise interlock with adjacent armour stone units. Do not place rocks smaller than the specified armour class to fill gaps or voids in the seawall. Each armour stone (except the bottom layer resting on the seabed) shall be placed to be in contact with other armour or filter stone at least three points underneath such that it is in a stable, interlocked position.

Existing rock in the ramp will need to be removed and sorted for reuse.

Placement shall be of a high quality. This is effectively special placement as defined in the Shore Protection Manual (2006). This will require a skilled operator with a grab and or bucket. Rock placed on the crest shall be long axis horizontal to maximise stability. The Contractor shall use water to wash sand through voids of structure that will be buried beneath the beach or dunes upon completion.

4.3. Construction of Jetty

4.3.1. Geotechnical

Bedrock levels beneath the existing jetty were identified in the original design for the jetty and are shown on the Drawings. Bedrock levels are not currently available for the two seaward piles but there is general geotechnical information for the harbour. The contractor will need to check these bedrock levels onsite in the pre-construction survey prior to Drawings being Issued for Construction.

Geotechnical reports are available from the adjacent quarry from which the breakwater rock was sourced. This material was identified as gneiss with a median density of 2.4T/m³ and an estimated UCS ranging from 163-210MPA. Available geotechnical reports for the harbour are provided in Attachment 5.

4.3.2. Piling

The 'Option One' pile design is drilling CHS steel piles into the underlying shallow bedrock.

The minimum pile depths are 2.5m for competent rock, and 5.5m for sand. The Contractors piling methodology and ITPs should be based on this design.

An alternate design (Option Two) for concrete piles is also provided.

Proof lateral load testing of selected pile(s) should be considered in the Piling ITP to demonstrate the piles can withstand the design loads.

4.3.3. Jetty Construction

The jetty should be constructed as per the Drawings and the approved ITPs including:

- ITP1: Steel Fabrication.
- ITP2: Corrosion Protection.
- ITP4: Jetty Installation.

In particular, the Contractor should ensure any damage to corrosion protection systems during transport and/or installation are rectified onsite to the satisfaction of the Principal.

5. Reinstatement

The Contractor shall ensure the site is tidy at the completion of Works. This includes removal of all visible rock and gravel from the beach, plant and equipment, fencing, signage, and rubbish. The beach shall be raked to remove small rocks and gravel to Principal's satisfaction. This may require a number of sweeps of the beach to remove small rocks following construction (refer Section 1.7.6).

The road and stormwater infrastructure shall be reinstated in accordance with the Shire of Jerramungup's Engineering and Works Services Specifications Section 2 (Designs and Plans) and Section 3 (Construction).

The Contractor shall arrange a final inspection of the Site with the Principal following completion of reinstatement works and have the capacity to rectify and observed damage or further reinstatement required.

6. Quality Control

6.1. Hold Points and Quality Documentation

The Principal will inspect the works regularly through the construction program. Minimum required inspections and hold points for the Jetty and Ramp Refurbishment are detailed below. Additional hold points are at the discretion of the Principal or as noted throughout the Specification.

Table 6.1 Boat Ramps and Jetty Refurbishment - Hold Points

Hold Point	Description	Record	Completed By	Frequency
Pre-Construction & Offsite Fabrication				
1.	Management plans (refer Section 1.19)	Reports	Contractor	Within 3-weeks on contract award.
2.	Construction Program	Gantt Chart	Contractor	Fortnightly
3.	Feature survey (incl. rock probes)	Drawing, *.dwg	Contractor	Within 2-weeks on contract award.
4.	IFC Drawings	Drawing set, *.dwg	Principal	Within 4-weeks on contract award.
5.	Steelwork Shop Drawings	Drawings (pdf)	Contractor	Prior to fabrication
6.	Steelwork	ITP	Contractor	As outlined in ITP1: Steel Fabrication.
7.	Corrosion Protection System	ITP	Contractor	As outlined in ITP2: Painting.
8.	Pre-cast concrete slabs	ITP	Contractor	As outlined in ITP3: Pre-cast concrete.
Construction				
9.	Demolition of existing facility	Site photographs	Contractor	Completion of demolition
10.	Piling	ITP & Survey Inspection	Contractor Principal	As outlined in ITP4: Piling. (incl. provisional lateral load testing)
11.	Jetty Substructure	ITP Inspection	Contractor Principal	As outlined in ITP5: Jetty Installation.
12.	Ramp formation, geofabric and base	ITP Inspection	Contractor Principal	As outlined in ITP 6: Ramp Formation)
13.	Toe beam	ITP & Survey	Contractor Principal	As outlined in ITP7: Insitu Concrete.
14.	Ramp and Kerb Installation	ITP Inspection	Contractor Principal	As outlined in ITP 8: Ramp Installation.
15.	Rock Protection	ITP	Contractor	As outlined in ITP 9: Rock Protection.
16.	Jetty Abutment	ITP	Contractor	As outlined in ITP7.
17.	Completion	As-con survey Inspection	Contractor Principal	At completion.

Failure to meet the Specification shall be noted together with the Contractor's planned corrective action for the Principal's review and approval. The Principal requires all quality control documentation to have been submitted and accepted prior to approval of any payment claims.

6.2. Tolerances

All armour stone shall be delivered and placed to the tolerances discussed herein and to the layers, dimensions, lines, levels and slopes as shown on the Drawings. The groyne shall be constructed to the following tolerances. These tolerances are not cumulative.

Table 6.2 Tolerances

Description	Tolerance
Pile Position - horizontal	$\pm 0.10\text{m}$
Deck Level - Jetty	$\pm 0.10\text{m}$
Ramp toe elevation	$\pm 0.10\text{m}$
Differential between adjacent slabs	$\pm 0.05\text{mm}$
Differential between adjacent jetty FRP grating units	$\pm 0.01\text{mm}$
Batter Slope	± 0.1
Rock Layer Thickness (Armour)	$+0.15\text{m}, -0.15\text{m}$
Rock Armour Toe	At least 500mm below insitu ramp base.
Median Rock Density	$+0.1 \text{ T/m}^3, -0.1 \text{ T/m}^3$



7. Maintenance

Contractor is to tighten all bolts at 3 and 12 months after practical completion. Also corrosion protection is to be inspected and re-instated as required (i.e. 12 months defects liability).

Annual inspections are to be carried out to the structure by the Shire, paying particular attention to:

- A. Structural integrity of steel members
- B. Structural integrity of fixings.
- C. Performance of the corrosion protection system.
- D. Rubber fenders and ladders

Where necessary replace items that appear to lack structural integrity in consultation with engineer.

Where necessary replace/improve corrosion protection system.

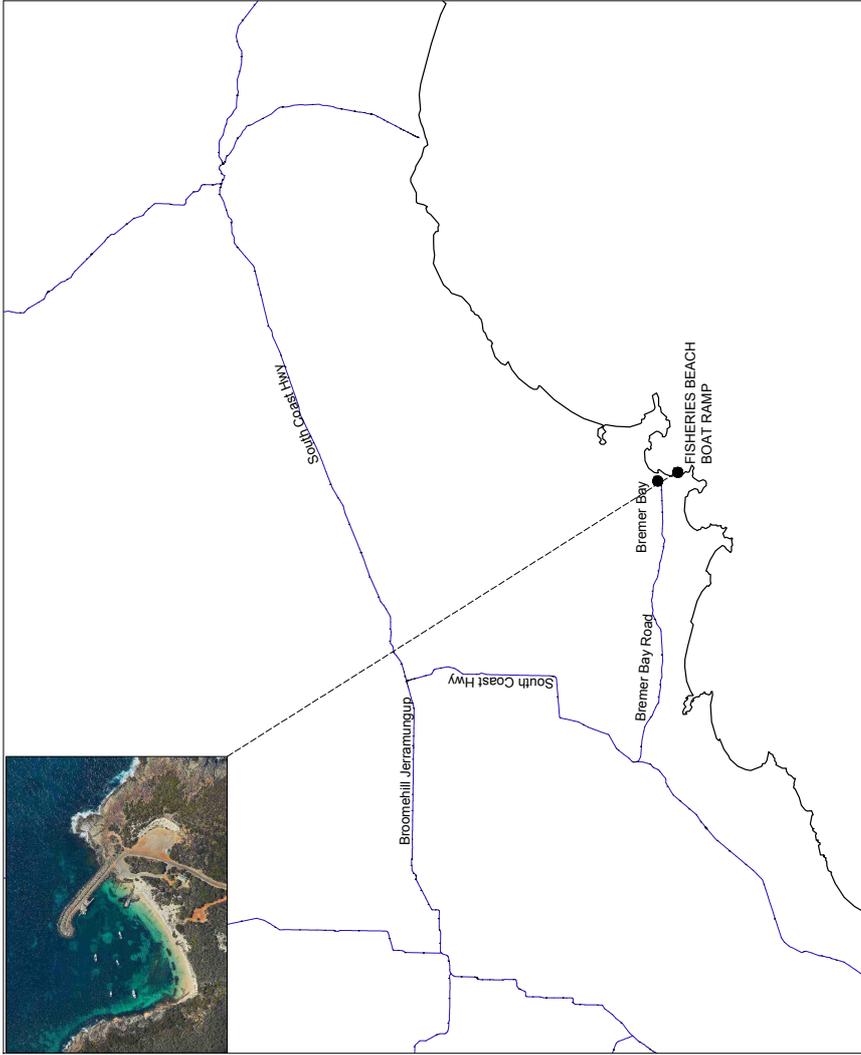


*Technical Specification
Fishery Beach Marina Boat Ramps and Jetty Refurbishment*

ATTACHMENT 1 DRAWINGS

NOT FOR CONSTRUCTION

FISHERIES BEACH BOAT RAMP MARITIME CONSTRUCTION DRAWINGS SHIRE OF JERRAMUNGUP



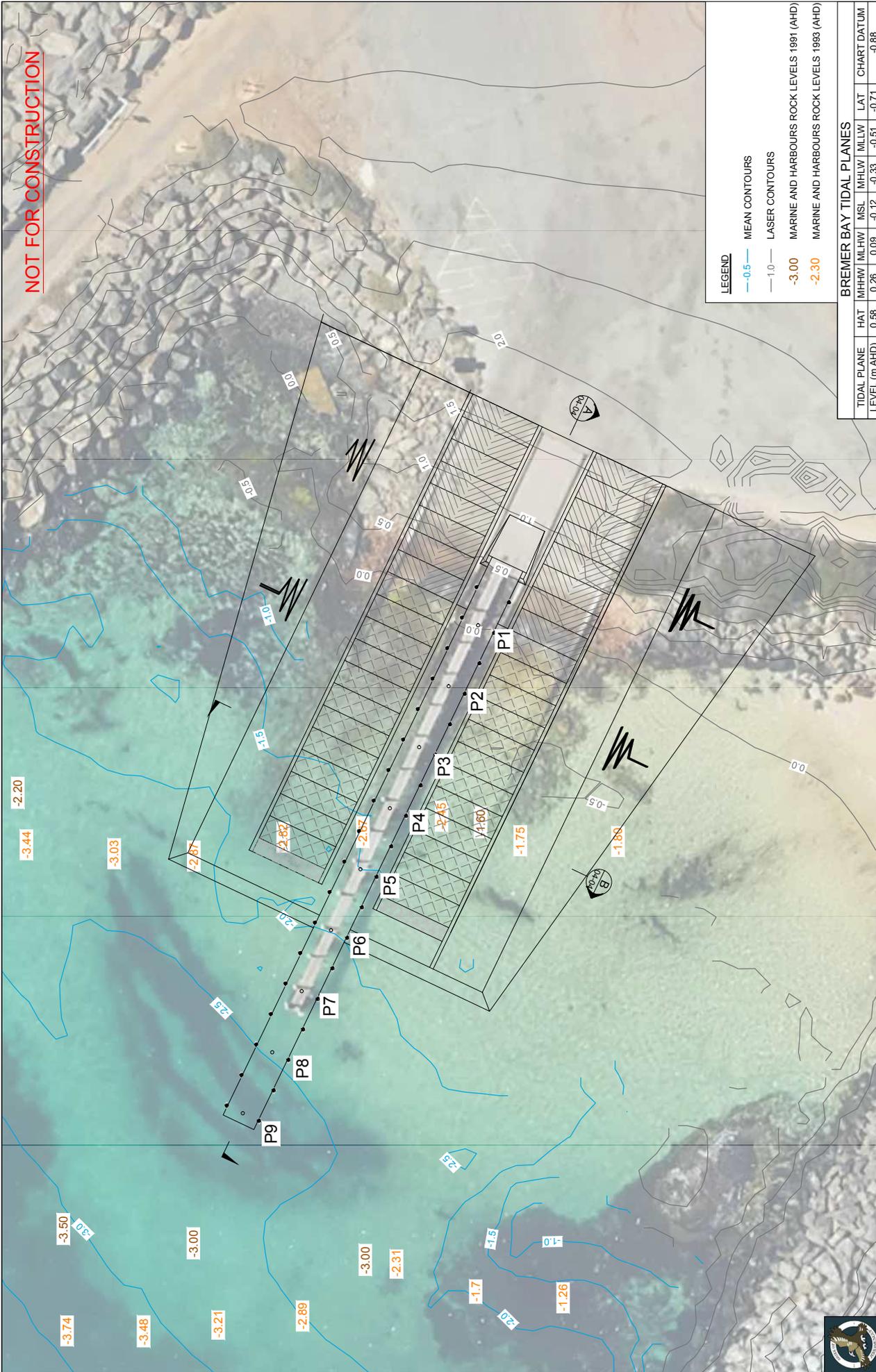
DRAWING INDEX

DRAWING NUMBER	TITLE
SE064-04-01	LOCALITY PLAN AND DRAWING INDEX.
SE064-04-02	DRAWING NOTES
SE064-04-03	SITE LAYOUT.
SE064-04-04	BOAT RAMP DETAILS
SE064-04-05	BOAT RAMP PRE-CAST CONCRETE UNITS DETAILS SHEET 1 OF 2
SE064-04-06	BOAT RAMP PRE-CAST CONCRETE UNITS DETAILS SHEET 2 OF 2
SE064-04-07	JETTY DETAILS SHEET 1 OF 3
SE064-04-08	JETTY DETAILS SHEET 2 OF 3
SE064-04-09	JETTY DETAILS SHEET 3 OF 3
SE064-04-10	PILE OPTIONS
SE064-04-11	CHAFFER OPTIONS



				SHIRE OF JERRAMUNGUP FISHERY BEACH MARINA BOAT RAMPS AND JETTY REFURBISHMENT LOCALITY PLAN AND DRAWING INDEX																																																						
SCALE : DIAGRAMATIC		DATUM VERTICAL AUSTRALIAN HEIGHT DATUM (1984) UNITS IN METRES ABOVE CHART ON UNITS AND BELOW TIDAL BENCHMARK (MADMS)		PROJECT NO. SE064-04																																																						
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NOT FOR CONSTRUCTION



LEGEND

- 0.5 — MEAN CONTOURS
- 1.0 — LASER CONTOURS
- 3.00 — MARINE AND HARBOURS ROCK LEVELS 1991 (AHD)
- 2.30 — MARINE AND HARBOURS ROCK LEVELS 1993 (AHD)

BREMER BAY TIDAL PLANES

TIDAL PLANE LEVEL (m AHD)	HAT	MHHW	MLHW	MSL	MHLW	MLLW	LAT	CHART DATUM
0.58	0.26	0.09	-0.12	-0.33	-0.51	-0.71		-0.88

Civil/Structural
Consulting Pty Ltd

Seashore Engineering

DATE	SIGNATURE	NAME	ACTION
30/10/2018		SB	ENGINEER
30/10/2018		OS	DRAWN
		SB	ENGINEERING CHECK
		SB	STRUCTURAL CHECK
		SB	APPROVED

SCALE 1 : 200

0 10 METERS

DATUM
VERTICAL
AUSTRALIAN HEIGHT DATUM (1984) (MADSL) WHICH IS 1.8m ABOVE CHART DATUM (GDA) AND 1.8m BELOW TIDAL BENCHMARK (GMSD)

HORIZONTAL MAP GRID OF AUSTRALIA, BASED ON GDA94

NOTES

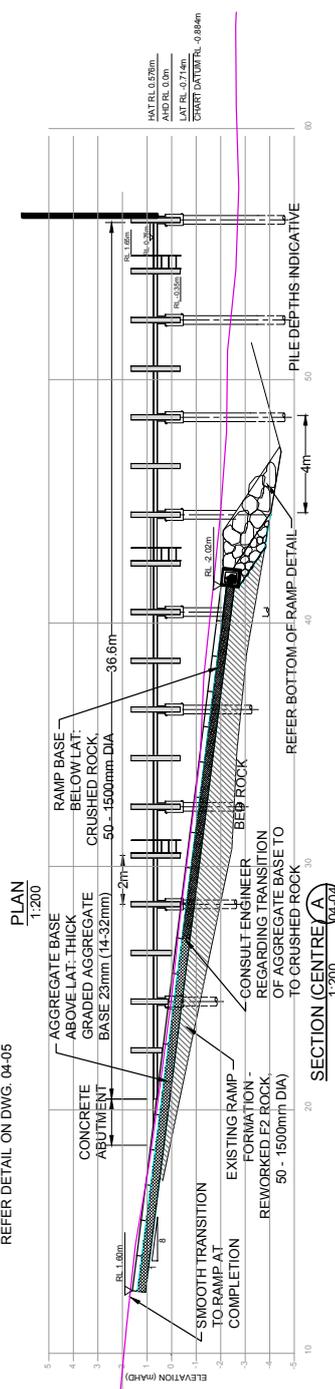
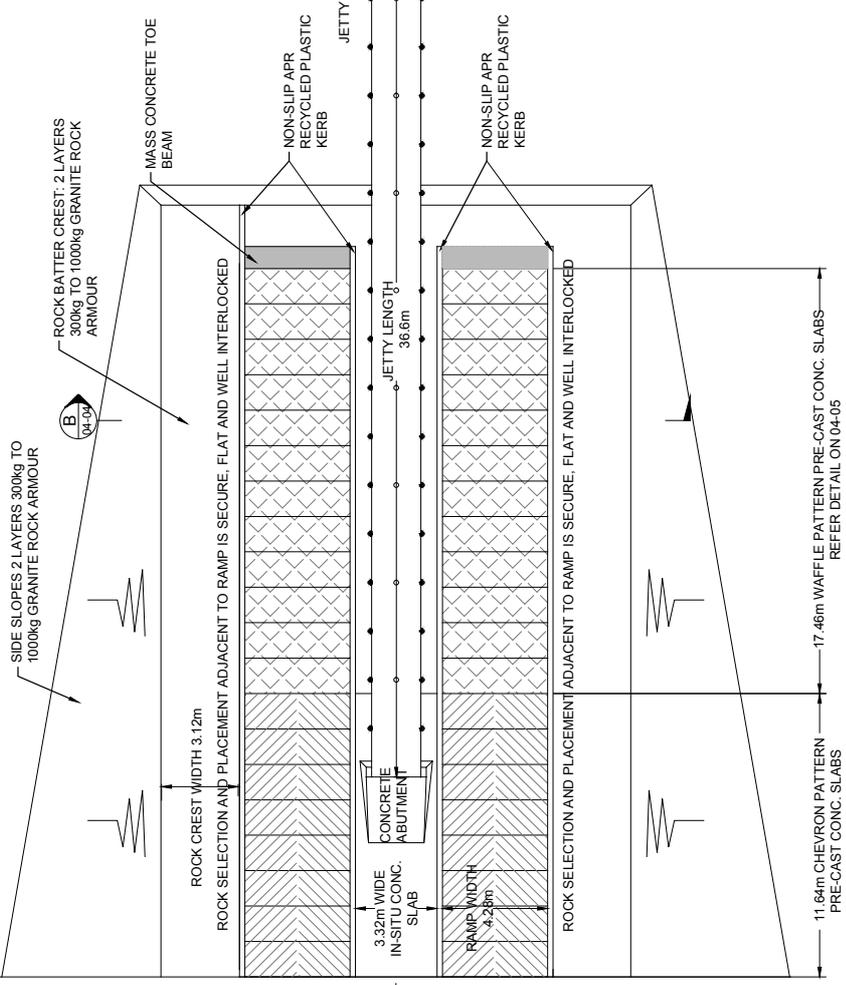
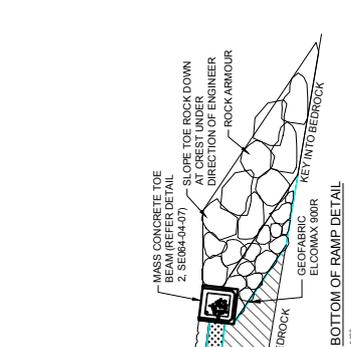
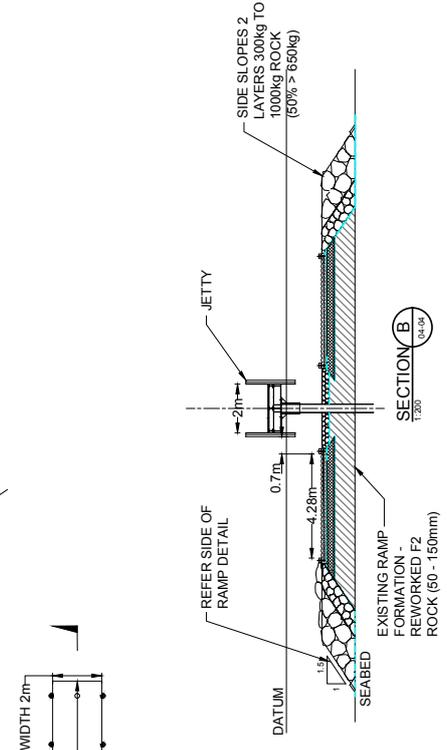
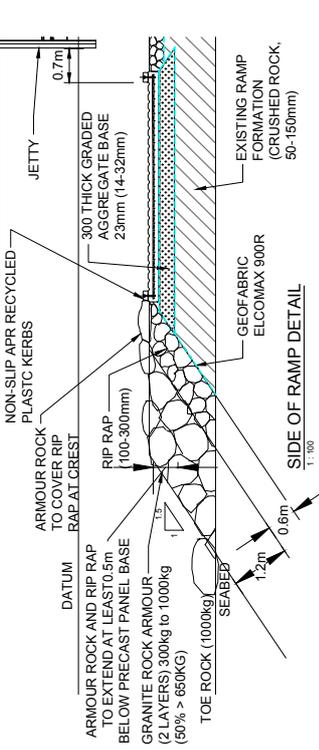
1. ORIGINAL IMAGE APRIL 2020
2. CONTOURS BASED ON 2020 DOT LASER AND MEAN SURVEYS
3. TIDAL PLANES SUPPLIED BY DOT
4. PRE-CONSTRUCTION SURVEY REQUIRED BEFORE ISSUE OF P.C.

NO.	DATE	DESCRIPTION	BY	CHECKED BY
1	14/05/2021	ISSUED FOR TENDER	DF	SB
0	10/03/2018	FINAL	OS	SB
A	30/07/2018	PRELIMINARY	OS	SB
		AMENDMENT	DFN	SB

PROJECT NO. SE064-04

ORG SIZE ARCHIVE - see 2020/2021/2022/2023/2024/2025/2026/2027/2028/2029/2030/2031/2032/2033/2034/2035/2036/2037/2038/2039/2040/2041/2042/2043/2044/2045/2046/2047/2048/2049/2050/2051/2052/2053/2054/2055/2056/2057/2058/2059/2060/2061/2062/2063/2064/2065/2066/2067/2068/2069/2070/2071/2072/2073/2074/2075/2076/2077/2078/2079/2080/2081/2082/2083/2084/2085/2086/2087/2088/2089/2090/2091/2092/2093/2094/2095/2096/2097/2098/2099/2100/2101/2102/2103/2104/2105/2106/2107/2108/2109/2110/2111/2112/2113/2114/2115/2116/2117/2118/2119/2120/2121/2122/2123/2124/2125/2126/2127/2128/2129/2130/2131/2132/2133/2134/2135/2136/2137/2138/2139/2140/2141/2142/2143/2144/2145/2146/2147/2148/2149/2150/2151/2152/2153/2154/2155/2156/2157/2158/2159/2160/2161/2162/2163/2164/2165/2166/2167/2168/2169/2170/2171/2172/2173/2174/2175/2176/2177/2178/2179/2180/2181/2182/2183/2184/2185/2186/2187/2188/2189/2190/2191/2192/2193/2194/2195/2196/2197/2198/2199/2200/2201/2202/2203/2204/2205/2206/2207/2208/2209/2210/2211/2212/2213/2214/2215/2216/2217/2218/2219/2220/2221/2222/2223/2224/2225/2226/2227/2228/2229/2230/2231/2232/2233/2234/2235/2236/2237/2238/2239/2240/2241/2242/2243/2244/2245/2246/2247/2248/2249/2250/2251/2252/2253/2254/2255/2256/2257/2258/2259/2260/2261/2262/2263/2264/2265/2266/2267/2268/2269/2270/2271/2272/2273/2274/2275/2276/2277/2278/2279/2280/2281/2282/2283/2284/2285/2286/2287/2288/2289/2290/2291/2292/2293/2294/2295/2296/2297/2298/2299/2300/2301/2302/2303/2304/2305/2306/2307/2308/2309/2310/2311/2312/2313/2314/2315/2316/2317/2318/2319/2320/2321/2322/2323/2324/2325/2326/2327/2328/2329/2330/2331/2332/2333/2334/2335/2336/2337/2338/2339/2340/2341/2342/2343/2344/2345/2346/2347/2348/2349/2350/2351/2352/2353/2354/2355/2356/2357/2358/2359/2360/2361/2362/2363/2364/2365/2366/2367/2368/2369/2370/2371/2372/2373/2374/2375/2376/2377/2378/2379/2380/2381/2382/2383/2384/2385/2386/2387/2388/2389/2390/2391/2392/2393/2394/2395/2396/2397/2398/2399/2400/2401/2402/2403/2404/2405/2406/2407/2408/2409/2410/2411/2412/2413/2414/2415/2416/2417/2418/2419/2420/2421/2422/2423/2424/2425/2426/2427/2428/2429/2430/2431/2432/2433/2434/2435/2436/2437/2438/2439/2440/2441/2442/2443/2444/2445/2446/2447/2448/2449/2450/2451/2452/2453/2454/2455/2456/2457/2458/2459/2460/2461/2462/2463/2464/2465/2466/2467/2468/2469/2470/2471/2472/2473/2474/2475/2476/2477/2478/2479/2480/2481/2482/2483/2484/2485/2486/2487/2488/2489/2490/2491/2492/2493/2494/2495/2496/2497/2498/2499/2500/2501/2502/2503/2504/2505/2506/2507/2508/2509/2510/2511/2512/2513/2514/2515/2516/2517/2518/2519/2520/2521/2522/2523/2524/2525/2526/2527/2528/2529/2530/2531/2532/2533/2534/2535/2536/2537/2538/2539/2540/2541/2542/2543/2544/2545/2546/2547/2548/2549/2550/2551/2552/2553/2554/2555/2556/2557/2558/2559/2560/2561/2562/2563/2564/2565/2566/2567/2568/2569/2570/2571/2572/2573/2574/2575/2576/2577/2578/2579/2580/2581/2582/2583/2584/2585/2586/2587/2588/2589/2590/2591/2592/2593/2594/2595/2596/2597/2598/2599/2600/2601/2602/2603/2604/2605/2606/2607/2608/2609/2610/2611/2612/2613/2614/2615/2616/2617/2618/2619/2620/2621/2622/2623/2624/2625/2626/2627/2628/2629/2630/2631/2632/2633/2634/2635/2636/2637/2638/2639/2640/2641/2642/2643/2644/2645/2646/2647/2648/2649/2650/2651/2652/2653/2654/2655/2656/2657/2658/2659/2660/2661/2662/2663/2664/2665/2666/2667/2668/2669/2670/2671/2672/2673/2674/2675/2676/2677/2678/2679/2680/2681/2682/2683/2684/2685/2686/2687/2688/2689/2690/2691/2692/2693/2694/2695/2696/2697/2698/2699/2700/2701/2702/2703/2704/2705/2706/2707/2708/2709/2710/2711/2712/2713/2714/2715/2716/2717/2718/2719/2720/2721/2722/2723/2724/2725/2726/2727/2728/2729/2730/2731/2732/2733/2734/2735/2736/2737/2738/2739/2740/2741/2742/2743/2744/2745/2746/2747/2748/2749/2750/2751/2752/2753/2754/2755/2756/2757/2758/2759/2760/2761/2762/2763/2764/2765/2766/2767/2768/2769/2770/2771/2772/2773/2774/2775/2776/2777/2778/2779/2780/2781/2782/2783/2784/2785/2786/2787/2788/2789/2790/2791/2792/2793/2794/2795/2796/2797/2798/2799/2800/2801/2802/2803/2804/2805/2806/2807/2808/2809/2810/2811/2812/2813/2814/2815/2816/2817/2818/2819/2820/2821/2822/2823/2824/2825/2826/2827/2828/2829/2830/2831/2832/2833/2834/2835/2836/2837/2838/2839/2840/2841/2842/2843/2844/2845/2846/2847/2848/2849/2850/2851/2852/2853/2854/2855/2856/2857/2858/2859/2860/2861/2862/2863/2864/2865/2866/2867/2868/2869/2870/2871/2872/2873/2874/2875/2876/2877/2878/2879/2880/2881/2882/2883/2884/2885/2886/2887/2888/2889/2890/2891/2892/2893/2894/2895/2896/2897/2898/2899/2900/2901/2902/2903/2904/2905/2906/2907/2908/2909/2910/2911/2912/2913/2914/2915/2916/2917/2918/2919/2920/2921/2922/2923/2924/2925/2926/2927/2928/2929/2930/2931/2932/2933/2934/2935/2936/2937/2938/2939/2940/2941/2942/2943/2944/2945/2946/2947/2948/2949/2950/2951/2952/2953/2954/2955/2956/2957/2958/2959/2960/2961/2962/2963/2964/2965/2966/2967/2968/2969/2970/2971/2972/2973/2974/2975/2976/2977/2978/2979/2980/2981/2982/2983/2984/2985/2986/2987/2988/2989/2990/2991/2992/2993/2994/2995/2996/2997/2998/2999/3000/3001/3002/3003/3004/3005/3006/3007/3008/3009/3010/3011/3012/3013/3014/3015/3016/3017/3018/3019/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NOT FOR CONSTRUCTION



REFER DRAWING NOTE SS ON DWG. 04-02 REGARDING INSTALLATION OF WARNING SIGNAGE BY OTHERS.

NOTES

- NATURAL SURFACE LEVELS BASED ON INTERPOLATION OF 18122011 SURVEY BY DoT
- ROCK LEVELS BASED ON DRAWING 3719-09

SCALE 1:200

UNLESS OTHERWISE NOTED METERS

DATUM VERTICAL

HORIZONTAL MAP GRID OF AUSTRALIA, BASED ON GDA94

NO.	DATE	BY	CHECKED	APPROVED	ACTION
1	14/05/2021	ISSUED FOR TENDER	DF	SB	ENGINEER
2	10/02/2018	FINAL	OS	SB	DRAWN
3	05/02/2018	PRELIMINARY	OS	SB	CHECK
4		AMENDMENT	DFN	SB	DESIGN CHECK
5			DFN	SB	APPROVED
6			DFN	SB	PRODUCT MARK

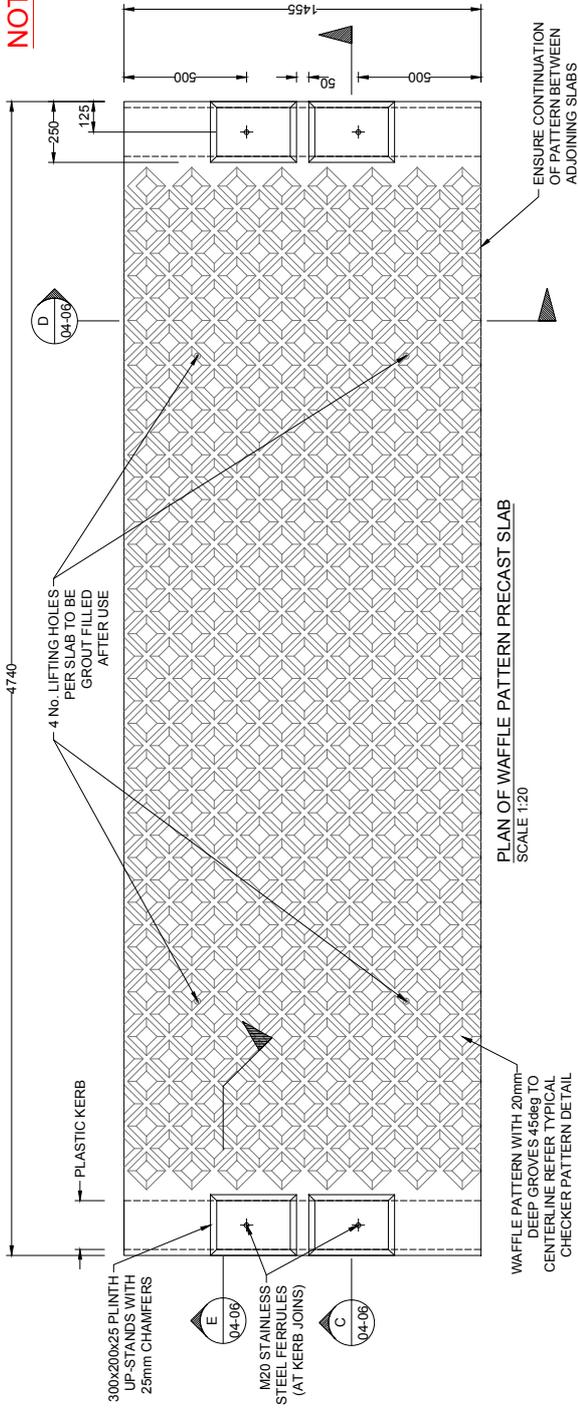
Civil/Structural Consulting Pty Ltd

Seashore Engineering

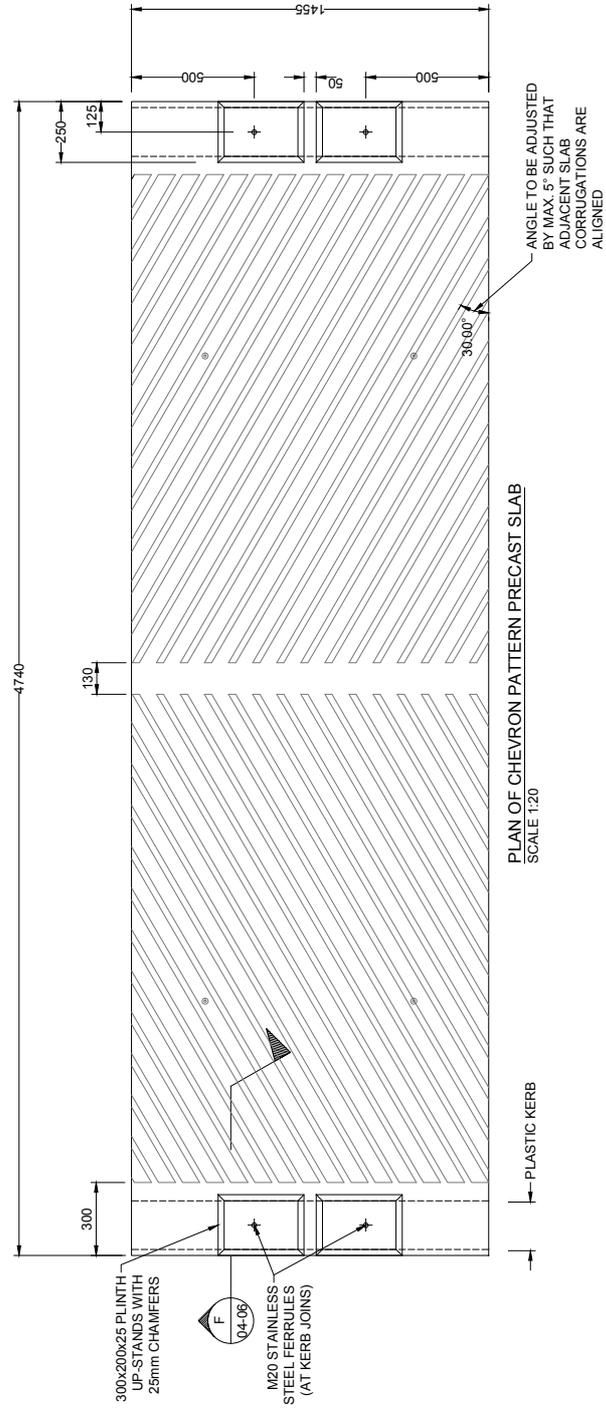
SHIRE OF JERRAMUNGUP
FISHERY BEACH MARINA BOAT RAMPS AND
JETTY REFURBISHMENT
BOAT RAMP DETAILS

DRAWING NUMBER: **SE 064-04-04** 1

NOT FOR CONSTRUCTION



PLAN OF WAFLE PATTERN PRECAST SLAB
SCALE 1:20

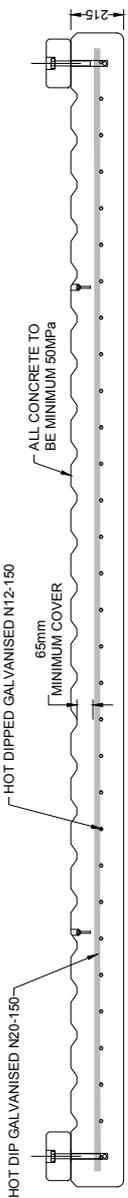


PLAN OF CHEVRON PATTERN PRECAST SLAB
SCALE 1:20

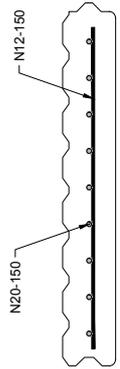
		SHIRE OF JERRAMUNGUP JETTY BEACH MARINA BOAT RAMPS AND JETTY REFURBISHMENT PRE-CAST PANEL DETAILS SHEET 1 OF 2		DRAWING NUMBER SE 064-04-05	
Civil/Structural Consulting Pty Ltd 		ACTION DRAWER: SB DRAWN: OS ENGINEERING: SB CHECK: SB PROJECT CHECK: SB APPROVED: SB PROJECT MARK:		DATE 06/03/2018 06/03/2018	
SIGNATURE NAME SB OS SB SB SB		SCALE 1:20 0.2 0 0.2 1 METERS DATUM VERTICAL HORIZONTAL AUSTRALIAN HEIGHT DATUM (FOR AUSTRALIAN MAPS) IS SEA ABOVE CHART ON UTM (GDA) AND IS BELOW TIDAL BENCHMARK (MADMS)		NOTES 1. NATURAL SURFACE LEVELS BASED ON INTERPOLATION OF 18/12/2011 SURVEY BY DoT 2. ROCK LEVELS BASED ON DRAWING 37/19-09	
ORG SIZE: A3 DATE: 05/02/2018 REVISION: 1 PROJECT NO: SE064		PROJECT NO: SE064			



NOT FOR CONSTRUCTION



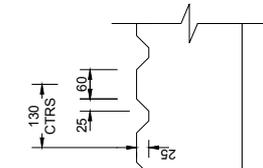
SECTION C
1:20
04-09



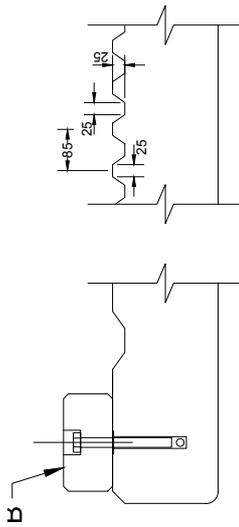
SECTION D
1:20
04-09

M20 STAINLESS STEEL BOLT AND WASHER. MINIMUM 35mm HOLE WITH APPROPRIATE "NEVER SEEZE". ENSURE HEAD NOT PROUD. FILL HOLE WITH SIKAFLEX

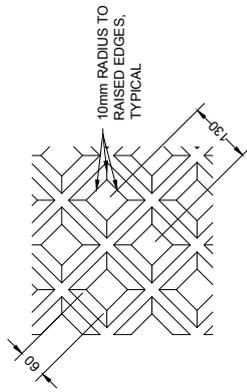
APR RECYCLED PLASTIC KERBS WITH NON SLIP SURFACE TO LOCK RAMP SLABS TOGETHER I.E. JOINTS TO BUTT MIDSPAN ON PLANKS (REQUIRES ONSITE MEASUREMENTS)



SECTION E
1:10
04-09



SECTION F
1:10
04-09



TYPICAL WAFFLE PATTERN DETAIL PLAN
SCALE 1:10

REV	DATE	DESCRIPTION	BY	CHKD	APP'D
1	04/02/2021	ISSUED FOR TENDER	DF	SB	
0	10/02/2018	FINAL	OS	SB	
A	05/02/2018	PRELIMINARY	OS	SB	
		AMENDMENT	DFN	OS/DFN	
<p>ORG SIZE: ARCHIVE <small>ARCHIVE IS A COPY OF THE ORIGINAL DRAWING AND SHOULD NOT BE USED FOR CONSTRUCTION PURPOSES. FOR MORE INFORMATION CONTACT THE PROJECT MANAGER.</small></p>					
PROJECT NO			SE064		

NOTES
 1. NATURAL SURFACE LEVELS BASED ON INTERPOLATION OF 18/12/2011 SURVEY BY DoT
 2. ROCK LEVELS BASED ON DRAWING 37/9-09

SCALE 1:20
 0.2 0 0.2
 METERS
 UNLESS OTHERWISE NOTED

AUSTRALIAN BEST PRACTICE (AS/NZS 1170:2002) ABOVE CHART
 ON 10M (CD) AND 10M BELOW TOTAL BENCHMARK (BM) 01

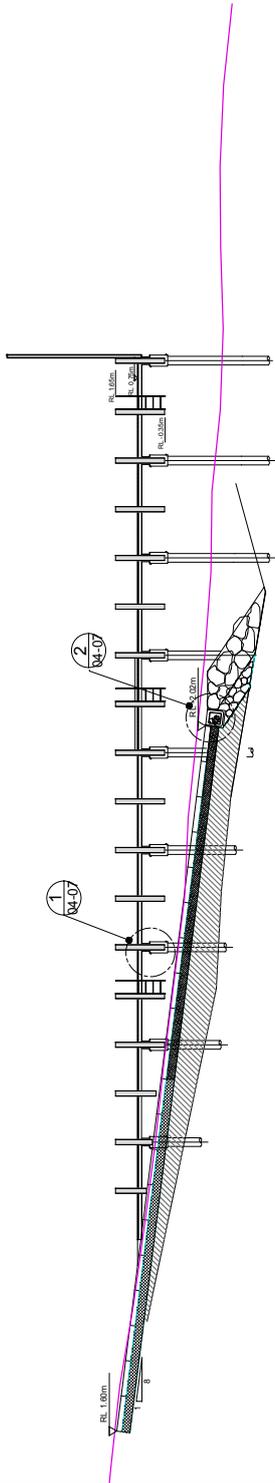
ACTION	NAME	SIGNATURE	DATE
DESIGNED	SB		06/03/2018
DRAWN	OS		06/03/2018
ENGINEERING CHECK	SB		
STRUCTURAL CHECK	SB		
APPROVED			
PROJECT MGR			



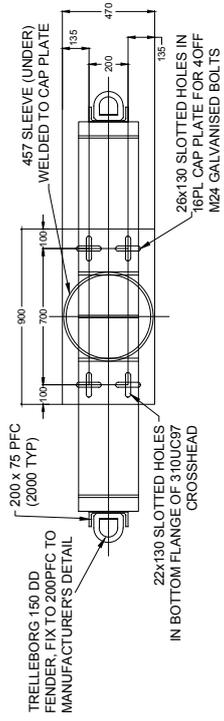
SHIRE OF JERRAMUNGUP
 FISHERY BEACH MARINA BOAT RAMPS AND JETTY REFURBISHMENT
 PRE-CAST PANEL DETAILS
 DRAWING NUMBER: SE 064-04-06
 REV: 1



DESIGN VESSEL:
8.0m LONG
0.9m DRAFT
DESIGN MAX WATER LEVEL:
1.0m AHD
DESIGN LIFE:
20 YRS



SECTION A-A
SCALE: 1:200
04-07



SECTION H
SCALE: 1:25
04-07

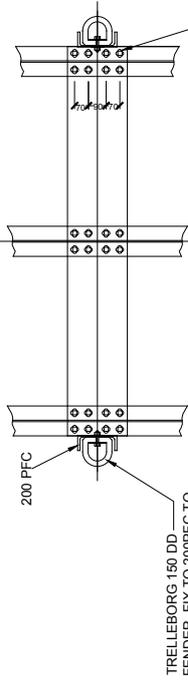
TRELLEBORG 150 DD FENDER, FIX TO 200PFC TO MANUFACTURER'S DETAIL

200 x 75 PFC (2000 TYP)

22x130 SLOTTED HOLES IN BOTTOM FLANGE OF 310UC97 CROSSHEAD

457 SLEEVE (UNDER) WELDED TO CAP PLATE

26x130 SLOTTED HOLES IN 16PL CAP PLATE FOR 4OFF M24 GALVANISED BOLTS



SECTION G
SCALE: 1:25
04-07

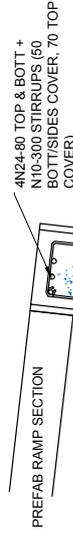
TRELLEBORG 150 DD FENDER, FIX TO 200PFC TO MANUFACTURER'S DETAIL

200 PFC

310UC97 CROSSHEAD

16PL CAP PLATE

Ø22 x 50 SLOTTED HOLES IN BOTTOM FLANGE OF 150UC37 (TYP.) FOR M20 GALVANISED BOLTS AND Ø22 x 50 SLOTTED HOLES IN TOP FLANGE OF 310UC97 (AT 90° TO SLOTTED HOLES IN 150UC37)



SCALE: 1:25
04-07

PREFAB CONCRETE CULVERT SECTIONS 450x450 (ACTING AS FORMS)

ALL REINFORCEMENT HD GALVANISED

DETAIL 2
SCALE: 1:25
04-07

SECTION H
SCALE: 1:25
04-07

GROUTING PROCEDURE TO BE SUBMITTED TO PRINCIPAL FOR WRITTEN APPROVAL AT LEAST 3 WEEKS PRIOR TO CONSTRUCTION

16PL WEB STIFFENERS BOTH SIDES (TYP.)

355.6 CHS 12.7 PILE

3mm FILLET WELD SURFACE SLEEVE (TYP.)

ALL ROUND O/S PILE & INNER SURFACE SLEEVE (TYP.)

FRP DECKING TREADWELL GATEX - BAREFOOT MINI MESH MG38M SPANNING WIDTH OF JETTY (DOUBLE SPAN). CONNECTIONS TO MANUFACTURER'S DETAIL. FOR WAVE LOADED APPLICATIONS.

200 x 75 PFC (2000 TYP)

310UC97 CROSSHEAD

16PL CAP PLATE

10PL STIFFENERS UNDER 150UC37 (TYP.)

12PL GUSSETS

60MPa NON-SHRINK GROUT B.A.S.F MASTER FLOW 880W

457CHS12.7 SLEEVE

16PL WEB STIFFENERS BOTH SIDES (TYP.)

355.6 CHS 12.7 PILE

3mm FILLET WELD SURFACE SLEEVE (TYP.)

ALL ROUND O/S PILE & INNER SURFACE SLEEVE (TYP.)

16PL WEB STIFFENERS BOTH SIDES (TYP.)

355.6 CHS 12.7 PILE

16PL WEB STIFFENERS BOTH SIDES (TYP.)

355.6 CHS 12.7 PILE

16PL WEB STIFFENERS BOTH SIDES (TYP.)

355.6 CHS 12.7 PILE

16PL WEB STIFFENERS BOTH SIDES (TYP.)

355.6 CHS 12.7 PILE

16PL WEB STIFFENERS BOTH SIDES (TYP.)

355.6 CHS 12.7 PILE

16PL WEB STIFFENERS BOTH SIDES (TYP.)

355.6 CHS 12.7 PILE

16PL WEB STIFFENERS BOTH SIDES (TYP.)

355.6 CHS 12.7 PILE

NOT FOR CONSTRUCTION

NOTES

NO.	DATE	ISSUED FOR	BY	REV.
1	01/09/2020	FOR TENDER	DF	SR
2	04/05/2021	REVISED FOR TENDER	DF	SR
3	10/02/2018	FINAL	OS	SR
4	05/02/2018	PRELIMINARY	OS	SR
5		AMENDMENT	DFN	SR

DATE: 04/05/2021
DRAWN: DF
CHECKED: SR
APPROVED: SR

PROJECT NO: SE064-04
DRAWING NO: SE064-04-07

SCALE: 1:50
0.5 0 1 2 METERS
UNLESS OTHERWISE STATED

DATUM: VERTICAL
HORIZONTAL: N/A

Australian Weight Datum (WGD) is used unless otherwise stated. All dimensions are in meters unless otherwise stated.

Civil/Structural Consulting Pty Ltd
Seashore Engineering

ACTION	DATE	SIGNATURE	NAME	TITLE
ENGINEER	06/03/2018		TM	TM
DRAWN	06/03/2018		TM	TM
CHECKED			SB	SB
ENGINEERING			SB	SB
DESIGN CHECK			SB	SB
APPROVED				



ACTION	NAME	DATE
DESIGNED	TM	06/03/2018
DRAWN	TM	06/03/2018
ENGINEERING CHECK	SB	
STRUCTURAL CHECK	SB	
APPROVED		
PROJECT NO.		

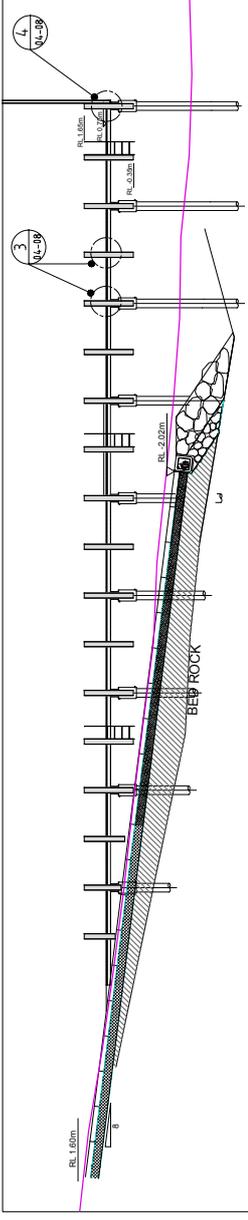
SCALE	UNLESS OTHERWISE STATED
1:50	2 METERS
DATION	
VERTICAL	
HORIZONTAL	

NO.	DATE	DESCRIPTION
2	04/06/2021	ISSUED FOR TENDER
1	01/06/2020	REV 1
0	10/02/2018	FINAL
A	05/02/2018	PRELIMINARY
REV	DATE	DESCRIPTION
DESIGNED BY		
DRAWN BY		
CHECKED BY		
PROJECT NO.	SE064-04	
ORIG. SIZE	A3	

NOTES

DESIGN VESSEL:
8.0m LONG
0.9m DRAFT
DESIGN MAX WATER LEVEL:
1.0m AHD
DESIGN LIFE:
20 YRS

PILE INSTALLATION
CHS PILES SHALL BE DRILLED MINIMUM 2.0m INTO COMPETENT ROCK LAYER (>60MPa). WHERE ROCK IS NOT PRESENT DRILL MINIMUM 5.0m INTO SAND (>15MPa). WHERE CAVITIES ARE CREATED AROUND PILES THESE ARE TO BE GROUT FILLED TO THE SATISFACTION OF THE SUPERINTENDENT.

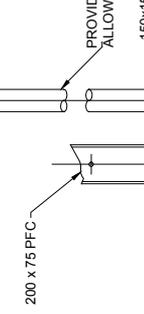


SECTION A
SCALE: 1:200

CONTRACTOR TO PROVIDE NAVIGATION LIGHT AFFIXED TO POLE. SYSTEM IS TO COMPLY WITH DEPARTMENT OF TRANSPORT SPECIFICATIONS.

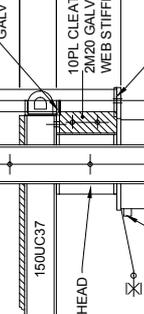
114.3CHSS.0 GALV WITH WEATHERPROOF CAP. ALL PAINTED YELLOW.

PROVIDE SUITABLE HINGE TO CHS TO ALLOW ACCESS FOR GLOBE CHANGE



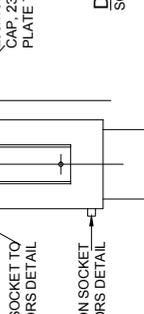
150UC37 CROSSHEAD

10PL CLEAT + 2M20 GALV TO WEB STIFFENER



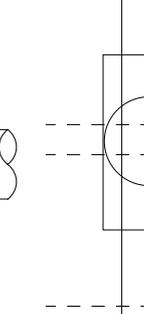
150UC37 CROSSHEAD

235x160X18PL CLEAT TO PILE CAP, 235x150X12PL BASE PLATE TO CHS, 2M20 GALV



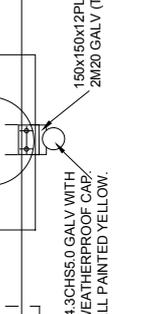
150UC37 CROSSHEAD

200 x 75 PFC



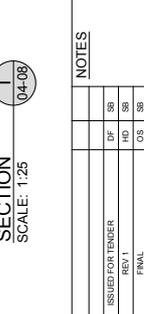
150UC37 CROSSHEAD

110x60x10PL (TRIM TO SUIT) + 2M12 GALV



150UC37 CROSSHEAD

275x125x12PL GUSSETT + 125x125x10PL CAP. 2M16 GALV

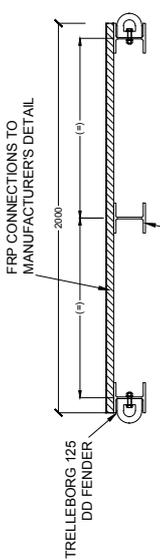


150UC37 CROSSHEAD

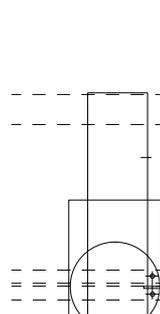
FRP DECKING TREDWELL GATEX - MINI MESH M338M. CONNECTIONS TO MANUFACTURER'S DETAIL, FOR WAVE LOADED APPLICATIONS.



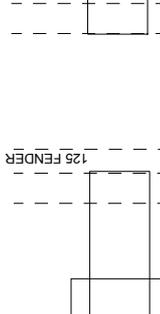
150UC37 CROSSHEAD



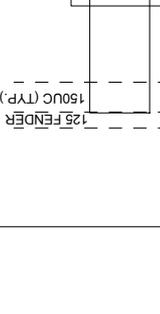
DETAIL 3
SCALE: 1:25



DETAIL 3
SCALE: 1:25



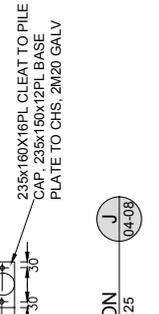
DETAIL 3
SCALE: 1:25



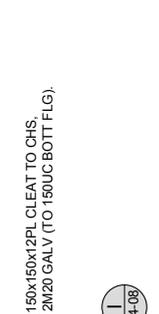
DETAIL 3
SCALE: 1:25



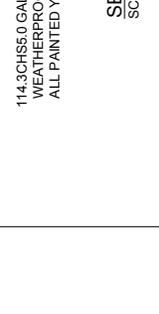
DETAIL 3
SCALE: 1:25



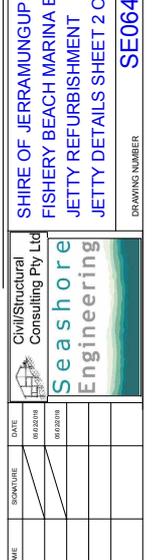
DETAIL 3
SCALE: 1:25



DETAIL 3
SCALE: 1:25



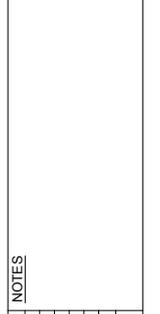
DETAIL 3
SCALE: 1:25



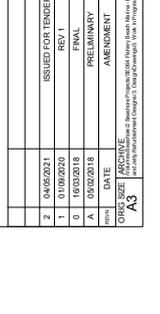
DETAIL 3
SCALE: 1:25



DETAIL 3
SCALE: 1:25



DETAIL 3
SCALE: 1:25



DETAIL 3
SCALE: 1:25



DETAIL 3
SCALE: 1:25



DETAIL 3
SCALE: 1:25

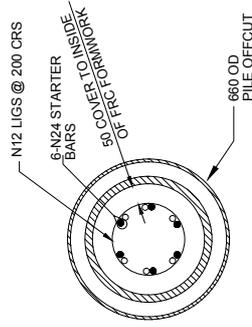
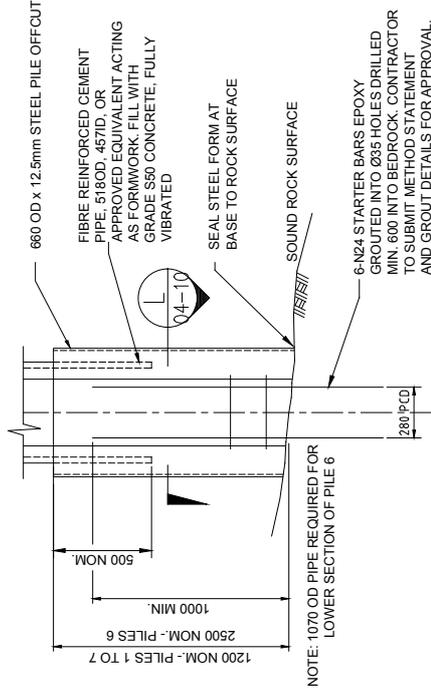
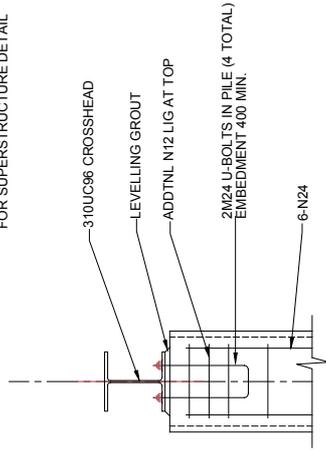


DETAIL 3
SCALE: 1:25

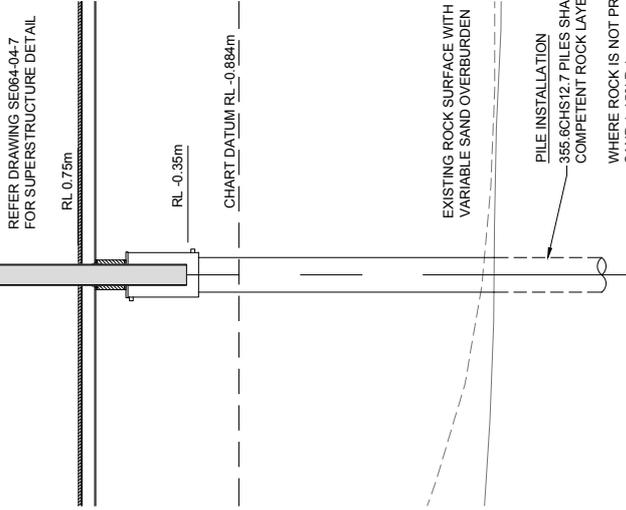


DETAIL 3
SCALE: 1:25

REFER DRAWING SE064-04-7 FOR SUPERSTRUCTURE DETAIL



SECTION SCALE: 1:20



OPTION 1 - STEEL
 SCALE 1 : 50

OPTION 2 - CONCRETE
 SCALE 1 : 25



NOT FOR CONSTRUCTION

SHIRE OF JERRAMUNGUP
 FISHERY BEACH MARINA BOAT RAMPS AND
 JETTY REFURBISHMENT
 PILE OPTIONS



DATE	SIGNATURE	NAME	ACTION
20/10/2021		TM	DESIGNED
20/10/2021		SB	DRAWN
		SB	ENGINEERING CHECK
		SB	STRUCTURAL CHECK
			APPROVED
			PROJECT NAME

SCALE 1 : 50
 0 5 10 20 METERS
 UNLESS OTHERWISE STATED
 DATUM
 VERTICAL
 HORIZONTAL N/A
 AUSTRALIAN WEIGHTS & MEASURES ACT, 1988 (UNLESS OTHERWISE SPECIFIED)
 ON 100 (SD) AND 4 (SD) BELOW TOTAL BENCHMARK DIMENSIONS

NO.	REVISION	DATE	BY	CHKD BY	APPROVED BY
1	ISSUED FOR TENDER	04/02/2021	DFN	SB	
	AMENDMENT				

PROJECT NO.	SE064-04
DATE	04/02/2021
SCALE	1:50
PROJECT NAME	FISHERY BEACH MARINA BOAT RAMPS AND JETTY REFURBISHMENT
PROJECT NO.	SE064-04
DATE	04/02/2021
SCALE	1:50
PROJECT NAME	FISHERY BEACH MARINA BOAT RAMPS AND JETTY REFURBISHMENT

DRAWING NUMBER
 SE064-04-10
 1



*Technical Specification
Fishery Beach Marina Boat Ramps and Jetty Refurbishment*

ATTACHMENT 2 SITE PHOTOGRAPHS



Ramp and Jetty - 2017



**Boat ramps and rock protection
- 2017**



Jetty and piles - 2017



**Ramps and Jetty looking out towards
harbour - 2017**



Jetty and breakwater - 2017



Existing finger jetty - 2017



Paved jetty approach - 2017



**Boat ramps looking towards harbour
- Dec 2020**



Boat ramps and jetty - Dec 2020



*Technical Specification
Fishery Beach Marina Boat Ramps and Jetty Refurbishment*

ATTACHMENT 3 TIDE PREDICTIONS and TYPICAL METOCEAN CONDITIONS

Note: Tide predictions are to Chart Datum

AUSTRALIA, SOUTH COAST – ALBANY

2021

LAT 35° 02' S LONG 117° 53' E

TIMES AND HEIGHTS OF HIGH AND LOW WATERS

TIME ZONE -0800

SEPTEMBER

Time	m	Time	m	Time	m	Time	m
1	0720 0.94 1652 0.42	9	0009 0.82 0544 0.51 1213 0.95 1830 0.51	17	0905 1.06 1700 0.26 2356 0.73	25	0648 0.54 1112 0.68 1632 0.50 2359 1.00
WE		TH		FR*		SA	
2	0809 1.01 1652 0.38	10	0025 0.87 0636 0.53 1241 0.80 1818 0.56	18	0305 0.68 0944 1.08 1717 0.30 2331 0.72	26	0736 0.57 1103 0.64 1630 0.47
TH		FR		SA		SU	
3	0847 1.07 1658 0.35	11	0043 0.91 0744 0.57 1238 0.66 1708 0.57	19	0338 0.61 1017 1.06 1728 0.36 2326 0.74	27	0019 1.00 0850 0.61 1020 0.62 1627 0.45
FR		SA		SU		MO	
4	0922 1.12 1709 0.33 2341 0.72	12	0100 0.95 1600 0.49	20	0409 0.55 1043 1.02 1729 0.42 2330 0.77	28	0040 0.98 1614 0.43
SA*		SU		MO		TU	
5	0304 0.65 0957 1.16 1726 0.33 2335 0.72	13	0106 0.97 1536 0.37	21	0439 0.51 1100 0.96 1731 0.48 2324 0.82	29	0059 0.95 1601 0.40
SU		MO		TU		WE	
6	0341 0.59 1030 1.16 1744 0.35 2342 0.74	14	0118 0.96 1558 0.29	22	0508 0.50 1113 0.88 1730 0.51 2326 0.87	30	0114 0.90 1600 0.37
MO		TU		WE		TH	
7	0418 0.54 1105 1.13 1802 0.39 2354 0.77	15	0145 0.92 0330 0.92 0723 0.95 1620 0.24	23	0538 0.50 1123 0.81 1706 0.53 2334 0.93		
TU		WE		TH			
8	0459 0.51 1139 1.06 1819 0.44	16	0819 1.01 1642 0.24	24	0611 0.51 1116 0.74 1654 0.52 2344 0.97		
WE		TH		FR			

OCTOBER

Time	m	Time	m	Time	m	Time	m
1	0745 0.91 1600 0.35 2356 0.78	9	0711 0.41 1310 0.58 1618 0.40 2228 0.80	17	0331 0.62 0936 0.91 1618 0.40 2228 0.80	25	0750 0.47 1109 0.52 1531 0.46 2351 1.06
FR*		SA		SU		MO	
2	0233 0.76 0830 0.97 1608 0.33 2303 0.75	10	0001 1.05 1200 0.43	18	0352 0.55 1005 0.88 1615 0.45 2229 0.85	26	0851 0.51 1006 0.51 1520 0.43
SA		SU		MO		TU	
3	0254 0.67 0907 1.02 1621 0.32 2243 0.77	11	0010 1.06 1405 0.32	19	0419 0.49 1028 0.84 1617 0.48 2228 0.91	27	0011 1.02 1508 0.41
SU		MO		TU		WE	
4	0324 0.59 0944 1.05 1636 0.34 2244 0.80	12	0014 1.03 1446 0.25	20	0448 0.45 1043 0.78 1611 0.51 2231 0.97	28	0029 0.97 1500 0.39
MO		TU		WE		TH	
5	0400 0.51 1021 1.03 1651 0.38 2254 0.86	13	0025 0.98 1519 0.22	21	0519 0.43 1100 0.73 1600 0.51 2244 1.02	29	0041 0.91 1458 0.37
TU		WE		TH		FR	
6	0440 0.44 1100 0.97 1705 0.43 2308 0.92	14	0025 0.91 1545 0.23 1705 0.43 2308 0.92	22	0553 0.42 1116 0.67 1553 0.51 2257 1.06	30	0007 0.84 1503 0.36 2245 0.79
WE		TH*		FR		SA*	
7	0525 0.40 1140 0.87 1713 0.50 2325 0.98	15	0326 0.79 0816 0.91 1603 0.28 2313 0.78	23	0628 0.42 1126 0.61 1535 0.49 2312 1.08	31	0236 0.74 0754 0.87 1514 0.36 2159 0.80
TH		FR		SA		SU	
8	0615 0.39 1221 0.73 1704 0.55 2344 1.03	16	0323 0.70 0900 0.92 1615 0.34 2246 0.77	24	0706 0.44 1115 0.56 1533 0.47 2330 1.08		
FR		SA		SU			

NOVEMBER

Time	m	Time	m	Time	m	Time	m
1	0258 0.64 0845 0.90 1526 0.37 2148 0.85	9	1301 0.23 2353 1.04	17	0436 0.47 1024 0.67 1453 0.53 2143 1.03	25	0009 1.04 1340 0.42
MO		TU		WE		TH	
2	0331 0.54 0930 0.90 1538 0.40 2155 0.93	10	1402 0.22	18	0500 0.42 1045 0.64 1452 0.53 2157 1.09	26	0032 0.98 1343 0.41
TU		WE		TH		FR	
3	0412 0.44 1016 0.86 1551 0.45 2209 1.01	11	0000 0.96 1442 0.25 2338 0.88	19	0530 0.38 1108 0.60 1453 0.52 2214 1.13	27	0057 0.92 1351 0.41
WE		TH		FR		SA	
4	0458 0.35 1105 0.79 1600 0.51 2229 1.08	12	0554 0.79 0630 0.79 1507 0.31 2303 0.82	20	0603 0.36 1132 0.57 1441 0.51 2233 1.15	28	0054 0.83 1359 0.42 2145 0.80
TH		FR		SA		SU	
5	0547 0.30 1200 0.68 1557 0.55 2251 1.14	13	0424 0.72 0800 0.78 1520 0.38 2216 0.80	21	0638 0.35 1158 0.53 1444 0.49 2255 1.15	29	0249 0.73 0637 0.76 1407 0.43 2100 0.85
FR		SA		SU		MO	
6	0644 0.28 1311 0.56 1442 0.55 2315 1.17	14	0405 0.65 0853 0.76 1518 0.45 2145 0.83	22	0715 0.36 1220 0.49 1445 0.47 2318 1.13	30	0315 0.61 0827 0.75 1420 0.46 2100 0.94
SA		SU		MO		TU	
7	0815 0.29 2338 1.16	15	0411 0.58 0930 0.73 1506 0.50 2137 0.90	23	0756 0.39 1233 0.46 1434 0.45 2344 1.09		
SU		MO		TU			
8	1124 0.27 2350 1.11	16	0420 0.52 1000 0.70 1502 0.52 2137 0.96	24	0846 0.42 1149 0.44 1412 0.43		
MO		TU		WE			

DECEMBER

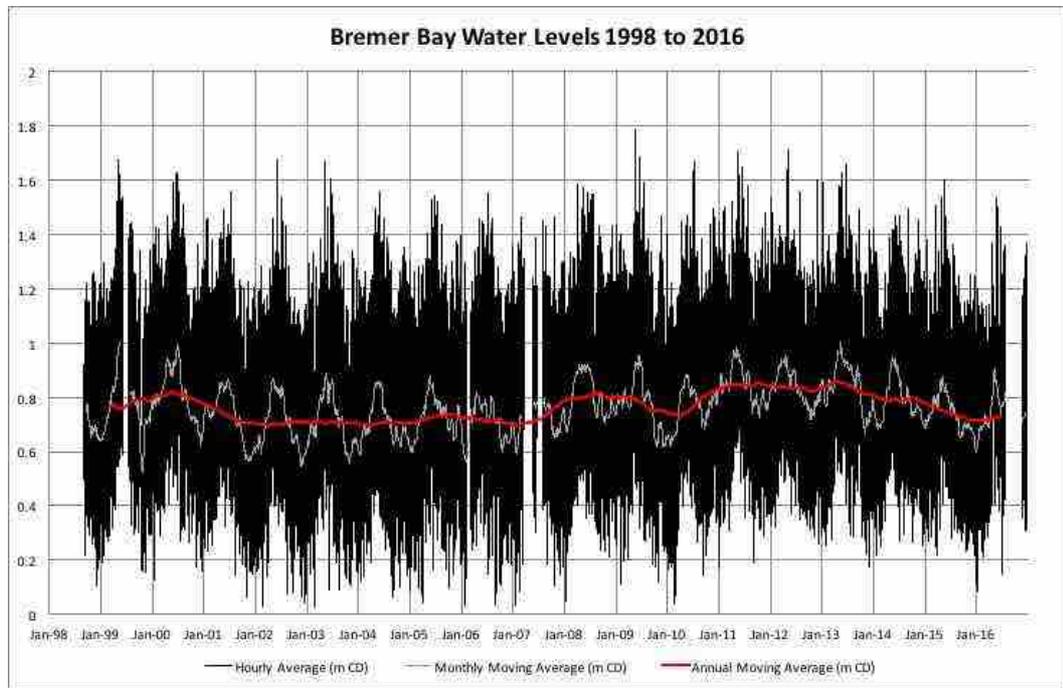
Time	m	Time	m	Time	m	Time	m
1	0354 0.48 0933 0.73 1435 0.50 2114 1.04	9	0009 1.02 1318 0.29 2359 0.93	17	0538 0.37 1140 0.56 1320 0.55 2135 1.14	25	0046 0.99 0939 0.43
WE		TH		FR		SA	
2	0439 0.36 1035 0.69 1448 0.54 2135 1.13	10	1405 0.36 2335 0.85	18	0552 0.33 1203 0.54 1330 0.54 2200 1.17	26	0104 0.91 1026 0.46
TH		FR		SA		SU	
3	0529 0.26 1139 0.63 1453 0.57 2203 1.21	11	1429 0.44 2233 0.81	19	0616 0.30 1229 0.53 1351 0.52 2226 1.18	27	0100 0.81 1124 0.50 2031 0.79
FR		SA		SU		MO	
4	0625 0.19 1234 1.25	12	0641 0.62 0736 0.63 1430 0.52 2135 0.82	20	0646 0.30 1255 0.51 1410 0.50 2254 1.17	28	1211 0.54 2010 0.88
SA		SU		MO		TU	
5	0730 0.16 2307 1.24	13	0611 0.57 1002 0.61 1344 0.56 2059 0.88	21	0717 0.31 1321 0.49 1422 0.48 2323 1.15	29	0430 0.53 0916 0.60 1242 0.57 2020 0.99
SU		MO		TU		WE	
6	0845 0.17 2341 1.19	14	0557 0.52 1051 0.59 1317 0.58 2055 0.95	22	0749 0.33 2353 1.11	30	0445 0.39 1112 0.61 1308 0.60 2045 1.10
MO		TU		WE		TH	
7	1030 0.21	15	0538 0.47 1119 0.58 1309 0.57 2100 1.03	23	0823 0.36	31	0520 0.26 1245 0.61 1317 0.61 2118 1.19
TU		WE		TH		FR	
8	0009 1.11 1209 0.24	16	0534 0.42 1123 0.57 1321 0.56 2114 1.09	24	0021 1.05 0859 0.39		
WE		TH		FR			

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Datum of Predictions is Lowest Astronomical Tide

* Extra Tides

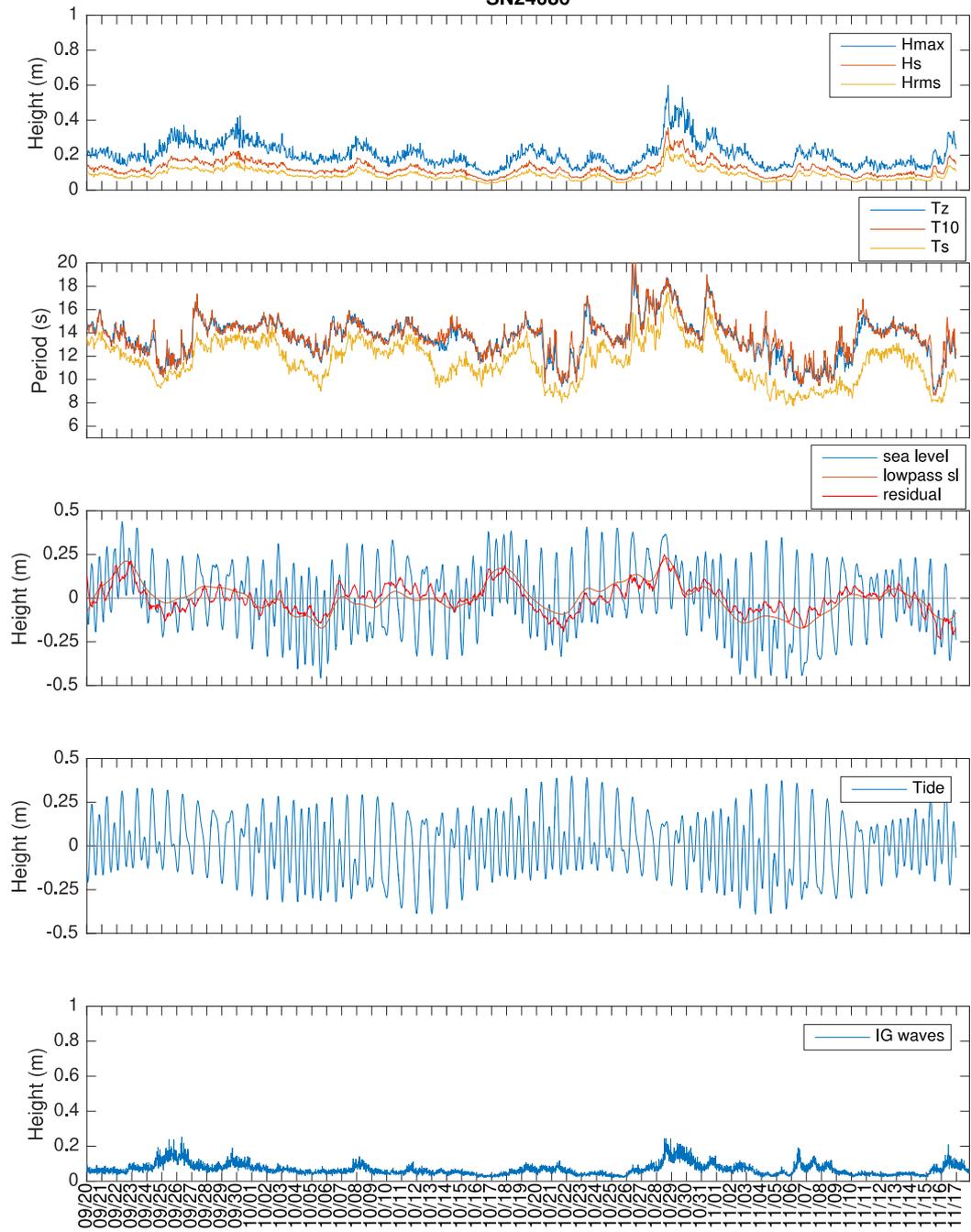
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Attachment E Metocean Analysis

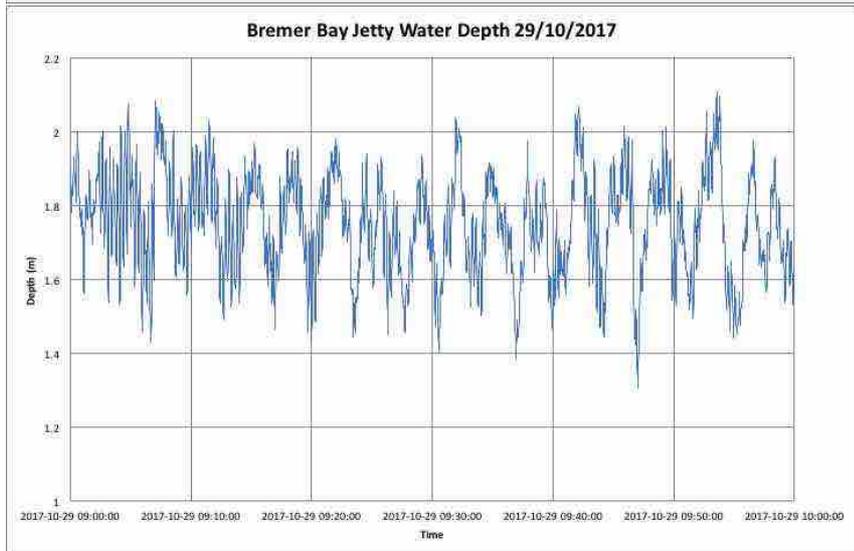
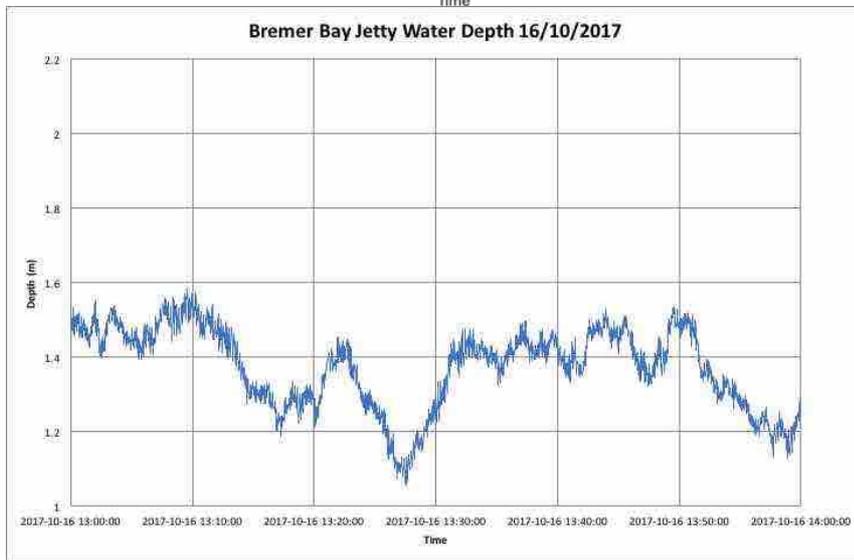
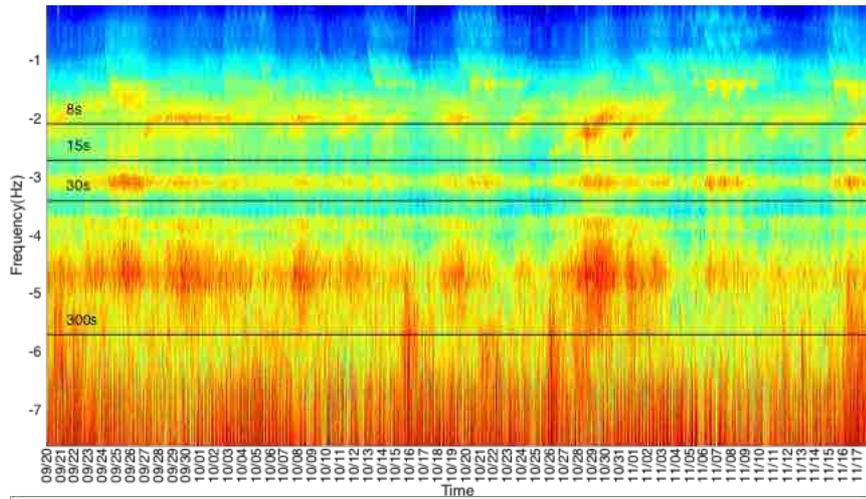


Water Levels from Tide Gauge

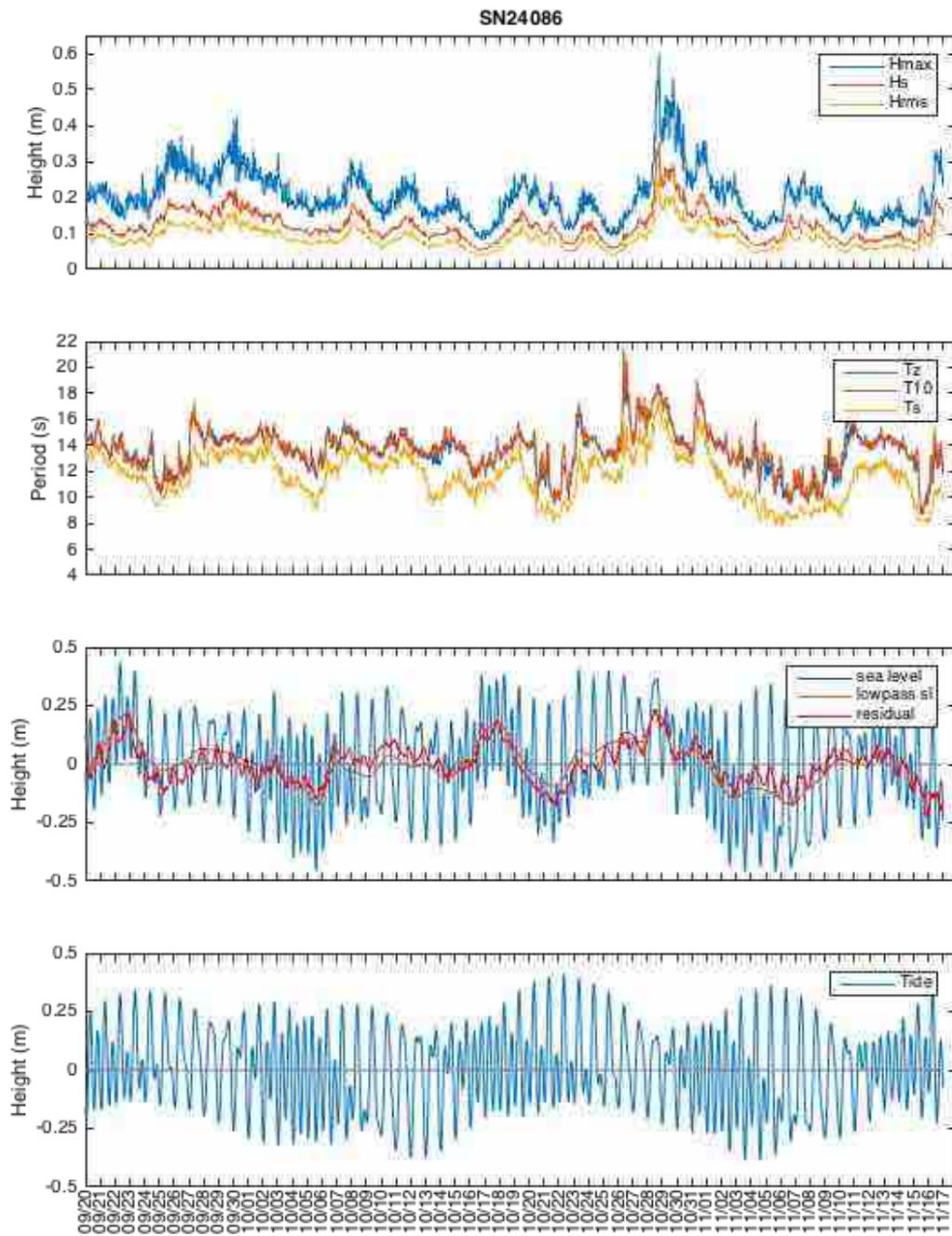
SN24086



Wave Heights at Jetty



Frequency Bands at Jetty (upper) and water level variations over a 1-hour period at jetty (middle and lower)



Wave Heights at Wharf

AUSTRALIA, SOUTH COAST – ESPERANCE

2021

LAT 33° 52' S LONG 121° 54' E

TIMES AND HEIGHTS OF HIGH AND LOW WATERS

TIME ZONE -0800

SEPTEMBER

Time	m	Time	m	Time	m	Time	m
1 0800	0.90	9 0549	0.38	17 0211	0.66	25 0637	0.45
WE 1711	0.40	TH 1830	0.40	FR 1700	0.23	SA 1714	0.39
				2326	0.67		
2 0837	0.98	10 0014	0.89	18 0301	0.56	26 0011	0.99
TH 1659	0.36	FR 0634	0.42	SA 0954	1.08	SU 0713	0.50
		FR 1225	0.85	SA 1715	0.26	SU 1133	0.68
		1830	0.45	2304	0.69	1711	0.38
3 0909	1.05	11 0038	0.93	19 0339	0.48	27 0030	0.98
FR 1701	0.32	SA 0725	0.48	1024	1.07	0756	0.56
FR 2322	0.67	SA 1230	0.70	SU 1717	0.30	MO 1122	0.64
		1757	0.46	2309	0.73	1710	0.38
4 0249	0.61	12 0104	0.95	20 0413	0.42	28 0054	0.95
SA 0940	1.12	TH 0827	0.57	1043	1.04	0900	0.62
SA 1707	0.30	SU 1058	0.62	MO 1720	0.34	TU 1029	0.63
2305	0.68	1717	0.42	2306	0.77	1705	0.37
5 0324	0.53	13 0129	0.95	21 0445	0.38	29 0117	0.90
SU 1010	1.17	MO 1636	0.34	TU 1054	0.99	WE 1647	0.37
SU 1718	0.28			TU 1730	0.37	WE 1647	0.37
2307	0.71			2307	0.84		
6 0357	0.46	14 0144	0.91	22 0513	0.37	30 0142	0.83
MO 1040	1.19	TU 1641	0.27	1109	0.93	0606	0.80
MO 1735	0.28			WE 1733	0.40	TH 0716	0.80
2318	0.75			2322	0.90	1622	0.35
7 0431	0.41	15 0155	0.85	23 0539	0.38		
TU 1110	1.16	WE 0249	0.85	1127	0.86		
TU 1755	0.30	WE 0741	0.91	TH 1717	0.41		
2334	0.79	1641	0.23	2341	0.95		
8 0508	0.38	16 0836	0.99	24 0606	0.41		
WE 1139	1.09	TH 1645	0.22	1135	0.79		
WE 1814	0.34	TH 2354	0.69	FR 1714	0.40		
2352	0.84			2357	0.98		

OCTOBER

Time	m	Time	m	Time	m	Time	m
1 0813	0.88	9 0652	0.33	17 0324	0.52	25 0720	0.42
FR 1617	0.32	SA 1208	0.62	TH 0939	0.91	MO 1127	0.57
FR 2334	0.70	SA 1653	0.42	SU 1619	0.33	MO 1625	0.37
				2215	0.78		
2 0227	0.66	10 0008	1.07	18 0344	0.44	26 0006	1.04
SA 0847	0.96	10 0744	0.41	MO 1003	0.89	TH 0800	0.47
SA 1615	0.29	SU 1147	0.49	MO 1615	0.35	TU 1115	0.53
2236	0.70	1621	0.39	2219	0.85	1625	0.36
3 0257	0.57	11 0031	1.05	19 0413	0.38	27 0029	0.99
SU 0920	1.02	MO 1530	0.30	TU 1016	0.85	TH 0859	0.52
SU 1619	0.27			TU 1621	0.37	WE 1014	0.53
2223	0.74			2220	0.92	1617	0.36
4 0329	0.47	12 0041	1.00	20 0443	0.34	28 0051	0.93
MO 0952	1.06	TU 1544	0.23	MO 1028	0.81	TH 1553	0.36
MO 1632	0.27			WE 1625	0.38		
2230	0.80			2231	0.99		
5 0403	0.38	13 0035	0.92	21 0513	0.33	29 0114	0.85
SU 1024	1.06	WE 1558	0.20	TH 1045	0.77	FR 1533	0.35
TU 1649	0.28			TH 1615	0.39	FR 1533	0.35
2244	0.87			2250	1.04		
6 0441	0.32	14 0050	0.84	22 0543	0.33	30 0707	0.80
WE 1056	1.00	TH 1600	0.21	FR 1106	0.72	SA 1522	0.33
WE 1706	0.32	TH 2327	0.75	FR 1615	0.38	SA 2236	0.72
2300	0.94			2310	1.08		
7 0521	0.29	15 0315	0.70	23 0614	0.34	31 0217	0.66
TH 1127	0.90	FR 0827	0.88	SA 1120	0.66	TH 0808	0.86
TH 1720	0.37	FR 1609	0.24	SA 1621	0.38	SU 1517	0.31
2320	1.01	2304	0.72	2328	1.09	SU 2144	0.75
8 0605	0.29	16 0324	0.61	24 0645	0.37		
FR 1151	0.77	SA 0906	0.91	TU 1124	0.61		
FR 1718	0.41	SA 1619	0.29	SU 1623	0.37		
2343	1.05	2223	0.73	2345	1.08		

NOVEMBER

Time	m	Time	m	Time	m	Time	m
1 0249	0.55	9 0017	1.09	17 0415	0.39	25 0027	1.02
MO 0851	0.90	TU 1435	0.24	WE 0957	0.68	TH 0856	0.44
MO 1526	0.30			WE 1517	0.41	TH 1148	0.45
2139	0.83			2146	1.03	1552	0.39
2 0326	0.44	10 0029	1.00	18 0445	0.34	26 0056	0.95
TU 0931	0.91	WE 1502	0.22	TH 1012	0.65	FR 1510	0.41
TU 1541	0.31			TH 1515	0.41		
2151	0.92			2203	1.09		
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WE 1011	0.88	TH 1517	0.24	FR 1034	0.63	TH 1422	0.40
WE 1557	0.34			FR 1521	0.40	SA 1422	0.40
2209	1.02			2226	1.14		
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TH 1010	0.80	FR 1520	0.29	1100	0.59	SU 1358	0.39
TH 1612	0.37	FR 2245	0.75	SA 1533	0.39	SU 2137	0.72
2230	1.10			2248	1.15		
5 0530	0.22	13 0326	0.67	21 0617	0.30	29 0150	0.67
FR 1129	0.69	SA 0758	0.75	TH 1122	0.56	MO 0700	0.74
FR 1615	0.41	SA 1529	0.34	SU 1544	0.38	MO 1406	0.39
2253	1.16	2220	0.74	2312	1.15	2052	0.80
6 0617	0.22	14 0338	0.59	22 0650	0.32	30 0248	0.55
SA 1201	0.55	SU 0844	0.74	MO 1138	0.52	TH 0822	0.74
SA 1600	0.42	SU 1529	0.39	MO 1552	0.38	TU 1423	0.39
2320	1.18	2131	0.80	2335	1.12	2058	0.91
7 0709	0.27	15 0347	0.52	23 0726	0.36		
SU 1216	0.42	MO 0917	0.72	TH 1148	0.50		
SU 1542	0.39	MO 1507	0.41	TU 1600	0.38		
2349	1.16	2134	0.87				
8 0820	0.34	16 0353	0.45	24 0000	1.08		
MO 0905	0.34	TH 0943	0.70	TH 0804	0.40		
MO 1410	0.31	TU 1511	0.41	WE 1156	0.47		
		2139	0.95	1600	0.38		

DECEMBER

Time	m	Time	m	Time	m	Time	m
1 0334	0.42	9 0053	0.99	17 0503	0.34	25 0105	0.97
WE 0921	0.73	TH 1438	0.30	FR 1037	0.54	SA 0909	0.39
WE 1443	0.40			FR 1423	0.45	SA 1423	0.50
2117	1.02			2146	1.13	1617	0.49
2 0419	0.31	10 0023	0.88	18 0527	0.30	26 0132	0.89
TH 1015	0.68	FR 1449	0.36	SA 1055	0.53	SU 0955	0.43
TH 1502	0.42			SA 1447	0.44		
2143	1.13			2214	1.16		
3 0505	0.22	11 0026	0.80	19 0555	0.27	27 0154	0.78
FR 1108	0.61	SA 1442	0.42	TH 1117	0.53	MO 1053	0.46
FR 1517	0.43	SA 2233	0.74	SU 1510	0.42	MO 2030	0.71
2210	1.21			2242	1.18		
4 0555	0.17	12 1445	0.48	20 0624	0.27	28 1200	0.48
SA 1204	0.53	SU 2145	0.76	MO 1140	0.51	TH 2001	0.82
SA 1516	0.44			MO 1531	0.40	TU 2001	0.82
2241	1.25			2310	1.17		
5 0648	0.17	13 0630	0.55	21 0655	0.28	29 0405	0.52
SU 1311	0.44	MO 0822	0.56	TU 1200	0.50	TH 0825	0.57
SU 1510	0.42	MO 1325	0.51	TU 1553	0.40	WE 1253	0.50
2314	1.24	2053	0.83	2339	1.14	2024	0.95
6 0800	0.21	14 0531	0.51	22 0726	0.30	30 0431	0.37
MO 2349	1.18	TU 0923	0.55	WE 1221	0.49	TH 1000	0.56
		TU 1340	0.50	WE 1613	0.40	TH 1335	0.50
		2100	0.92			2057	1.07
7 1016	0.25	15 0453	0.46	23 0008	1.10	31 0509	0.25
TU 1016	0.25	WE 0958	0.54	TH 0758	0.33	TH 1105	0.55
		WE 1353	0.48	TH 1245	0.49	FR 1411	0.50
		2109	1.00	1628	0.41	FR 2132	1.17
8 0024	1.10	16 0450	0.40	24 0037	1.04		
WE 1350	0.28	TH 1021	0.54	FR 0831	0.36		
		TH 1403	0.47	FR 1317	0.49		
		2124	1.07	1634	0.45		

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Datum of Predictions is Lowest Astronomical Tide

* Extra Tides

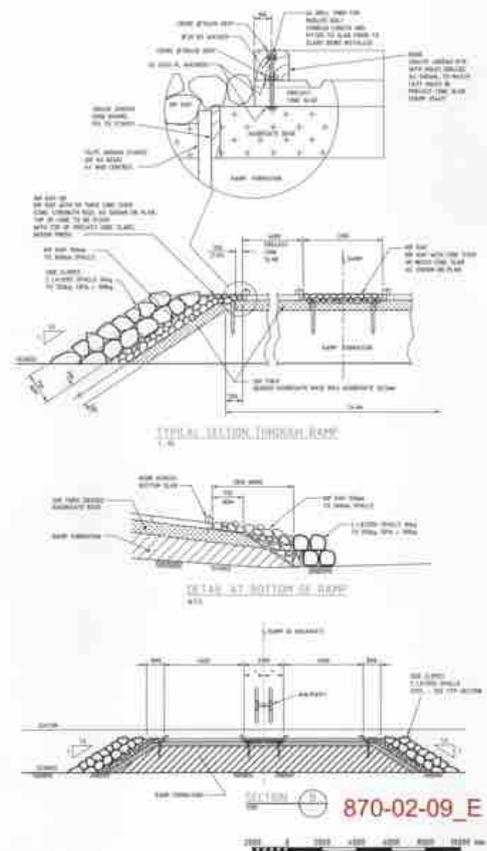
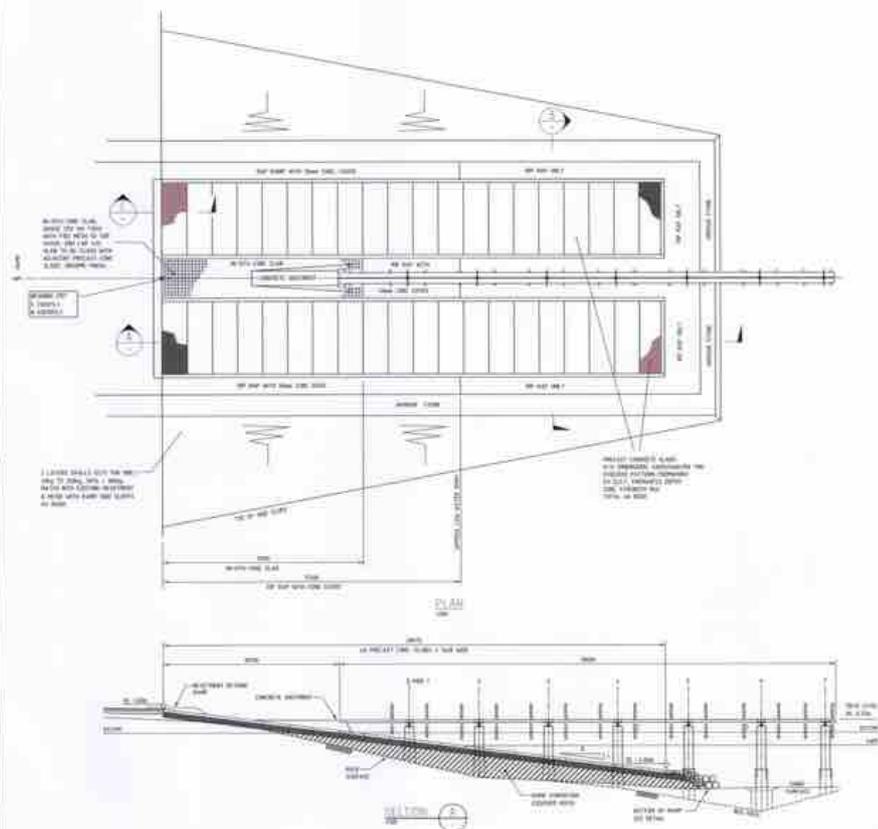
Moon Phase Symbols ● New Moon ○ First Quarter ○ Full Moon ○ Last Quarter



*Technical Specification
Fishery Beach Marina Boat Ramps and Jetty Refurbishment*

ATTACHMENT 4 AVAILABLE DRAWINGS OF EXISTING STRUCTURES

NO SCALE



870-02-09_E

NO.	DESCRIPTION	DATE	BY	CHECKED
1	ISSUED FOR PERMITS	11/15/09	J. EAGLE	
2	ISSUED FOR CONSTRUCTION	11/15/09	J. EAGLE	
3	ISSUED FOR AS-BUILT	11/15/09	J. EAGLE	

DEPARTMENT OF TRANSPORT

**Halpern
Glick
Maunsell**

CONSULTING ENGINEERS AND
ENVIRONMENTAL SCIENTISTS
1000 JEFFERSON AVENUE, SUITE 1000
DENVER, COLORADO 80202
TEL: 303.733.1000 FAX: 303.733.1001
WWW.HALPERNGLICHTMAUNSELL.COM

PROJECT NUMBER: 870-02-09
DATE: 11/15/09
DRAWN BY: J. EAGLE
CHECKED BY: J. EAGLE

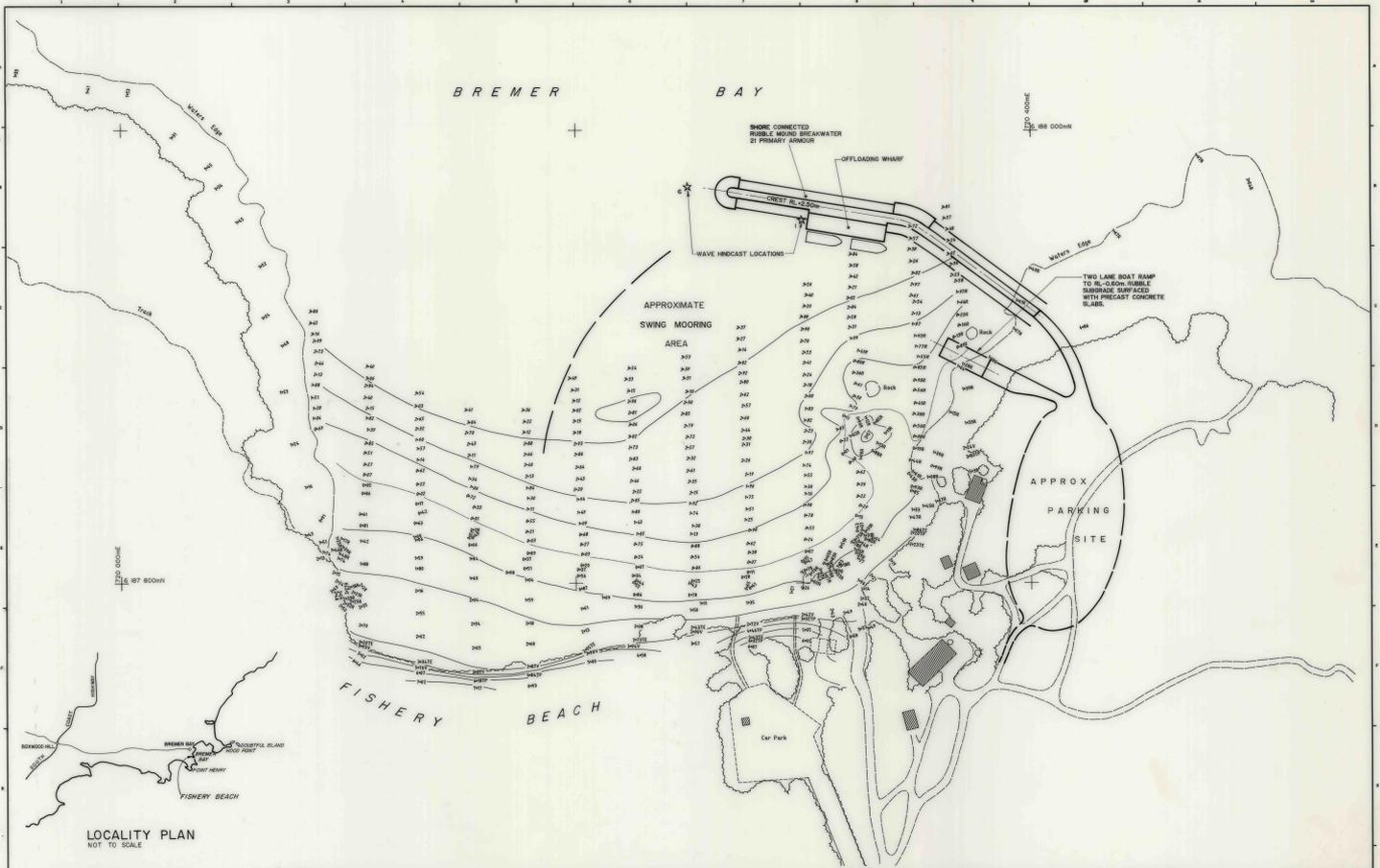
PROJECT NAME: BAYVIEW BOAT MARINA
GENERAL ARRANGEMENT
SCALE: 1/8" = 1'-0"

NO.	DESCRIPTION	DATE
1	ISSUED FOR PERMITS	11/15/09
2	ISSUED FOR CONSTRUCTION	11/15/09
3	ISSUED FOR AS-BUILT	11/15/09



*Technical Specification
Fishery Beach Marina Boat Ramps and Jetty Refurbishment*

ATTACHMENT 5 GEOTECHNICAL DATA



GENERAL NOTES: 1. THIS ORS DERIVED FROM ORS NO. 462 - 03 - 01. 2. AUSTRALIAN MAP GRID BASED ON A.S.G. 84.		SCALE: 1 : 750 UNLESS OTHERWISE STATED DIMENSIONS IN mm DATUMS: 3.397m BELOW BM DM1 05124.635m BELOW DOLA BM 887 20 AND 0.880m BELOW A.H.L.	<table border="1"> <tr> <td>DESIGNED</td> <td><i>David Ryan</i></td> <td>APPROVED</td> <td></td> </tr> <tr> <td>DRAWN</td> <td><i>my sketch</i></td> <td>APPROVED</td> <td></td> </tr> <tr> <td>CHECKED</td> <td></td> <td>APPROVED</td> <td></td> </tr> <tr> <td>DATE</td> <td></td> <td>APPROVED</td> <td></td> </tr> <tr> <td>PROJECT MANAGER</td> <td></td> <td>APPROVED</td> <td></td> </tr> </table>	DESIGNED	<i>David Ryan</i>	APPROVED		DRAWN	<i>my sketch</i>	APPROVED		CHECKED		APPROVED		DATE		APPROVED		PROJECT MANAGER		APPROVED		DEPARTMENT OF MARINE & HARBOURS - WESTERN AUSTRALIA BREMER BAY - FISHERY BEACH PROPOSED FISHING INDUSTRY FACILITY PRELIMINARY LAYOUT DRAWING NUMBER 617 - 1 - 1												
DESIGNED	<i>David Ryan</i>	APPROVED																																		
DRAWN	<i>my sketch</i>	APPROVED																																		
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<table border="1"> <tr> <th>REV</th> <th>DATE</th> <th>DESCRIPTION</th> <th>BY</th> <th>APP'D</th> </tr> <tr> <td>A1</td> <td>0</td> <td></td> <td></td> <td></td> </tr> </table>	REV	DATE	DESCRIPTION	BY	APP'D	A1	0				100% MARINE SURVEY BY GUYLER MARINE SURVEY																									
REV	DATE	DESCRIPTION	BY	APP'D																																
A1	0																																			

FILE EG 418. DOC

TO SUTURA 2000 yellow

PIM:EG 418:MF125/94
Mr P I Manning
222 3498

Coastal Information and Engineering Services
Department of Transport
1 Essex Street
FREMANTLE WA 6160

Attention: Mr G Enston

**PROPOSED BOATING FACILITY
FISHERY BEACH-BREMER BAY**

PRELIMINARY OBSERVATIONS

A request was made by the Coastal Information and Engineering Services Section of the Department of Transport for the Engineering Section of the Geological Survey to undertake a preliminary geotechnical investigation of the proposed boating facility at Bremer Bay.

The study was initiated to provide preliminary information and recommendations as to the likely geotechnical characteristics of the rock mass in the local vicinity of the facility. Specifically, the investigation was to identify whether the proposed excavation for the car and trailer parking facility could provide suitable material for the construction of the breakwater.

Discussions were held between Mr G Enston of the Department of Marine and Harbours and Messrs I H Lewis and P I Manning of the Geological Survey and a site visit arranged for the week beginning 21 February 1994.

Initial reconnaissance was undertaken of the Bremer Bay locality to identify previously mapped basement outcrop. A more detailed geotechnical traverse of the exposure in the area of the proposed facility was mapped during the course of the site visit.

The following comments are preliminary observations only and are provided for planning purposes. A more detailed analysis will be provided as the field investigation proceeds.

1. Preliminary Reconnaissance

Reconnaissance of the local area around the Bremer Bay township was undertaken to identify the major outcrops of gneissic basement rock mapped previously on the 1:250 000 scale geologic map. This was to locate possible secondary sites for the provision of suitable construction

material for the proposed Fishery Beach facility should the rock in the immediate vicinity of the proposed facility prove unsatisfactory.

With the exception of a site located near Dillons Beach the exposures of basement rocks are now within the boundaries of a DOLA land subdivision and form a local landmark.

The site identified along Dillons Beach Road occurs as a ridge-line some five kilometres from the intersection with Bremer Bay Road. Though minimal in exposure, the basement rocks are thought to form the ridge with an undetermined thickness of sandcover overlying the gneisses. Further work would be required to provide useful information as to the extent and nature of the rockmass.

2. Geotechnical Mapping-Fishery Beach

Mapping of the basement gneiss above the high water line of Fishery Beach around the proposed construction area identified the following major features:

*** Foliation**

Foliation which is a laminated structure resulting from segregation of different minerals into distinctive layers or bands is the dominant structural feature visible in the outcrop. It has an approximate orientation of 78/320 (dip/dip direction) and is a continuous feature across the exposure. Foliation is tight and does not break easily when subjected to impact, although in some instances it can have an influence on the shape of the rock blocks.

*** Major Joint Sets**

Two predominant joint sets were identified. The first set has an approximate orientation of 78/040 with an observed spacing of individual joints of between 1 and 2.5 metres. The second set is oriented at 76/130. The spacing of this set was observed as approximately 2 to 4 metres. Closer spacing of the joints was noted to the west of the proposed facility.

Sheet jointing (large flat lying joints) resulting from stress relief was noted close to the water-line in the vicinity of the proposed breakwater. The orientation of the sheet joints is varied and this feature is not particularly well represented due to the lack of vertical exposure. Sheet joints at the water-line show an approximate orientation of 30-40/312-033 and a spacing of between 0.5 and 0.75 metres. If similar joints are present within the proposed quarry area, they could significantly affect the size of the possible rock blocks.

3. Discussion

Geotechnical mapping of Fishery Beach has identified a number of structural features which are important for the provision of suitable material for the construction of the proposed fishing boat facility.

Primarily, the shape and size of blocks interpreted from the mapping would be approximately tabular in shape, with minimum dimensions of 0.5 x 1 x 2 metres. Assuming a density of 2.4 for the gneiss, the mass of the blocks will therefore be in the order of 2.4 tonnes.

Zones of the exposure are massive with the major structural feature being foliation. To the east of the proposed facility, the structure becomes more complex with a number of minor fold axes recognised.

It must be stressed that these observations are preliminary only. The information gathered was obtained from the edge of the proposed excavation. Minimal information was gathered from the proposed car-park area due to the sand and vegetation cover in this area. Rock exposure observed in the car-park could not be relied upon to provide useful geotechnical information because of the strong weathering characteristics and the question of whether the material exposed in the tracks is in-situ or has been transported by machinery. Consequently the competency of the rockmass in the proposed quarry can only be determined reliably by exploratory drilling.

4. Recommendations

The character of the rockmass in the proposed car-park and quarry area has been inferred almost exclusively from the data collected from the beach front. From this initial data the rock would seem suitable for the provision of construction material for the breakwater.

To reduce contractual exposure during the construction phase, to gain information about the structural features identified from surface mapping and to provide an indication of the overburden materials present, a minimum of three NQ size diamond cored geotechnical boreholes should be drilled into the rockmass.

The current information is biased towards the steeply dipping features, and contains minimal data on those features that may lie at low angles. Cored drillholes will provide further information on the orientation of these particular structures, the weathering patterns of the rockmass, and any significant zones of weakness in the proposed excavation.

We trust that this information meets your present needs and we look forward to assisting you with this project as it proceeds beyond the feasibility stage. Should you require any further assistance please contact Mr P I Manning.

P Guj
DIRECTOR
GEOLOGICAL SURVEY
14 March 1994
EG 418
MF 125/94

ENGINEERING GEOLOGY REPORT EG 424

**A GEOTECHNICAL APPRAISAL OF THE
PROPOSED FISHING BOAT HARBOUR
BREAKWATER MATERIALS SOURCE
AT
FISHERY BEACH
BREMER BAY**

By
P I MANNING

NOTE

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Western Australia
Geological Survey
Perth, November 1994

ENGINEERING GEOLOGY REPORT EG 424

A GEOTECHNICAL APPRAISAL OF THE PROPOSED FISHING BOAT HARBOUR BREAKWATER MATERIALS SOURCE AT FISHERY BEACH BREMER BAY

1.0 INTRODUCTION

2.0 BACKGROUND

3.0 ENGINEERING GEOLOGICAL AND GEOTECHNICAL CONDITIONS

3.1 Site Geology

3.1.1 Sand-cover

3.1.2 Rocktypes

3.2 Rock Structure

3.2.1 Shearing

3.2.2 Jointing

3.2.3 Foliation

3.3 Rock Weathering

3.3.1 Summary of Borehole Logging

3.4 Material Strength

3.5 Hydrogeology

4.0 ENGINEERING GEOLOGICAL AND GEOTECHNICAL IMPLICATIONS

4.1 Block Size and Shape

4.1.1 Horizon 1

4.1.2 Horizon 2

4.2 Excavation Method

4.3 Material Yield

4.4 Suitability of Quarried Material for use as a Roadbase

5.0 CONCLUSIONS

6.0 RECOMMENDATIONS

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Figure 2 Location of boreholes

Figure 3 Photographs showing distinctive foliation throughout rockmass

Figure 4 Photograph of quartzo-feldspathic dyke

Figure 5 Photograph of shear surface in the vicinity of proposed boat ramp

Figure 6 Stereographic analysis of structural data

Figure 7 Photograph of clustered joints

Figure 8 Photographs of Joint Set 3 to east of proposed breakwater

Figure 9 Workability of rockmasses

APPENDICES

Appendix 1 Petrography Report

Appendix 2 Borehole Logs and Explanatory Notes

Appendix 3 Core Photography

Appendix 4 Notes on the Description of Block Size and Shape for Jointed Rockmasses

1.0 INTRODUCTION

At the request of the Coastal Information and Engineering Section of the Department of Transport (CIES), the Engineering Geology Section of the Geological Survey Division, Department of Minerals and Energy (GSWA) have provided geotechnical assistance with the investigation of a source of rock for the construction of a proposed breakwater at Fishery Beach near Bremer Bay (Figure 1). This report presents the results of the assessment of the suitability of the rockmass contained within the hillside above the proposed fishing boat harbour for use as construction material for the breakwater and other ancillary facilities.

Fishery Beach is located some 7km south of Bremer Bay township which is approximately 550km southeast of Perth.

The planned excavation above Fishery Beach is proposed by CIES to be quarried to a depth of between 6 and 8m below the existing natural surface. The resultant floor of the quarry will form a car-park for boat trailers and other vehicles utilising the facility.

The report contains a description and analysis of the data collected:

- a) during a preliminary reconnaissance mapping programme of the rock exposure above the water-line, and
- b) from subsequent logging of the drillcore recovered from a four hole drilling programme carried out across the proposed quarry site.

The study addresses the following major issues raised in the CIES letter of 1 June 1994:

- * the potential of the rockmass to provide the amount and required size of blocks to form the primary armour for the breakwater;
- * the amount of overburden that will require stripping from the quarry; and
- * the potential of the quarried material as a source for road construction aggregate.

2.0 BACKGROUND TO INVESTIGATION PROGRAMME

Preliminary discussions between representatives of the CIES and the GSWA identified that the proposed facility could be economically feasible if the required construction material could be sourced locally from the rockmass at the proposed car-park site. CIES's requirements were that such an excavation must be able to provide blocks of material that can withstand the substantial forces generated by wave action. CIES have indicated for the Bremer Bay location, that these blocks must have a mass in excess of 2.5 tonnes.

A field reconnaissance mapping programme was undertaken by an engineering geologist from GSWA in February 1994 and the results of that programme were provided to CIES in Engineering Geology Report EG 418 in March 1994. That report identified that gneissic rock was present in a semi-continuous outcrop along the headland to the east of Fishery Beach and it was inferred that if similar material occurred within the proposed quarry area, the rockmass should have the potential to provide the material required for the proposed breakwater and other uses.

The March 1994 report noted that the reconnaissance mapping was biased towards steeply dipping features and that cored boreholes would be required to test the competency of the rockmass. It also noted the requirement to identify particular structural features that may influence the nature of the individual blocks that may be extracted from the quarry.

An investigative diamond drilling programme was performed between June 13 and 18, 1994 under the supervision of an engineering geologist from GSWA. The drilling consisted of a programme of four NQ sized cored boreholes (BB#1 to BB#4 inclusive) inclined at 60° below horizontal. The locations of the boreholes are shown in Figure 2. A total of 57.2m was drilled.

Two boreholes were located at the rear of the quarry on the upper slopes of the hillside overlooking Fishery Beach at a maximum RL of 18m. These boreholes are identified as BB#1 and BB#2. The orientation of these two holes was 320°, which was designed to intersect and investigate the foliation trend as determined from the earlier reconnaissance mapping. The remaining boreholes BB#3 and BB#4 were oriented at approximately 230° to provide information on structures with a north-south trend.

Surficial sands were wash-drilled. All the boreholes were fully cored from the contact with solid rock. Orientation data of intersected discontinuities was obtained using the spear technique whereby a small diameter rod with a wax pencil set into its end, is lowered down the inside of the drilling rods to mark the low point of the core inside the core barrel. Assessment of the recovered drill-core and mapping of the shoreline outcrops provided information on the rock substance and rockmass conditions such as distribution and extent of weathering, rock substance strengths, discontinuity characteristics and orientations, and an indication of the groundwater conditions.

The drillcore was photographed on site, transported to Perth and sampled for petrographic analysis. Appendix 1 contains the results of the petrographic analysis.

The drillcore is now stored at the GSWA facility in Carlisle, Perth.

Appendix 2 contains copies of the borehole logs and explanatory notes while Appendix 3 presents the core photographs. Appendix 4 contains a description of the parameters used to describe blocks of rock within a rockmass.

3.0 ENGINEERING GEOLOGICAL AND GEOTECHNICAL CONDITIONS

3.1 Site Geology

The regional geology of Bremer Bay is described in the explanatory notes of the 1:250 000 scale geological sheet (Thom and Chin, 1984).

Fishery Beach lies in the southernmost of five tectonic zones occurring on the Bremer Bay sheet. The original Archean rocks which are thought to be between 2.6 and 3.1 billion years old have been subjected to a major tectonic event which occurred between 1.2 and 1.4 billion years ago. This event has overprinted the rocks with a strong penetrative foliation and variably developed banding. The basement rocks have been field classed as granodioritic gneisses, but due to the tectonic events are more correctly granulite facies metamorphic rocks.

The physiography of the southern coast is generally comprised of rocky headlands of Proterozoic gneiss fringed and overlain by elongate hills of limestone and dune sand. Small gullies lead from the ridges down to the shoreline. Fishery Beach lies in the lee of one of these hills, and is characterised by a rocky headland which rises sharply from the sea and overlain partially by dune sands. Limestone ridges were observed further inland and to the south.

The regional mapping undertaken by Thom and Chin was used to identify the distribution of basement rocks and the general physiography of the site in the preliminary reconnaissance phase.

3.1.1 Sand-cover

Sand-cover is extensive over the proposed quarry site and is observed to be variable in thickness and distribution as shown in the drill logs. It is thought that the sands are derived from the weathering of the surrounding topography and redeposited by aeolian processes.

Borehole BB#1 was drilled directly into outcrop and BB#2 encountered 0.9m of sand-cover. Depths of cover by sand ranged from 1.2 to 1.6m in thickness in BB#3 and BB#4. There is an inferred progressive increase in this cover towards the road access located in a gully that runs down to the water-line where boats are currently launched. It is expected that local variations may occur in the depth of sand-cover over weathered depressions which are infilled by surficial material.

The full extent of surface rock exposure however, has not been determined by a comprehensive mapping programme. Consequently it must be assumed that some sand-cover will exist above most of the surface of the quarry.

3.1.2 Rocktypes

Reconnaissance mapping of the exposure above the water-line at Fishery Beach and logging of the drillcore has identified a relatively homogeneous grano-dioritic rockmass characterised by a strong foliation. The foliation is defined by the alignment of biotite plates in the rockmass, and is recognised by distinctive visible banding (Figure 3). A detailed petrographic description is provided in Appendix 1.

For simplicity in this report these rocks have been termed as "gneiss".

Vein quartz and quartzo-feldspathic dykes have also been observed penetrating the gneiss in various locations along the shoreline exposure. The dykes which are approximately 0.25m thick and traceable in excess of 20m are thought not to represent a significant proportion of the rockmass (Figure 4).

3.2 Rock Structure

Rock masses comprise blocks of rock separated by complex intersecting discontinuities. These discontinuities may take the form of faults, shears, joints, foliation and bedding. Bedding is not associated with the basement rocks in the investigation area. However faults, shears, joints and foliation are the dominant structural features present.

It is convention within this report to describe the inclination and orientation of any structural plane in terms of dip and dip direction respectively.

(a) Faults and Shears

A fault is a fracture along which there has been recognisable displacement, ranging from a few centimetres to kilometres in scale. The margins of faults are often striated and polished (slickensided) as a result of the displacement that has occurred. Frequently rock on both sides of a fault is shattered and altered or weathered. This results in infilling such as breccia or gouge. Fault widths may vary from the small scale to the large scale. Where there is no individual surface of movement, but the displacement is taken up over a zone of many, closely spaced surfaces, the term shear zone may be used. Shears up to 0.5m wide; represented by intense fracturing within the shear or with sets of closely spaced sometimes quartz filled joints were recognised within the gneiss. Cross fractured quartz veins are also the result of shearing.

Faults and shears commonly develop into sites of locally more intense weathering resulting in localised, often narrow and elongate depressions within the general topographic surface. Where there is a surface cover such as the sand-cover at this site, the presence or extent of individual faults or shears may not be recognised during investigations.

(b) Joints

A joint is a break in the continuity of a body of rock, along which there has been no visible displacement. A group of sub-parallel joints is called a joint set. Joint sets intersect to form a joint system. Joints can be open, filled or healed, and are the most commonly developed of all geological structures.

Sheet jointing is a special form of jointing where previously deeply buried rock, which has experienced unloading following erosion will become decompressed with time and expand normal to the free surface, developing joints sub-parallel to the erosional surface. These features are often irregular and curved, and may represent zones of preferential water passage and/or weathering.

(c) Foliation

In metamorphic rocks such as gneiss, there are commonly pervasive surfaces or bands of colour defined by a preferred orientation of inequant minerals, laminar mineral aggregates, or some combination of those microstructures. This banding

is known as foliation and is the most obvious and dominant structure observable within the gneiss.

The discontinuities mentioned above have been recognised in the investigation area both from geological mapping around the shoreline and the measurement, analysis and interpretation of the borehole data. These discontinuities are relevant to the overall geotechnical characteristics of the site, and will effect the behaviour of the rockmass during quarrying activities.

3.2.1 Shearing

Shearing of the rockmass has been identified above the water-line in the vicinity of the proposed access ramp for small boats and in boreholes BB#2 and BB#4. Spacing between individual shears is very wide (over 2m) with some offset of surrounding veining in the order of 0.2 to 0.3m.

Sheared surfaces have a steep dip towards the southwest (Figure 5) which is approximately normal (at 90°) to foliation.

Significant weathering of the sheared planes was noted in a number of boreholes. Specifically, at 8.6m in BB#2 where there is 100mm of completely weathered rock and, in the interval 1.6 to 2.2m in BB#4 where the rock fabric has deteriorated to such an extent that the rock surrounding the shear is completely weathered and exhibits soil characteristics.

3.2.2 Jointing

Two major joint sets and a minor set were identified within the proposed quarry area.

A stereographic analysis of the structural data is shown in Figure 6. The figure is a compilation of stereographic plots showing the progression in interpretation of the raw data through to the identification of the major structural features and their mean orientations in space.

JOINT SET 1

Joint Set 1 has a flat dip of 9° to the south (mean orientation 9/180) and is a discontinuity which was encountered in all of the boreholes but rarely in exposure mapping due to its low angle. Set 1 discontinuities may represent sheet joints resulting from stress relief.

The mean spacing (excluding the more closely spaced joints near surface due to exfoliation) between adjacent Set 1 discontinuities has been calculated from the borehole data to be approximately 2.1m.

It should be noted that between 0 and 1m depth in Borehole BB#1, 1.74 to 4.0m in BB#2 and 2.2 to 5.2m in BB#4, a dip direction was not able to be calculated because reliable core orientation measurements were unable to be made due to the highly weathered core in these intervals. Despite this lack of data, it has been assumed based on observations at other excavations, that between 0 and 3m depth the spacings of joints within the rockmass will be significantly less than the calculated mean of 2.1m. This is due to the usual occurrence of more closely spaced stress relief jointing in the upper parts of the rock profile. Spacing of these particular joints is expected to range between 0.5 and 0.75m in near surface zones.

Persistence of joints within this set is thought to be extensive based on exposures on the shoreline and in similar rocks elsewhere. The joint surfaces are generally observed to be curved or undulating.

JOINT SET 2

Joint Set 2 is steeply dipping to the north east with a mean orientation of 85/042. This set is recognised in both shoreline exposure mapping and from boreholes. It has a clustered nature with joints appearing in groups (Figure 7). The mean spacing between individual joints is 0.9m; the spacing between groups generally exceeds 10m. Individual joints have a persistence of over 7.5m for each joint trace.

JOINT SET 3

The joints identified within this set are considered to be of minor occurrence and appear in the shoreline rock exposure to the east of the proposed breakwater (Figure 8).

The set is steeply dipping to the southeast and has a mean orientation of 78/134. Spacing of joints within this set is similar to that of Set 2 whereby joints tend to be clustered with a significant interval between the next recognisable group of joints. The mean spacing of recognised joints within this set is 2.5m.

3.2.3 Foliation

Foliation, as shown in Figure 5 is well defined and is identified by distinctive 3 to 5mm wide bands of dark minerals (biotite) separated by pale coloured minerals (quartz,

feldspar and minor hornblende). It has been shown to be steeply inclined to the north west (mean orientation of 76/322).

Few of the foliation planes have developed clay infill to any major extent where the plane of foliation is open. However, where the weathering profile is more extensive in the vicinity of BB#4, deeper penetration by groundwater and subsequent deterioration of the rock fabric has been observed around shear surfaces.

3.3 Rock Weathering

Weathering is a geological process of physical and/or chemical degradation which generally results in a change in mineralogy with a reduction in grain size and/or strength compared with the parent material. Chemical weathering processes and associated laterisation, which may have occurred under pre-existing tropical and sub-tropical climatic conditions are dominant in Western Australia.

Rock weathering assessments have been performed on the exposed rock outcrops and the samples recovered from the cored boreholes. The terms used to describe chemical weathering of crystalline rocks are outlined in Appendix 2. The variation in weathering for the boreholes is presented in detail on the geological logs.

The actual degree of weathering depends on:

- (i) environmental factors which govern the weathering process, namely time, climate, temperature, hydrogeological conditions, topography and biological conditions;
- (ii) the properties of the material forming the rock substance, such as mineral composition, grain size, clay percentage, permeability and intergranular cohesion; and
- (iii) the properties of the rockmass such as jointing, shearing and fracture spacing which allow access of water and dissipation of water pressure.

Progressive chemical weathering of basement rocks, veins, dykes and shear zones produces various materials which may range from fresh rock with stained defect surfaces to residual sandy soils (Appendix 2). The abbreviations used in the explanatory notes to this appendix are referred to in the following descriptions of the individual boreholes.

Surface mapping has shown the potential for variable weathering profiles in surface outcrop. Some exposed rock is slightly weathered at surface but other material collected

from access tracks shows significant degradation of the rock fabric to a highly weathered state. Drilling has confirmed the variability of the weathered profile in the rockmass.

BB#1 was drilled directly into exposed rock of which 3cm was slightly weathered before fresh rock was encountered. The slightly weathered rock was found to have a 'high' field strength and the fresh rock was found to be of very high strength. The drillcore was variably foliated with no zones of weak rock. Iron oxide staining (FRST) has penetrated the rockmass via discontinuity surfaces in this borehole to an approximate depth of 11m, the remaining rock in the borehole is fresh (FR).

BB#2 encountered 0.9m of overlying unconsolidated sands with a highly weathered zone to 1.6m deep. Below this zone FRST persists along discontinuity surfaces to approximately 6.2m deep, thereafter the rock is fresh. A highly weathered shear plane was encountered at 8.62m which was infilled with 100mm of material exhibiting soil properties.

Sand-cover in BB#3 was 1.6m with slightly weathered to fresh rock with stained structures to 3.0m. The rest of the borehole penetrated a relatively massive gneiss with few defects.

In BB#4 sand-cover was 1.2m thick with highly weathered rock to 2.2m. Zones of penetrative weathering along discontinuity surfaces (FRST) were intersected throughout the core to 10.4m. Field strength testing of the drillcore between these weathered surfaces gave a high strength classification.

3.3.1 Summary of Borehole Logging

As a result of the weathering of rockmasses, there can be significant variations in the weathering profile. Whilst the properties of the rock substance are important in weathering, the differential weathering is significantly affected by rockmass properties such as discontinuity spacing and orientation.

Weathering of the rockmass has locally changed the properties of the gneiss to such an extent that the material encountered during investigation (excluding the overlying surficial sands) can be separated for geotechnical purposes into two horizons.

Horizon 1

This is a zone defined as being both weathered (slightly to highly) and having closely to medium spaced joints. Joints may be partially filled with thin layers of clays from either penetration by surface water or by actual degradation of the joint surface. In the latter

case, the fabric of the rock is changed. Generally the substance strength of this horizon was found to be less than that of Horizon 2.

Horizon 1 is expected to be encountered at irregular depths, dependent on the rock surface topography below the surficial cover of sand. Drilling has shown a variability in the thicknesses of this horizon in the order of 0.8m in BB#1, with no surficial sand-cover; 3.9m in BB#2, with 0.9m of sand-cover; 0.8m in BB#3, with 1.5m of sand-cover and approximately 4m in BB#4 with 1.7m of sand-cover. Comparison of the core recovered indicates that Horizon 1 may be thicker in the southwest corner of the quarry in the area of the proposed access ramp into the excavation. Due to the weathering of this horizon, significant amounts of waste material may be generated when excavated.

Horizon 2

This zone is regarded as a competent core of rock which may be slightly weathered but is predominantly unweathered. Individual joint surfaces may be highly weathered, however it is considered that the penetration of weathering into the rock fabric is not extensive. The horizon exhibits high substance strength characteristics and has more widely spaced joints. Occasional iron staining of the rock was noted on a number of joint surfaces. When tested, the rock immediately surrounding these discoloured joints did not show significant variance in strength compared to the results obtained from tests undertaken on fresh rock.

3.4 Material Strength

Point load testing has been undertaken on intervals of the core to determine the relative strength of the gneiss. A series of 10 tests were performed over the length of each cored borehole with a range of values obtained. An $I_S(50)$ value (Fitzhardinge, 1978) was calculated and a mean strength value for the length of each borehole was derived.

It should be noted that the method adopted to derive the mean values progressively discards high and low values before taking the mean of the remaining two values. A conversion factor of 24 is commonly used to convert $I_S(50)$ values obtained from 'N' size core to equivalent Unconfined Compressive Strength (UCS) values (Bieniawski, 1975). The resultant mean values are shown in the following table:

<i>Borehole</i>	<i>Mean $I_S(50)$</i>	<i>Strength Class</i>	<i>Estimated UCS</i>
BB#1	8.77MPa	Very High Strength	210MPa
BB#2	9.45MPa	Very High Strength	227MPa
BB#3	6.93MPa	Very High Strength	166MPa
BB#4	6.80MPa	Very High Strength	163MPa

Variations in individual results were due to either weathering of the rock and/or, the test being performed over existing defects within the core.

Point load testing of the rock was undertaken at selected intervals along the core. The findings were that breakage along foliation did not occur preferentially. It is assumed therefore that foliation is unlikely to be a controlling influence on block size.

3.5 Hydrogeology

No water loss or gain of any consequence was noted during the drilling programme. No water levels were observed in any of the boreholes at the completion of the drilling programme.

4.0 ENGINEERING GEOLOGICAL AND GEOTECHNICAL IMPLICATIONS

CIES has determined that approximately 25,000m³ of rock will be required to construct the breakwater and ancillary works, of which some 7,000m³ will be required for primary armour. Primary armour is classed (by CIES) as individual rock blocks with a mass in excess of 2.5 tonnes. These are required to withstand substantial wave action.

To assess the capacity of the rockmass to provide primary armour, consideration was given to the density and nature of the gneiss, and also to the spacing of particular discontinuities. Specific gravity for gneissic rocks has been calculated using a number of samples taken from the drillcore, and has been found to be in the range approximately 2.2 to 2.5 with a mean of 2.35.

4.1 Block size and shape

Utilising the information derived from reconnaissance mapping and interpretation of the borehole logs it is inferred that two distinct horizons may exist within the rockmass. Within these two horizons the size and shape of the rock blocks are likely to vary.

4.1.1 Horizon 1

Based on the spacing and three dimensional orientation of joints found within the rockmass (Brown, 1981), remnant intact rock blocks are expected to have mean dimensions of 0.75m, 0.9m and 2.5m, with a resultant block size index (I_b) of 1.3m. Because one dimension is considerably larger than the others (Appendix 5), the block shape is likely to be defined as being horizontal columnar. The mass of the average in situ block is likely to be in the order of 4 tonnes. Should the spacing of joint set 1 be smaller ie 0.5m, the mass of an in situ block may be in the order of 2.5 tonnes.

4.1.2 Horizon 2

Within horizon 2, remnant intact rock blocks are likely to have mean dimensions of 2.1m, 0.9m and 2.5, resulting in a mean block size index of 1.8m. Because one dimension is considerably smaller than the others, the shape of the blocks are likely to be defined as being horizontal tabular with a mass per in situ block in excess of 10 tonnes. The increase in mass is attributable to the increase in joint spacing.

4.2 Excavation Method

Diagrams showing estimates of the workability of rock have been compiled by Muir Wood (1972) and Franklin et al. (1971). Their work is summarised on the diagram shown on Figure 9. These assessments consider aspects such as the UCS, the spacing of joints or the Rock Quality Designation of drill core, and are attempts to quantify excavation characteristics for underground and surface excavations.

Based on the Franklin et al. diagram, the rockmass at Bremer Bay would mainly fall within the blast to fracture field, although localised zones such as within Horizon 1 and also weathered and fractured shears, may fall within the blast to loosen field.

4.3 Material Yield

Previous analysis of breakwater construction in Western Australia by Mather (1984), found that quarries excavated to provide primary armour yielded between 10 and 40% of the total volume in suitable blocks. However, in most West Australian examples, the yield was more in the order of 10 to 20%.

In Horizon 1, the yield is likely to be less than Horizon 2 because the rockmass is more variable in terms of weathering and fracture spacing, and the natural average in situ block is already small.

It is also expected that in both horizons where the joints are more closely spaced, the rock blocks will be of smaller size than those found within the more massive parts of the rockmass.

4.4 Suitability of Quarried Material for use as Roadbase

Based on past experience by GSWA in the investigation of sites for aggregates, it is likely that the gneiss has some potential for road aggregate but this needs to be further investigated by Main Roads Western Australia (MRWA).

It is suggested that the unweathered gneiss should be sufficiently resistant to weathering effects during road service, however the more weathered material may suffer continued breakdown and for this reason should be separated from the main bulk of the extracted material. Polishing resistance should be investigated by laboratory testing. If the aggregate is likely to be used for concrete then the potential for alkali-silica reactivity due to the presence of secondary silica within the rockmass should be examined.

The field tests have been performed to provide preliminary information for the MRWA, however this should be augmented by a programme of physical testing to be performed at the MRWA Material Testing Laboratory. The core has been retained under cover for this purpose.

5.0 CONCLUSIONS

Investigation of the shoreline and subsurface rockmass has identified a number of constraining parameters relevant to the assessment of the potential usage of the hillside above Fishery Beach as the source of feedstock for the proposed fishing boat breakwater.

The main issues are:

- the amount and extent of sand-cover
- the amount, extent and distribution of the weathering profile and,
- the capability of the rockmass to provide the necessary volumes of primary armour for the breakwater.

Sand-cover is expected to vary in thickness over the hillside with maximum expression being found over the lower parts of the slope and in hollows where preferential weathering of the rockmass has occurred in zones of structural weakness. Observation of the core has shown a variable profile of sand-cover with a increasing depth of cover towards the existing road and buildings. A thickness of 1.5m of sand is likely over the site, although this figure is based on a few limited observations

Underlying the sand-cover is the gneissic rockmass which has been divided into two distinct horizons. These are identified by the presence in the upper horizon (Horizon 1) of a significant weathering profile which affects the overall strength of the zone and the closer spacing of the sheet joints. Horizon 2 is characterised by fresh high strength rock and wider spaced jointing. The gneissic rockmass may require blasting to excavate.

For construction purposes, Horizon 1 is less likely to be able to produce the required block size for primary armour than Horizon 2. Spacing between joints within each set but particularly sets 2 and 3, has indicated that there may be zones within the quarry where joints are clustered and this will limit the recovery of larger blocks where this occurs.

6.0 RECOMMENDATIONS

The extent of surficial sand-cover has not been fully determined, and should be further investigated prior to the commencement of quarrying operations. This could be simply accomplished by using a hand auger or small motorised auger to determine the depth to bed-rock. The resultant information will enable a more accurate calculation of overburden volume to be made.

Based on the investigation to date, it is also recommended that excavation in the vicinity of Borehole #4 for primary armour be limited due to the constraints of weathering, fracturing and the generally lower strength characteristics of the rocks present.

Because the quarry is to be used for the provision of primary armour for the breakwater, controlled blasting methods will need to be developed to ensure that the optimum yield of this grade of material is achieved.

Based on the simplistic model used in this report for the size and shape of the quarry, it is likely that the overlying sand-cover will require excavation beyond the quarry design limits to expose the underlying rockmass. Following completion of the excavation, the final slope angles at the rear of the quarry will be steep and should be laid back for both

safety and aesthetic considerations. However, the extent of this rehabilitation will be dependent on the final design of the car-park/quarry and the implementation of the quarrying operation.

7.0 REFERENCES

Copies of these references are held by the GSWA and are available on request.

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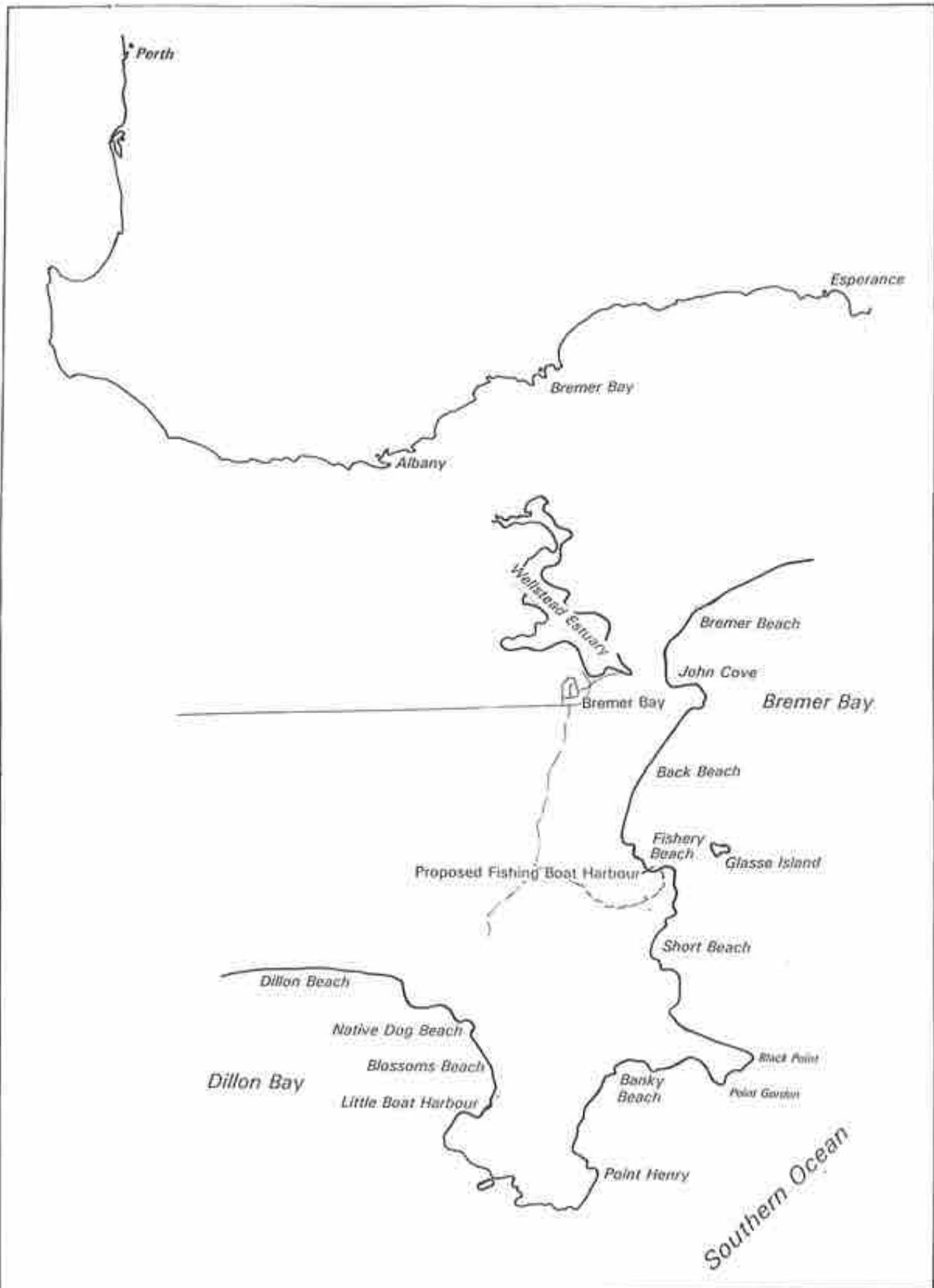
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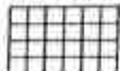


GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

FIGURE 1

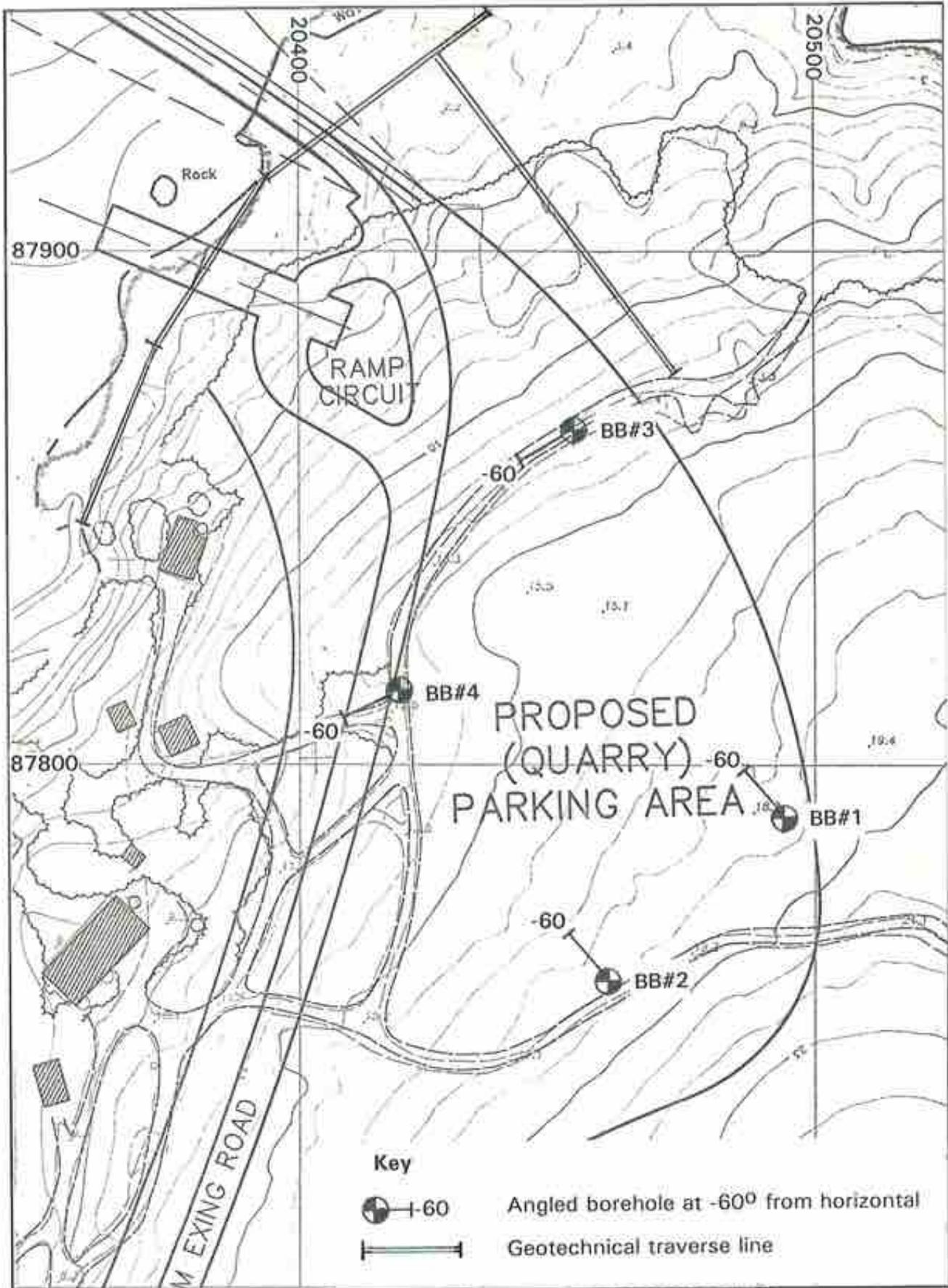
Location of proposed fishing boat harbour
Fishery Beach-Bremer Bay

MAP INDEX



	INITIAL	DATE
COMP	P.M.	8/94
DRAWN	P.M.	8/94
CHKD	P.M.	3/94
APVD	A.F.	12/94

TO ACCOMPANY EG 424



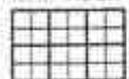
GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

	INITIAL	DATE
COMP	PIM	2/92
DRAWN	CES	92
CHKD	PIM	8/92
APVD	AF	12/92

FIGURE 2
Location of boreholes

TO ACCOMPANY EG 424

MAP INDEX





Photographs looking east

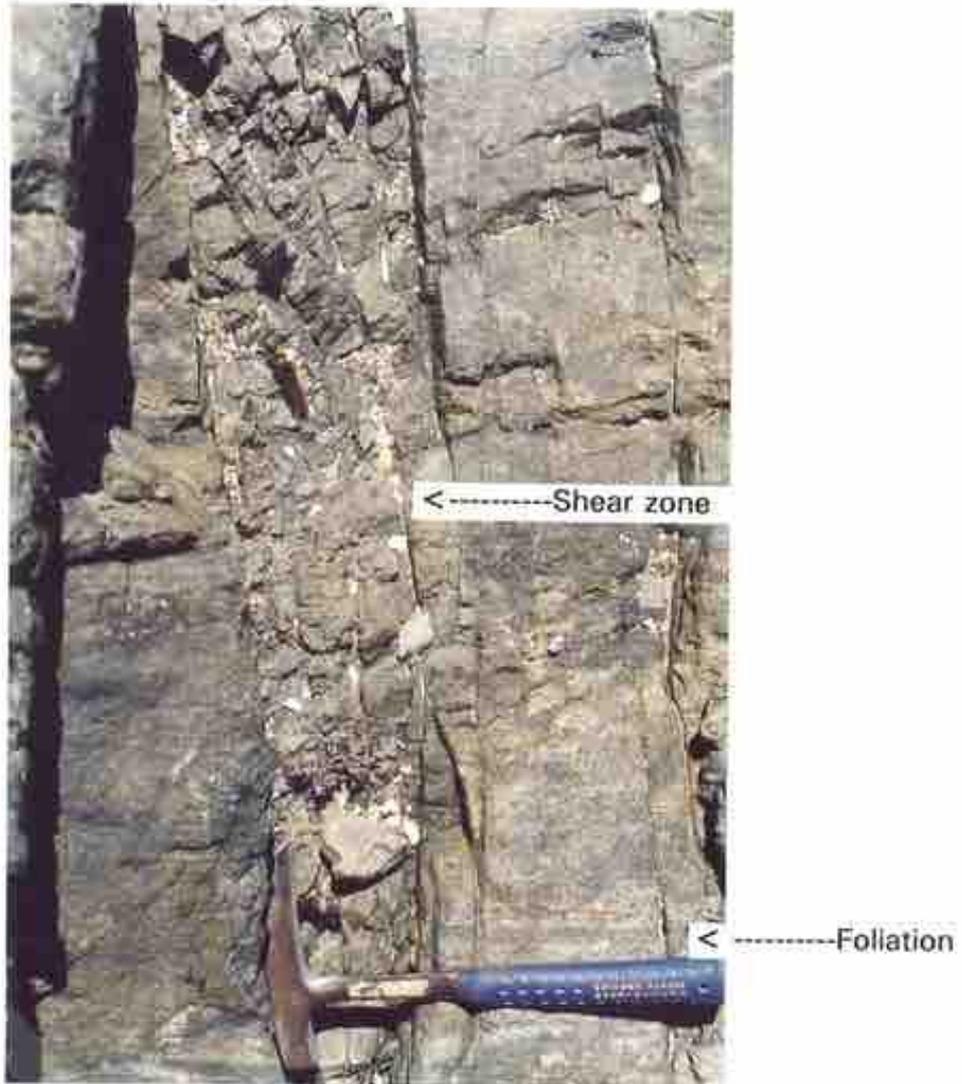
Note clustering of Joint Set 2 at proposed boat ramp and also in foreground

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA	
Project	EG 424
Client	Western Australia
Contract	EG 424
Scale	1:500
Author	Geological Survey of Western Australia
Editor	Geological Survey of Western Australia
Reviewer	Geological Survey of Western Australia
Approved	Geological Survey of Western Australia
Date	2024

FIGURE 3

Photographs showing distinctive foliation throughout the rockmass





GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

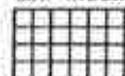
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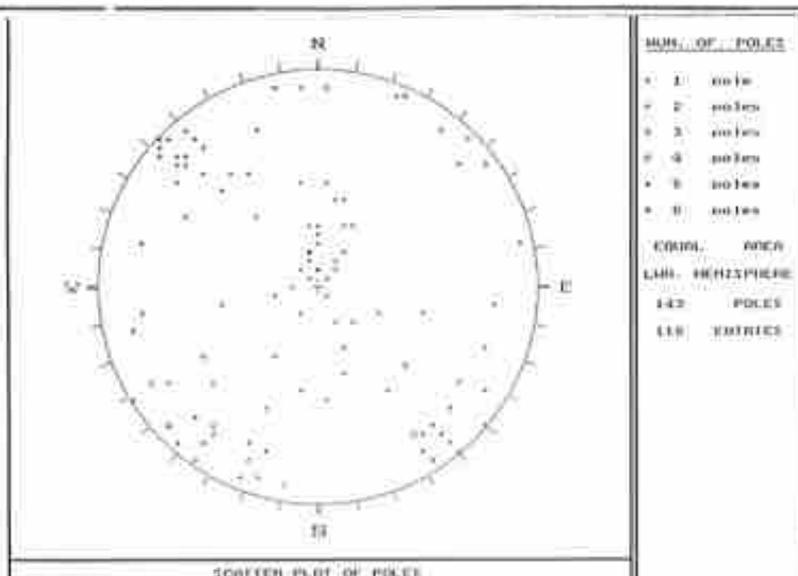
FIGURE 5

Photograph of shear surface in the vicinity of proposed boat ramp

TO ACCOMPANY EG 424

MAP INDEX

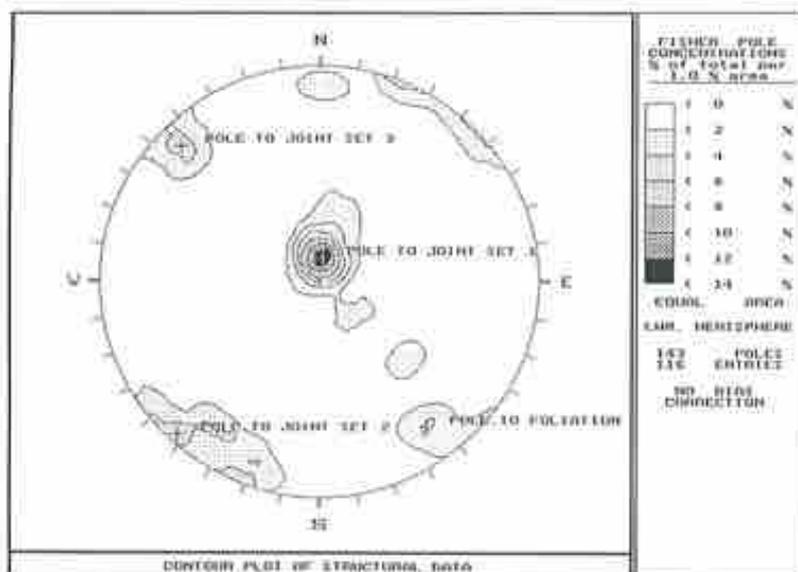




NUM. OF POLES

- 1 poles
- 2 poles
- 3 poles
- 4 poles
- 5 poles
- 6 poles

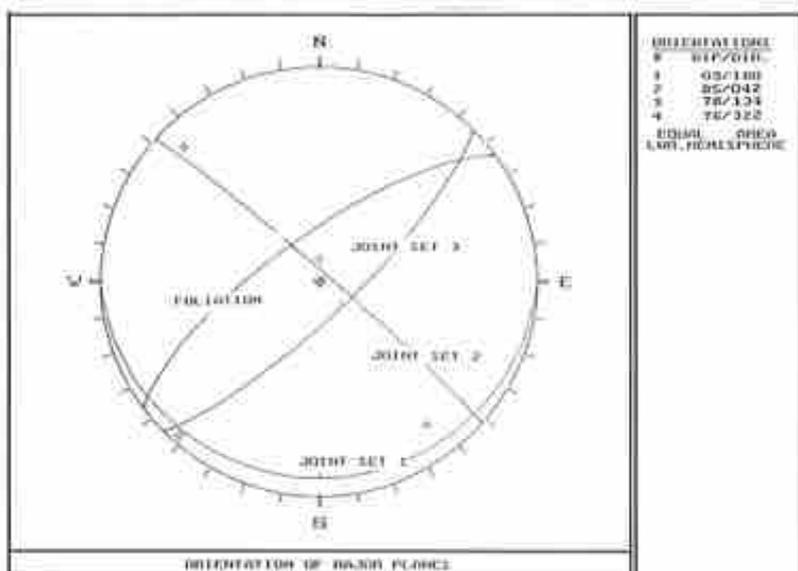
COORD. AREA
LOW. HEMISPHERE
 142 POLES
 118 ENTRIES



FISHER POLE CONCENTRATION
 % of total for 1.0 N area

0	N
2	N
4	N
6	N
8	N
10	N
12	N
14	N
16	N
18	N
20	N
22	N
24	N

COORD. AREA
LOW. HEMISPHERE
 142 POLES
 118 ENTRIES
 90 DIPS
 DIRECTION



DIP/SLIP

1	05/100
2	25/042
3	78/124
4	78/122

COORD. AREA
LOW. HEMISPHERE

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

	INITIAL	DATE
COMP	PIM	9/94
DRAWN	PIM	9/94
CHKD	PIM	9/94
APVD	APF	12/94

FIGURE 6
 Stereographic analysis of structural data

MAP INDEX

TO ACCOMPANY EG 424



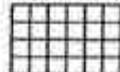
Joint Set 2----->

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

	INITIAL	DATE
COMP	PM	8/24
DRAWN	PM	8/24
CHKD	PM	8/24
APVD	AK	12/04

FIGURE 7 Photograph of clustered joints

MAP INDEX



TO ACCOMPANY EG 424



Approximate location of proposed boat ramp.

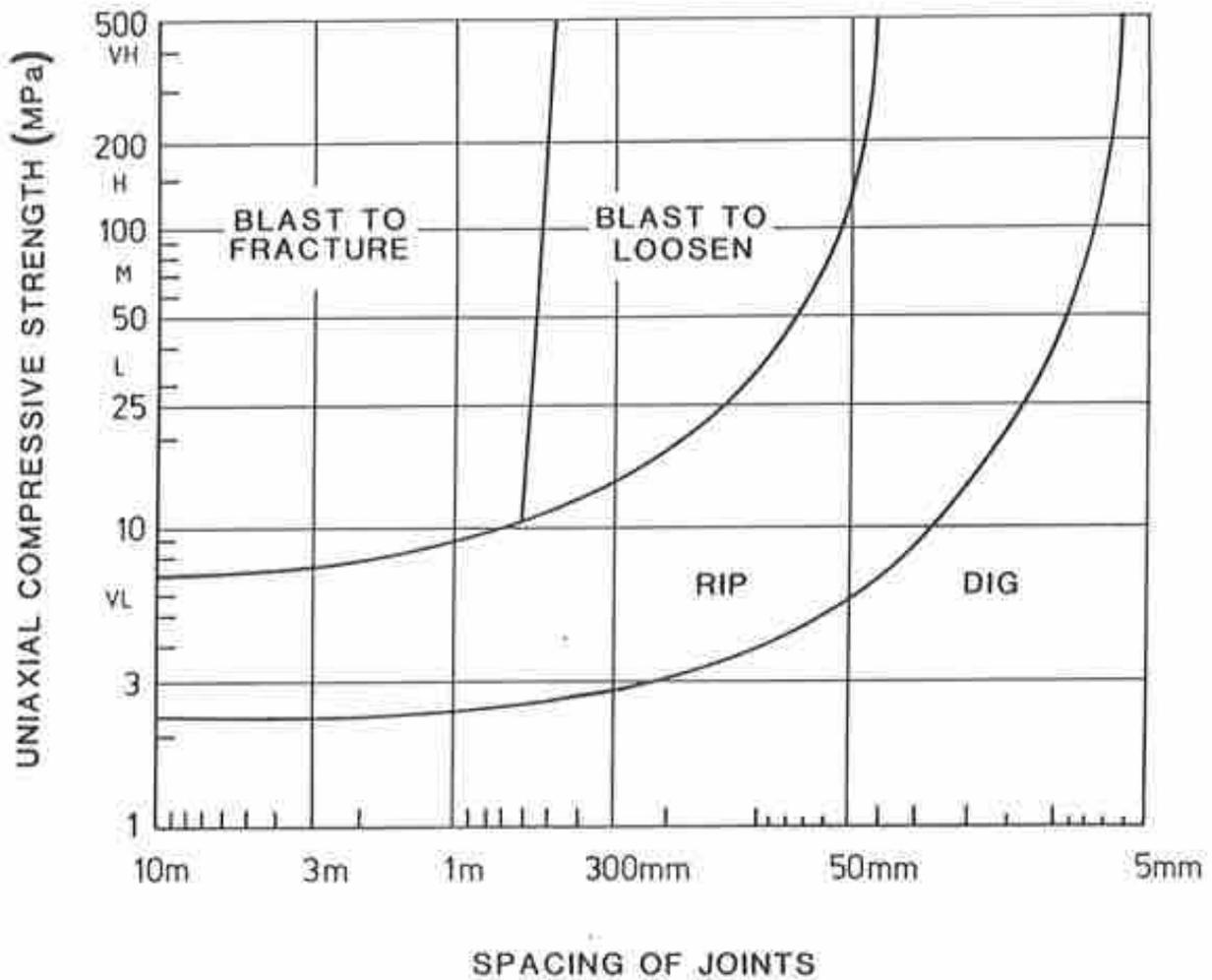
Approximate location of proposed breakwater.

Note cluster of joints at #1 thence very wide spacing to #2

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA	
Field	Date
Contour	1/100
Class	1/100
Code	1/100
Scale	1/100
Sheet	EG 424

FIGURE 8 Photograph of joint set 3 to east of proposed breakwater





Compiled from Franklin et al (1971)

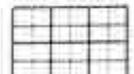
GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

	INITIAL	DATE
COMP	-	-
DRAWN	-	-
CHKD	PJA	10/94
APVD	AT	12/94

FIGURE 9

Workability of rockmasses

MAP INDEX



TO ACCOMPANY EG 424

APPENDIX 1

Petrography Report

Petrological Report 1640

**Petrography of four charnockitic samples
from Bremer Bay**

by
J.D.Lewis

NOTE

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Western Australia
Geological Survey

Perth, 1994

98425 Charnockitic quartz-diorite (Enderbite).

A coarse-grained, fresh, moderately oriented and layered rock, grey coloured, 'pepper and salt' appearance, with grainsize about 1-2 mm.

Mineralogy consists of hypersthene, andesine (An_{32}), lesser microcline, minor quartz, opaques and hornblende, and accessory apatite, biotite and zircon. The texture of the rock is xenomorphic granular, and typically charnockitic with characteristics of both igneous and metamorphic origin.

The pyroxene is distinctly pleochroic from pink to pale green, typical of hypersthene. Olive brown hornblende is concentrated in one layer within the section, with a few small grains scattered throughout the rock. The proportions of the feldspars are difficult to estimate, as some plagioclase is poorly twinned, and moderate strain may have given a false twinning to some microcline. Probably about two thirds is andesine and one third microcline. Quartz is not a major mineral, but forms elongate masses up to 5 mm long.

The overall composition of the rock is dioritic, and as with all charnockite is probably the result of high grade (granulite facies) metamorphism. The abundance of microcline suggests potash metasomatism.

98426 Charnockitic diorite (Enderbite)

Very similar in mineralogy and texture to 98425. This specimen includes a layer rich in red-brown biotite, and more abundant olive brown hornblende. Quartz is very rare, but apatite is abundant as prisms up to 1 mm long.

98427 Charnockitic diorite (Enderbite)

A variation of 98425 and 26, with abundant hornblende scattered throughout the rock, and calcic andesine (An_{40}). Grain size is more uniform at about 1.5 mm, and the proportion of microcline is lowest in this specimen.

Note: The three charnockitic rocks are distinctive and obviously related to each other. The rock body as a whole is gneissic, with moderate orientation and layering, resulting in layers rich in hornblende or red-brown biotite, within a quartz-poor matrix of hypersthene, andesine and microcline.

The origin of charnockites remain in dispute, but the rocks have the mineralogical characteristics of a volatile-poor granulite facies metamorphic rock, with an igneous texture. Similar rocks are found to the northeast, in the

Fraser Range. It is possible that these two groups of rocks are related structurally, and lie to the east of the Jerdacuttup/Fraser Fault.

98428 Leuco-monzogranite.

A coarse-grained, fresh, leucocratic, directionless, hypidiomorphic granular, granitic rock. Large grains of perthite and calcic oligoclase, 3-8 mm across, form the bulk of the rock, with lesser interstitial quartz, minor red-brown biotite and apatite, and accessory opaques, muscovite, carbonate and zircon.

The rock is lightly sheared and many grains are surrounded by narrow zones of recrystallized mosaic, and masses of myrmekite. Many grains are traversed by trains of minute bubbles, as found in the associated charnockitic rocks. The exact relationship of this specimen to the previous three is not obvious.

APPENDIX 2

Borehole Logs

NOTES TO ACCOMPANY CORED BOREHOLE LOGS, PREPARED BY THE
ENGINEERING GEOLOGY SECTION OF THE GEOLOGICAL SURVEY OF
WESTERN AUSTRALIA (GSA)

These notes outline, describe or define the descriptive or quantitative data presented in some of the columns forming the cored borehole log. They explain the terminology and basis of some of the classification systems used and are presented below in the order that column headings appear, from left to right on the log.

Geological unit. A name given by geologists to a specific group of soils or rocks. Each unit is defined by different physical, chemical or biological properties.

Description of core. A general field description based on rock name, colour, grain characteristics, structure, minor components.

Weathering. Weathering is defined as the group of processes whereby rocks on exposure to the weather change in character, decay and degrade to soil materials. Terms used to describe weathering comprise:

COMPLETELY WEATHERED ROCK (CW). Has soil properties and often shows complete change in appearance.

HIGHLY WEATHERED (HW). Shows considerable change in appearance and loss in strength. Material is still a rock but normally very weak.

MODERATELY WEATHERED (MW). Visible change in appearance and with significant loss in strength.

SLIGHTLY WEATHERED (SW). Visible change in appearance but no significant loss in strength.

FRESH ROCK WITH STAINED JOINTS (FRST). Joint faces coated or stained, usually with limonite, but the blocks between joints are not visibly weathered.

FRESH ROCK (FR). Rock which exhibits no visible evidence of weathering.

N/A Not Applicable

N/D Not Determined

Estimated Unconfined Compressive Strength.

A record of a qualitative estimate of likely unconfined compressive strength based on a series of index tests performed on the core. Where actual strength test results are available these should be presented in the tests column. The estimated strength values represent the rock substance strength. The rock mass strength may be considerably less. Terms used to describe estimated rock strength are:

Rock Strength Class	Symbol	Point Load Strength I _s (50) (MPa)	Approximate
			Unconfined Compressive Strength (MPa)
Extremely low	EL	0.03	0.7
Very low	VL	0.03 - 0.1	0.7 - 2.4
Low	L	0.1 - 0.3	2.4 - 7
Medium	M	0.3 - 1	7 - 24
High	H	1 - 3	24 - 70
Very high	VH	3 - 10	70 - 240
Extremely high	EH	>10	>240

N/A Not Applicable

N/D Not Determined

Index Tests used to define strength classes are:

- EL: Easily remoulded by hand to a material with soil properties.
- VL: May be crumbled in the hand; sandstone is friable.
- L : A piece of core, 150 mm long x 50 mm dia, may be broken by hand and easily scored with a knife; sharp edges of core may be friable and break during handling.
- M : A piece of core, 150 mm long x 50 mm dia, can be broken by hand with considerable difficulty, readily scored with knife.
- H : A piece of core, 150 mm long x 50 mm dia, cannot be broken by unaided hand; can be slightly scratched or scored with knife.
- VH: A piece of core, 150 mm long x 50 mm dia, may be broken readily with hand held hammer; cannot be scratched.
- EH: A piece of core, 150 mm long x 50 mm dia, is difficult to break with hand held hammer, rings when struck with hammer.

Cementation. Typically used for cemented sedimentary rocks, e.g. the Tamala Limestone; terms used to describe cementation are as follows:

UC	Uncemented
PC	Poorly cemented
MC	Moderately cemented
WC	Well cemented
N/A	Not Applicable
N/D	Not Determined

Graphic log. Where completed, the appropriate rock symbol is used to denote rock type and black infill is used to denote core loss.

Defect spacing. A graphic record of the spacing between natural pre-existing defects. Zones of core loss are left blank. Drilling induced fractures are ignored.

Description and orientation of rock defects.

Detailed description of individual rock defects is achieved by a coding system covering defect type and spacing, orientation, shape, roughness and nature of infilling materials. Note that orientation data is provided as a measurement of the angle (θ) of the defect relative to the core axis and represents the apparent orientation of the defect intersecting the core. If the borehole is vertical, the apparent dip angle ($90 - \theta$) will represent the true dip of the defects. Without orientation of the direction of the borehole however, the dip direction of individual defects will not be known. The format of the description of an individual defect is as follows:

31.50	J1	50/-	10	R	FLM	CB
Depth	Type/ Nature	Dip/Direction	Shape	Roughness	Film	Type of film

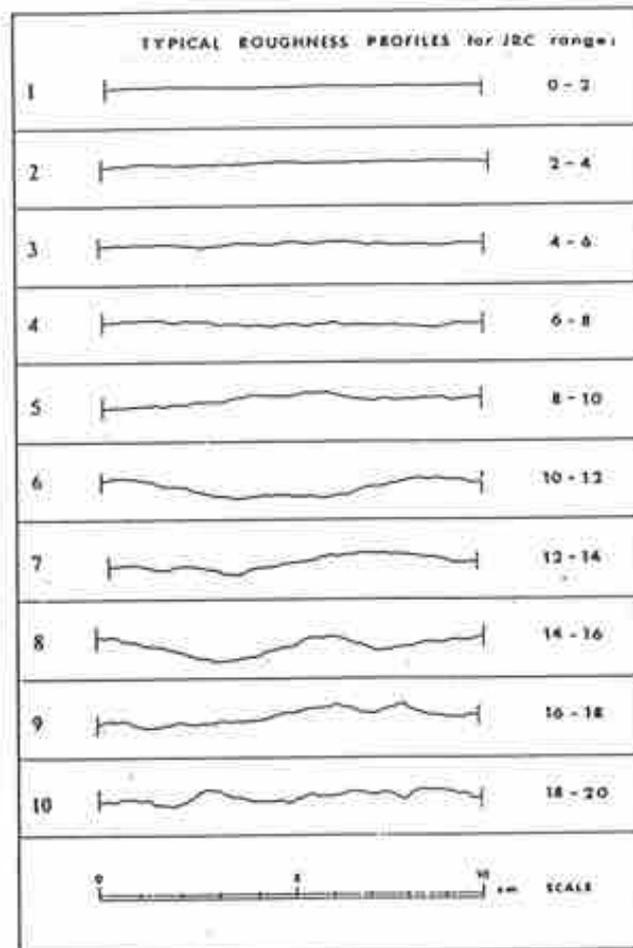
Codings used for the description include:

<u>Type</u>		<u>Roughness</u>	
Joint	J	S	Smooth
Bedding	B	SR	Slightly rough
Fault	F	R	Rough
Foliation	X	VR	Very rough
Cleavage	L	ST	Stepped
Vein	V	K	Slickensided
Shear	H		
Schistosity	S		

Nature

- 1 Pre-Drilling break
- 2 Uncertain whether induced
- 3 Definitely induced by drilling
- 5 Incomplete break
- 9 Trace of defect

Shape



Infilling Materials

FLM - Fil

INF - Infilling with thickness in mm

CLEAN - Clean

Infilling Materials:

AC	Actinolite	HB	Hornblende
AB	Albite	IL	Ilmenite
AM	Amphibole	IO	Iron Oxide
AT	Anatase	JA	Jasper
AH	Anhydrite	KA	Kaoline
AN	Anorthite	LI	Limonite
AP	Apatite	LF	Lithic fragments
AR	Aragonite	MG	Magnetite
AU	Augite	MI	Mica
BA	Barite	MN	Manganese
BX	Bauxite	MU	Muscovite
BE	Bentonite	NE	Neptheline
BI	Biotite	OI	Oil
BR	Brookite	OL	Olivine
CT	Calcite	OR	Orthoclase
CC	Caliche	OX	Iron oxide (undifferentiated)
CB	Carbonate	PG	Phlogopite
CS	Cassiterite	PH	Phosphate
CD	Chalcedony	PL	Plagioclase
CP	Chalcopyrite	PY	Pyrite
CL	Chlorite	PX	Pyroxene
CH	Chert	QZ	Quartz
C	Clay	QF	Quartz-frosted grains
DO	Dolomite	RF	Rock fragments
EP	Epidote	RU	Rutile
EV	Evaporite	SE	Selenite
FL	Fluorite	ST	Serpentine
FD	Feldspar	SH	Sulphides
GL	Galena	SD	Siderite
GA	Garnet	SI	Silica
GI	Gilsonite	SP	Sphalerite
GS	Glass	SL	Spinel
GL	Glauconite	SU	Sulphur
GO	Goethite	TA	Talc
GR	Graphite	TO	Tourmaline
GY	Gypsum	ZE	Zeolite
HA	Halite	ZR	Zircon
HE	Hematite		
HM	Heavy Minerals		

Lift and core recovery. Lift denotes the end of a core run and is shown by a horizontal line at the appropriate depth. Core recovery represents the ratio of core recovered to the length drilled expressed as a percentage.

RQD (Rock Quality Designation). This is a modified core recovery percentage in which all the pieces of intact core over 10 cm long are counted as recovery and are expressed as a percentage of the length drilled. The smaller pieces resulting from closer jointing, faulting or weathering are discounted. Note that when estimating RQD from drillcore it is necessary to discount artificial breaks clearly caused by the drilling process, and also those made deliberately when fitting core into the core tray. It should also be noted that the degree of fracturing of the core during the drilling process may be partly a function of core diameter in weaker rocks. RQD should not be determined on highly to completely weathered rock.

CORED BOREHOLE LOG				PROPOSED FISHING BOAT HARBOUR, BREMER BAY												
LOCATION		TOWN/CITY/SHIRE		BOREHOLE No. 88#1		Sheet 1 of 2										
FISHERY BEACH		BREMER BAY, JERRAMUNGUP SHIRE														
BOREHOLE LOCATION: NORTH EAST OF PROPOSED QUARRY																
DRILLING RIG: TRH200 DRILLER: B EDWARDS BARREL TYPE & LENGTH: NGI 1.5M BIT TYPE: GOLDFIELDS DIAMOND IMPREG. DRILLING FLUID: WATER		DATE COMMENCED: 14.06.04 DATE COMPLETED: 15.06.04 SUPERVISED BY: PIM CHECKED BY: PIM		AMG GRID REFERENCE: E 720495 ANGLE FROM HORIZONTAL: N 6187792 BEARING: 50 R.L. SURFACE: 520 DATUM: 18.87 DMH 051												
GEOLOGICAL UNIT	DESCRIPTION OF CORE	WEATHERING	ESTIMATED STRENGTH	CEMENTATION	GRAPHIC LOG	DEFECT SPACING (mm)		DESCRIPTION AND ORIENTATION OF ROCK DEFECTS & COMMENTS		WATER LEVEL	LEFT AND CORE RECOVERY	R. O. D.	TESTS	METHOD	CASING	
						RL (m)	DEPTH (m)	Particular	General							
	<p>0-10m (10m) - medium to coarse grained brown quartz (medium to coarse) matrix</p> <p>10-20m - medium to coarse grained brown quartz (medium to coarse) matrix</p> <p>20-30m - medium to coarse grained brown quartz (medium to coarse) matrix</p> <p>30-40m - medium to coarse grained brown quartz (medium to coarse) matrix</p> <p>40-50m - medium to coarse grained brown quartz (medium to coarse) matrix</p> <p>50-60m - medium to coarse grained brown quartz (medium to coarse) matrix</p> <p>60-70m - medium to coarse grained brown quartz (medium to coarse) matrix</p> <p>70-80m - medium to coarse grained brown quartz (medium to coarse) matrix</p> <p>80-90m - medium to coarse grained brown quartz (medium to coarse) matrix</p> <p>90-100m - medium to coarse grained brown quartz (medium to coarse) matrix</p>					10 20 30 40 50 60 70 80 90 100	10 20 30 40 50 60 70 80 90 100	0-10m (10m) - medium to coarse grained brown quartz (medium to coarse) matrix 10-20m - medium to coarse grained brown quartz (medium to coarse) matrix 20-30m - medium to coarse grained brown quartz (medium to coarse) matrix 30-40m - medium to coarse grained brown quartz (medium to coarse) matrix 40-50m - medium to coarse grained brown quartz (medium to coarse) matrix 50-60m - medium to coarse grained brown quartz (medium to coarse) matrix 60-70m - medium to coarse grained brown quartz (medium to coarse) matrix 70-80m - medium to coarse grained brown quartz (medium to coarse) matrix 80-90m - medium to coarse grained brown quartz (medium to coarse) matrix 90-100m - medium to coarse grained brown quartz (medium to coarse) matrix	Particular General							

WEATHERING		EDWARDS HIGH	
W1 - COMPLETELY WEATHERED W2 - HEAVILY WEATHERED W3 - MODERATELY WEATHERED W4 - SLIGHTLY WEATHERED W5 - FRESH	W6 - WEATHERED W7 - UNWEATHERED W8 - UNWEATHERED W9 - UNWEATHERED	E1 - EXTREMELY LOW E2 - VERY LOW E3 - LOW E4 - MODERATE E5 - HIGH E6 - VERY HIGH E7 - EXTREMELY HIGH	C1 - UNCEMENTED C2 - POORLY CEMENTED C3 - MODERATELY CEMENTED C4 - WELL CEMENTED C5 - NOT APPLICABLE C6 - NO CORE RECOVERED C7 - NOT DETERMINED C8 - UNKNOWN

GRADE OF CONTAMINATION		WATER	
G1 - UNCONTAMINATED G2 - SLIGHTLY CONTAMINATED G3 - MODERATELY CONTAMINATED G4 - HEAVILY CONTAMINATED G5 - NOT APPLICABLE G6 - NO CORE RECOVERED G7 - NOT DETERMINED G8 - UNKNOWN	W1 - WATER BOUND W2 - COMPLETELY DRY W3 - WET W4 - WET W5 - WET W6 - WATER BOUND	M1 - RESSAINTS TEST (PH) M2 - RESSAINTS TEST (PH) M3 - S&P M4 - S&P M5 - S&P M6 - S&P M7 - S&P M8 - S&P M9 - S&P M10 - S&P	M11 - RESSAINTS TEST (PH) M12 - RESSAINTS TEST (PH) M13 - S&P M14 - S&P M15 - S&P M16 - S&P M17 - S&P M18 - S&P M19 - S&P M20 - S&P

CASE		TESTS	
C1 - COMPLETELY WEATHERED C2 - HEAVILY WEATHERED C3 - MODERATELY WEATHERED C4 - SLIGHTLY WEATHERED C5 - FRESH	C6 - WEATHERED C7 - UNWEATHERED C8 - UNWEATHERED C9 - UNWEATHERED	T1 - UNCONTAMINATED T2 - SLIGHTLY CONTAMINATED T3 - MODERATELY CONTAMINATED T4 - HEAVILY CONTAMINATED T5 - NOT APPLICABLE T6 - NO CORE RECOVERED T7 - NOT DETERMINED T8 - UNKNOWN	T9 - WATER BOUND T10 - COMPLETELY DRY T11 - WET T12 - WET T13 - WET T14 - WATER BOUND

CASE		TESTS	
C1 - COMPLETELY WEATHERED C2 - HEAVILY WEATHERED C3 - MODERATELY WEATHERED C4 - SLIGHTLY WEATHERED C5 - FRESH	C6 - WEATHERED C7 - UNWEATHERED C8 - UNWEATHERED C9 - UNWEATHERED	T1 - UNCONTAMINATED T2 - SLIGHTLY CONTAMINATED T3 - MODERATELY CONTAMINATED T4 - HEAVILY CONTAMINATED T5 - NOT APPLICABLE T6 - NO CORE RECOVERED T7 - NOT DETERMINED T8 - UNKNOWN	T9 - WATER BOUND T10 - COMPLETELY DRY T11 - WET T12 - WET T13 - WET T14 - WATER BOUND

CASE		TESTS	
C1 - COMPLETELY WEATHERED C2 - HEAVILY WEATHERED C3 - MODERATELY WEATHERED C4 - SLIGHTLY WEATHERED C5 - FRESH	C6 - WEATHERED C7 - UNWEATHERED C8 - UNWEATHERED C9 - UNWEATHERED	T1 - UNCONTAMINATED T2 - SLIGHTLY CONTAMINATED T3 - MODERATELY CONTAMINATED T4 - HEAVILY CONTAMINATED T5 - NOT APPLICABLE T6 - NO CORE RECOVERED T7 - NOT DETERMINED T8 - UNKNOWN	T9 - WATER BOUND T10 - COMPLETELY DRY T11 - WET T12 - WET T13 - WET T14 - WATER BOUND

BREMER BAY, JERRAMUNGUP SHIRE

C. 00000-00000

CORED BOREHOLE LOG				PROPOSED FISHING BOAT HARBOUR, BREMER BAY										
LOCATION		TOWN/CITY/SHIRE		BOREHOLE No. BB#1		Sheet 2 of 2								
FISHERY BEACH		BREMER BAY-JERRAMUNGUP SHIRE												
BOREHOLE LOCATION: NORTH EAST OF PROPOSED QUARRY														
DRILLING RIG: TRM200 DRILLER: B EDWARDS BARREL TYPE & LENGTH: NQ 1.5M BIT TYPE: GOLDFIELDS DIAMOND IMPREG. DRILLING FLUID: WATER		DATE COMMENCED: 14.05.94 DATE COMPLETED: 15.05.94 SUPERVISED BY: PIM CHECKED BY: PIM		AMG GRID REFERENCE: N 720495 ANGLE FROM HORIZONTAL: 00 BEARING: 325 R.L. SURFACE: 18.67 DATUM: DM1051										
GEOLOGICAL UNIT	DESCRIPTION OF CORE	WEATHERING	ESTIMATED STRENGTH	CEMENTATION	GRAPHIC LOG	<input checked="" type="checkbox"/> DEFECT SPACING (mm) 10 30 100 300 1000 3000	DESCRIPTION AND ORIENTATION OF ROCK DEFECTS & COMMENTS		WATER LEVEL	LIFT AND CORE RECOVERY	R. Q. D.	TESTS	METHOD	CASING
							Particular	General						
SANDSTONE	00100 - fine grey, medium grained Blocky cementing matrix Some grey and dark matrix, predominantly blocky													
	00200 - fine to medium grained, medium grained cementing matrix Medium to dark matrix, predominantly blocky													
	00300 - fine to medium grained, medium grained cementing matrix Medium to dark matrix, predominantly blocky													
	00400 - fine to medium grained, medium grained cementing matrix Medium to dark matrix, predominantly blocky													
	00500 - fine to medium grained, medium grained cementing matrix Medium to dark matrix, predominantly blocky													
	00600 - fine to medium grained, medium grained cementing matrix Medium to dark matrix, predominantly blocky													
	00700 - fine to medium grained, medium grained cementing matrix Medium to dark matrix, predominantly blocky													
	00800 - fine to medium grained, medium grained cementing matrix Medium to dark matrix, predominantly blocky													
	00900 - fine to medium grained, medium grained cementing matrix Medium to dark matrix, predominantly blocky													
	01000 - fine to medium grained, medium grained cementing matrix Medium to dark matrix, predominantly blocky													

WEATHERING		ESTIMATED STRENGTH		GRADE OF CEMENTATION		WATER		TESTS	
CW - COMPLETELY WEATHERED HW - HIGHLY WEATHERED MW - MODERATELY WEATHERED SW - SLIGHTLY WEATHERED UN - UNDESIGNED	C1 - EXTREMELY LOW C2 - VERY LOW C3 - LOW C4 - MEDIUM C5 - HIGH C6 - VERY HIGH C7 - EXTREMELY HIGH	CC - UNDESIGNED PC - POORLY CEMENTED MC - MODERATELY CEMENTED SC - WELL CEMENTED NA - NOT APPLICABLE NC - NO CORE RECOVERY ND - NOT DETERMINED * - ESTIMATED	W1 - WATER BELOW W2 - COMPLETE DRILLING WATER W3 - LOSS W4 - PARTIAL DRILLING WATER W5 - LOSS W6 - WATER RETURN	FH - PRESSUREMETER TEST (MPa) L - PRESSURE TEST (LITERS) N10 - POINT LOAD INDEX N1 - SPT N2 - TUBE SAMPLE N3 - DEFORMED SAMPLE N4 - SHARP POINT LOAD INDEX (Pa) UCS - UNCONFINED COMPRESSIVE STRENGTH DCP - DCP					

CORED BOREHOLE LOG				PROPOSED FISHING BOAT HARBOUR — BREMER BAY										
LOCATION		TOWN/CITY/SHIRE		BOREHOLE No. BB#2		Sheet 1 of 2								
FISHERY BEACH		BREMER BAY - JERRAMUNGUP SHIRE												
BOREHOLE LOCATION: SOUTH EAST OF PROPOSED QUARRY														
DRILLING RIG: TRH 200		DATE COMMENCED: 15/06/84		AMG GRID REFERENCE: E 720 456										
DRILLER: B EDWARDS		DATE COMPLETED: 16/06/84		ANGLE FROM HORIZONTAL: N 6 187 756										
BARREL TYPE & LENGTH: NO 1.5 m		SUPERVISED BY: PIM		BEARING: 300										
BIT TYPE: GOLDFIELDS DIAMOND IMPREG.		CHECKED BY: PIM		R.L. SURFACE: 18.48										
DRILLING FLUID: WATER				DATUM: DMH 051										
GEOLOGICAL UNIT	DESCRIPTION OF CORE	WEATHERING	ESTIMATED STRENGTH	CEMENTATION	GRAPHIC LOG	<input checked="" type="checkbox"/> DEFECT SPACING (mm) R.L. (m) DEPTH (m)	DESCRIPTION AND ORIENTATION OF ROCK DEFECTS & COMMENTS		WATER LEVEL	LIFT AND CORE RECOVERY	R. Q. D.	TESTS	METHOD	CASING
							Particular	General						
	CLAYEY SAND, low to medium grade cementation with occasional spherules present	W1	W1			10								
	CLAYEY SAND, low to medium grade cementation with occasional spherules present	W2	W2			20								
	CLAYEY SAND, low to medium grade cementation with occasional spherules present	W3	W3			30								
	CLAYEY SAND, low to medium grade cementation with occasional spherules present	W4	W4			40								
	CLAYEY SAND, low to medium grade cementation with occasional spherules present	W5	W5			50								
	CLAYEY SAND, low to medium grade cementation with occasional spherules present	W6	W6			60								
	CLAYEY SAND, low to medium grade cementation with occasional spherules present	W7	W7			70								
	CLAYEY SAND, low to medium grade cementation with occasional spherules present	W8	W8			80								
	CLAYEY SAND, low to medium grade cementation with occasional spherules present	W9	W9			90								
	CLAYEY SAND, low to medium grade cementation with occasional spherules present	W10	W10			100								
	CLAYEY SAND, low to medium grade cementation with occasional spherules present	W11	W11			110								
	CLAYEY SAND, low to medium grade cementation with occasional spherules present	W12	W12			120								
	CLAYEY SAND, low to medium grade cementation with occasional spherules present	W13	W13			130								
	CLAYEY SAND, low to medium grade cementation with occasional spherules present	W14	W14			140								
	CLAYEY SAND, low to medium grade cementation with occasional spherules present	W15	W15			150								
	CLAYEY SAND, low to medium grade cementation with occasional spherules present	W16	W16			160								
	CLAYEY SAND, low to medium grade cementation with occasional spherules present	W17	W17			170								
	CLAYEY SAND, low to medium grade cementation with occasional spherules present	W18	W18			180								
	CLAYEY SAND, low to medium grade cementation with occasional spherules present	W19	W19			190								
	CLAYEY SAND, low to medium grade cementation with occasional spherules present	W20	W20			200								
	CLAYEY SAND, low to medium grade cementation with occasional spherules present	W21	W21			210								
	CLAYEY SAND, low to medium grade cementation with occasional spherules present	W22	W22			220								
	CLAYEY SAND, low to medium grade cementation with occasional spherules present	W23	W23			230								
	CLAYEY SAND, low to medium grade cementation with occasional spherules present	W24	W24			240								
	CLAYEY SAND, low to medium grade cementation with occasional spherules present	W25	W25			250								
	CLAYEY SAND, low to medium grade cementation with occasional spherules present	W26	W26			260								
	CLAYEY SAND, low to medium grade cementation with occasional spherules present	W27	W27			270								
	CLAYEY SAND, low to medium grade cementation with occasional spherules present	W28	W28			280								
	CLAYEY SAND, low to medium grade cementation with occasional spherules present	W29	W29			290								
	CLAYEY SAND, low to medium grade cementation with occasional spherules present	W30	W30			300								

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WEATHERING W1 - COMPLETELY WEATHERED W2 - HIGHLY WEATHERED W3 - MODERATELY WEATHERED W4 - SLIGHTLY WEATHERED W5 - FRESH	ESTIMATED STRENGTH S1 - EXTREMELY LOW S2 - VERY LOW S3 - LOW S4 - MEDIUM S5 - HIGH S6 - VERY HIGH S7 - EXTREMELY HIGH	DEGREE OF CEMENTATION C1 - UNCEMENTED C2 - POORLY CEMENTED C3 - MODERATELY CEMENTED C4 - WELL CEMENTED C5 - NOT APPLICABLE C6 - NO CORE PENETRATED C7 - NOT DETERMINED C8 - ESTIMATED	WATER WFL - WATER FLOW CFW - COMPLETE FLOWING WATER L - LOSS NDL - NATURAL DRILLER'S WATER L - LOSS WFL - WATER FLOW	TESTS W - WISCONSIN TEST APP. L - RESILIENT TEST (USGMA) NPL - POINT LOAD INDEX N - N.P.T. M - MURE SAMPLE S - DISTURBED SAMPLE SM - SOILMETER THROUGH HARDENED RQ - R.Q.D. US - UNCONSOLIDATED COMPRESSION STRENGTH D4 - D4 TEST P.N.A.
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APPENDIX 3

Core Photography



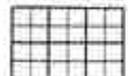
GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

	INITIAL	DATE
COMP	PIM	2/94
DRAWN	-	-
CHKD	PIM	2/94
APVD	AF	12/94

Core Photographs BB#1

TO ACCOMPANY EG 424

MAP INDEX





BB2 / 1

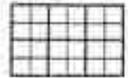


GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

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DRAWN	-	-
CHKD	Pim	8/11/44
APVD	AS	12/1/44

Core Photographs BB#2

MAP INDEX



TO ACCOMPANY EG 424



BB3/1



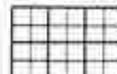
BB3/2

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

	INITIAL	DATE
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DRAWN	-	-
CHKD	PJM	8/44
APVD	AS	12/44

Core Photographs BB#3

MAP INDEX



TO ACCOMPANY EG 424



BB4/1

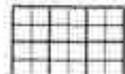


GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

	INITIAL	DATE
COMP	IM	2/94
DRAWN	-	-
CHKD	IM	2/94
APVD	AF	12/94

Core Photographs BB#4

MAP INDEX



TO ACCOMPANY EG 424

APPENDIX 4

Notes on the Description of Block Size and Shape for Jointed Rockmasses

NOTES ON THE DESCRIPTION OF BLOCK SIZE AND SHAPE FOR JOINTED ROCKMASSES (in Brown, 1981)

Block Size

Block size is an extremely important indicator of rockmass behaviour. Block dimensions are determined by discontinuity spacing, by the number of sets, and by the persistence of the discontinuities delineating potential blocks.

Number of Sets

The number of sets and the orientation determine the shape of the resulting blocks, which can take the approximate form of cubes, rhombohedrons, tetrahedrons, sheets etc. However, regular geometric shapes are the exception rather than the rule since the joints in any one set are seldom consistently parallel.

Rockmasses

Rockmasses can be described by the following adjectives, to give an impression of block size and shape:

<i>massive</i>	few joints or very wide spacing
<i>blocky</i>	approximately equidimensional
<i>tabular</i>	one dimension considerably smaller than the other two
<i>columnar</i>	one dimension considerably larger than the other two
<i>irregular</i>	wide variations of block size and shape
<i>crushed</i>	heavily jointed to "sugar cube"

Block Size Index (I_b)

The purpose of the block size index is to represent the average dimensions of typical rock blocks. The average value of individual modal spacings (S_1, S_2 etc) may not give a realistic value of I_b if there are more than 3 joint sets since the fourth set, (if widely spaced) will artificially increase I_b but have little influence on actual block size as observed in the field.

The relationship I_b is described by:

$$I_b = \frac{S_1 + S_2 + S_3}{3}$$

Quarrying

Rock quarrying and blasting efficiency are likely to be largely a function of the natural in situ block size. Block size can be described either by means of the average dimension of typical blocks (block size index I_b) or by the total number of joints intersecting a unit volume of the rockmass (volumetric joint count J_v).

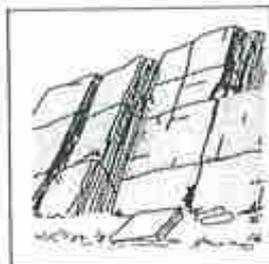
Sketches of Rockmasses



Blocky



Irregular



Tabular



Columnar



*Technical Specification
Fishery Beach Marina Boat Ramps and Jetty Refurbishment*

ATTACHMENT 6 SERVICES

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