FISHERY BEACH MARINA
BOAT RAMP AND JETTY CONSTRUCTION

TECHNICAL SPECIFICATION

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

October 2021
Rev C

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	04/05/2021
B	Issued for Tender	HD, TM (CSC)	SB	07/05/2021
C	Revised Issued for Tender	HD, SB	SB	04/10/2021

1 PRELIMINARIES

1.1 Description of the Works

The Fisheries Beach Marina recreational boating facility is located in Bremer Bay in the Shire of Jerramungup. The facility is located within the Department of Transports' (DoT) boat harbour and is managed by the Shire of Jerramungup (the Shire).

The Shire is the Principal for the Works.

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

In 2017, the Shire engaged Seashore Engineering 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 constructed with steel piles drilled int under-lying rock.

In April 2021, these works were issued for public tender, but did not proceed due to the tendered prices exceeding the available budget. The Shire have subsequently:

- secured additional funding for the works, and;
- revised the design package to include:
    - Option 1: the original design, boat ramp and steel pile jetty.
    - Option 2: a revised design, boat ramp and concrete pile jetty.
    - Option 3: a refurbishment option, boat ramp and refurbished concrete pile jetty.

The present Scope of Works includes demolition of the existing facility (Options 1 & 2), 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 by May 2022.

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

1.1.1. Design Options

The Drawings identify three 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 Principal is seeking prices for all three options. The preferred Option will be determined by the Principal prior to Tender Award.

Table 1.1 Boat Ramp and Jetty - Design Options

Description	Option 1	Option 2	Option 3	Drawing Ref.
Jetty				
General	36.6m x 2.0m.	36.6m x 2.0m.	28.6m x 1.2m.	SE064-04-03
Piles	Demolish existing. Install 9 x new Steel piles and pile cap.	Demolish existing. 9 x new concrete piles	Refurbish 7 x existing concrete piles.	SE064-04-10
Chafer	Steel C-Section with Rubber Fenders	Timber Chaffer with Rubber Fenders	Timber Chaffer with Rubber Fenders	SE064-04-11
Boat Ramp				
General	Demolish existing. 2 lanes (32m, 20 units)	Demolish existing. 2 lanes (32m, 20 units)	Demolish existing. 2 lanes (32m, 20 units)	SE064-04-04
Pre-Cast Concrete Boat Ramp Units - surface	12 x Waffle pattern per ramp (below water) 8 x Chevron pattern per ramp (above water)	20 x Waffle pattern (per ramp)	20 x Waffle pattern (per ramp)	SE064-04-05 SE064-04-06

Figure 1.1 Design Option 1 is based on a 2.0m wide jetty constructed with steel piles (example image Dunsborough, upper left), Design Option 2 requires demolition and replacement of concrete piles from existing jetty at Bremer Bay (lower), whilst Design Option 3 is based on a 1.2m wide jetty on refurbished concrete piles (example image Gracetown, upper right).

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. Further testing may be required to determine the design life of Option 3 if selected.

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 (Options 1 & 2) . 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 Ramp and Jetty Construction - Drawings

Title	Drawing Number	Revision
Locality Plan and Drawing Index	SE064-04-01	2
Drawing Notes	SE064-04-02	2
Site Layout	SE064-04-03	2
Boat Ramp Details	SE064-04-04	2
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	3
Jetty Details Sheet 2	SE064-04-08	3
Jetty Details Sheet 3	SE064-04-09	3
Pile Options	SE064-04-10	2
Cross Section and Chaffer Options	SE064-04-11	2

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 Transports' 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 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. Relevant 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 Contractors Site Plan.

1.7. Temporary Services

The Department of Transport have 'single phase and three phase power, water and lighting' are 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 undertake 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 of 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 an 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 1.2 which is based on the risk assessment matrix in Figure 1.3.

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.

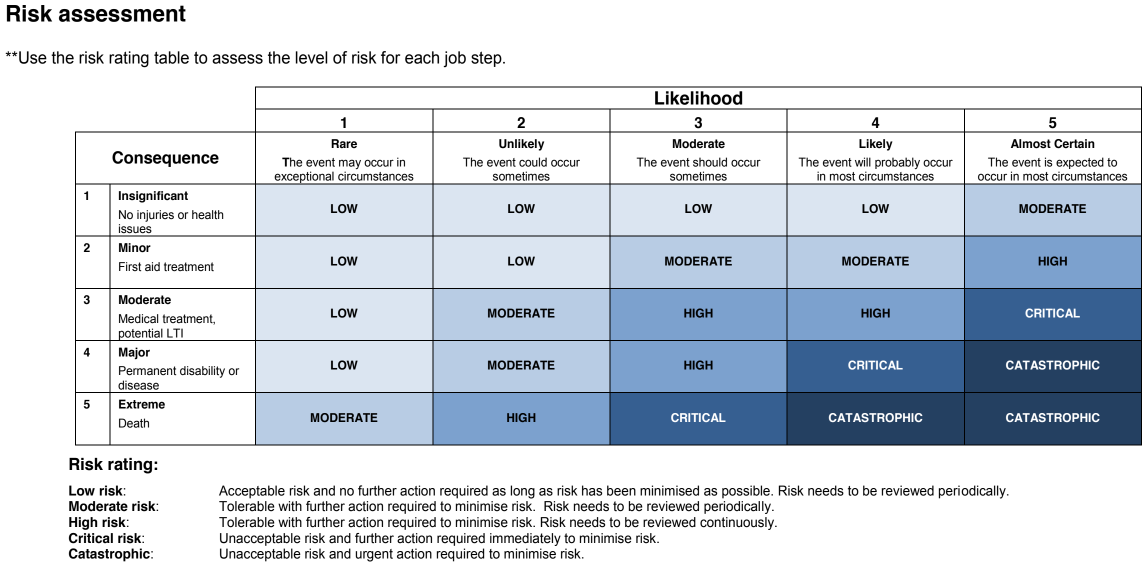
RISK ASSESSMENT
Fisheries Beach Boat Ramp Refurbishment - Safety in Design
Client: Shire of Jerramungup
Rev: A
Date: 28/4/21
Description: Construction, operation maintenance and demolition of Fisheries Beach Boat Ramp Refurbishment

Seashore Engineering

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 Elimination: Ramp to be closed during construction, maintenance and decommissioning, notice to mariners to be issued to inform 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/disembarking from vessels (use of jetty in more energetic wave climate) 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).	Moderate
Crush injury	Unlikely	Major	Moderate	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 Elimination: eliminate moveable gaps within holding structure (between pontoon units if used) that could crush limbs etc.	Moderate

Note: Risk Assessment Matrix sourced from Worksafe OHSE Subbypack.

Figure 1.2 Safety in Design Assessment



Risk assessment

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

		Likelihood				
		1	2	3	4	5
Consequence		**Rare** The event may occur in exceptional circumstances	**Unlikely** The event could occur sometimes	**Moderate** The event should occur sometimes	**Likely** The event will probably occur in most circumstances	**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 1.3 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 **31st January 2022,** following the summer school holidays.

The Date for Practical completion is **27th May 2022.** Any opportunity to provide temporary recreational boat launching during Eastern 2021 would be favourably considered by the Principal, but is not a requirement of the works.

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 or 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. Ramp Formation (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	Armour Stone	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 infirm 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
Concrete Piles (Options 2 & 3)	70	S50

Blinding concrete compressive strength shall be f'c = 15mpa

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 (Option 1) or concrete (Options 2 & 3) for the jetty piles.
- Steel superstructure.
- Corrosion protection painting systems for all steelwork and denso wrap for piles..
- Micromesh decking units, and associated fixtures, for the jetty decking.
- Rubber (Option 1) or timber (Options 2 & 3) chafers.
- Stainless steel ladders.
- 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 for Option 1 are Trelleborg 150DD rubber fender to fix to 200PFC as per Manufacturers detail. (refer Drawing SE064-04-07). An alternate option (Options 2 & 3) for a timber chafer and rubber fender is also outlined in the Drawings.

3.7. Concrete Piles (Provisional Option Two and Three)

Concrete Piles (Option Two (new) and Three (refurbish)) is outlined on the Drawings for the construction/refurbishment 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 of the existing pile locations, and with rock probes, is required to confirm existing rock levels, which are currently inferred from available geotechnical information.

For Option 3, The contract is required to refurbish the existing concrete piles provided visual inspections and load testing provide sufficient confidence that they are able to achieve a reasonable 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.

All timberwork to be in accordance with AS1720.1. Use only suitable quality jarrah, F11 Structural Grade 2, un-seasoned mill sawn finish.

3.9. Pile Protection (DENSO Wrap)

All piles to be wrapped with Denso Seashield Marine Piling tape (or equivalent approved) to piles from ~500mm below seabed height.

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.

For Options 1 & 2, the 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. For Option 3, the concrete piles are to be refurbished rather than demolished.

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 Boat 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 pile design for Option 1 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 new concrete piles, and refurbishment of existing concrete piles (Option 3) 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.

There are no borehole logs into underlying rock along the jetty alignment. Tenderer's should allow for 2.5m embedment of steel piles into competent rock. Determination of rock competence will require steady, moderate-strong resistance throughout the driving process and no evidence of substantial rock fracture. Criteria indicating acceptable strength of founding material will in part be dependent on the Contractors piling methodology and will be documented in the accepted Piling ITP prior to commencement.

This will be assessed during the works by the Principals Engineer, in consultation with the Contractor, in terms of the design loading for the jetty and a suitable factor of safety.

Available geotechnical records and rock probing for the existing jetty design (7 piles) suggest submerged rock is evident 1 to 2 metres below the seabed, with overlying sand. The level of the underlying rock at the location of the 2 new piles is not available, but can be inferred by Tenderers from surrounding rock levels identified in Drawing SE064-04-03, and confirmed in the Pre-Construction Feature Survey (refer Section 1.4 of the Technical Specification. However, if rock is not present, piles can be driven rather than drilled.

For Option 2, concrete piles are to be constructed by drilling starter bars at least 600mm into bedrock as per the Drawings, and installation of formwork, reinforcement and S50 concrete as per the Drawings.

For Option 3, the 7 existing concrete piles are to be refurbished as per the Drawings.

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

ATTACHMENT 1 DRAWINGS

NOT FOR CONSTRUCTION

FISHERIES BEACH MARINA - BOAT RAMP AND JETTY CONSTRUCTION

MARITIME CONSTRUCTION DRAWINGS

SHIRE OF JERRAMUNGUP


BOAT RAMP AND JETTY

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	CROSS SECTION AND CHAFFER OPTIONS

2	04/10/2021	REVISED ISSUED FOR TENDER	HD	SB
1	04/05/2021	ISSUED FOR TENDER	DF	SB
0	16/03/2018	FINAL	OS	SB
A	05/02/2018	PRELIMINARY	OS	SB
REVN	DATE	AMENDMENT	DRN	DESIGN APPROVAL

ORIG SIZE A3

ARCHIVE /Volumes/Seashore/2 Seashore Projects/SE064 Fishery Beach Marina - Boat Ramps and Jetty Refurbishment Designs/3. Design/Drawings/3. Work in Progress

PROJECT No SE064-04

NOTES

SCALE : DIAGRAMATIC

DATUM

VERTICAL AUSTRALIAN HEIGHT DATUM 1971 (AHD71) WHICH IS 0.884m ABOVE CHART DATUM (CD) AND 4.683m BELOW TIDAL BENCHMARK DMH093

HORIZONTAL MAP GRID OF AUSTRALIA, BASED ON GDA94

GDA

ACTION	NAME	SIGNATURE	DATE
ENGINEER	SB/TM		04/10/2021
DRAWN	HD/DF		04/10/2021
ENGINEERING CHECK	MJE		04/10/2021
DRAFTING CHECK	SB/DF		04/10/2021
APPROVED PROJECT MGR			

Civil/Structural Consulting Pty Ltd
Seashore Engineering

SHIRE OF JERRAMUNGUP
FISHERY BEACH MARINA - BOAT RAMP AND
JETTY CONSTRUCTION
LOCALITY PLAN AND DRAWING INDEX

DRAWING NUMBER SE 064-04-01

REVN 2

GENERAL NOTES

NOTES FOR FISHERIES BEACH BOAT RAMP DRAWINGS

DESIGN BASIS

DB1. THE BOAT LAUNCHING FACILITY HAS A DESIGN WORKING LIFE OF 25 YEARS AS PER AS4997 FOR SMALL CRAFT FACILITIES. THE BOAT RAMP HAS BEEN DEIGNED FOR THE LAUNCHING OF RECREATIONAL VESSELS, ANTICIPATED MAXIMUM VEHICLE WEIGHT 3.5 TONNES

DB2. THE JETTY IS DESIGNED FOR BERTHING OF UP TO 10 TONNE VESSEL TRAVELING AT A MAXIMUM OF 0.3m/s.

SAFETY

S1. SEASHORE ENGINEERING SAFETY IN DESIGN ASSESSMENT PROVIDED IN TECHNICAL SPECIFICATION. CONTRACTOR TO DEVELOP SMP FOR WORKS.

S2. HIGH RISK ACTIVITIES TO CONSIDER DURING CONSTRUCTION INCLUDE BUT ARE NOT LIMITED TO:
-- DEMOLITION OF LOAD BEARING STRUCTURE
-- TEMPORARY LOAD BEARING SUPPORT FOR STRUCTURAL ALTERATIONS OR REPAIRS
-- WORKING NEAR A TRENCH OR SHAFT DEEPER THAN 1.5m OR A TUNNEL
-- TILT UP OR PRECAST CONCRETE ELEMENTS
-- WORK ON, IN OR ADJACENT TO A ROAD, RAILWAY, SHIPPING LAND OR OTHER TRAFFIC CORRIDOR IN USE BY TRAFFIC OTHER THAN PEDESTRIANS
-- WORK IN AN AREA WITH MOVEMENT OF POWERED MOBILE PLANT
-- WORK IN OR NEAR WATER OR OTHER LIQUID THAT INVOLVES A RISK OF DROWNING
-- DIVING WORK

S3. THE SITE IS EXPOSED TO SHORT PERIOD WAVES LARGER THAN 0.2m. AS3962 2020 OUTLINES "WHILE IT IS PREFERABLE THAT THE BOAT RAMPS ARE LOCATED IN SHELTERED WATERS, THEY MAY ALSO BE LOCATED IN EXPOSED LOCATIONS TO PROVIDE DIRECT ACCESS TO OPEN WATERS FOR PUBIC AND COMMERCIAL BOATING. WHERE RAMPS ARE PROVIDED AT EXPOSED LOCATIONS, RAMP USERS MUST BE ADVISED THAT USE MAY BE RESTRICTED UNDER ADVERSE ENVIRONMENTAL CONDITIONS."

S4. DURING CONSTRUCTION THE CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING THE STRUCTURE IN A SAFE AND STABLE CONDITION AND SHALL ENSURE THAT NO PART IS OVER STRESSED DURING CONSTRUCTION ACTIVITIES, HAVING REGARD FOR THE ANTICIPATED CONDITIONS. IT IS THE CONTRACTOR'S RESPONSIBILITY TO ENSURE PUBLIC SAFETY IS MAINTAINED WITH REGARD TO THE PROPOSED WORKS AT ALL TIMES.

GENERAL

G1. 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 THECONTRACT. INSTRUCTIONS ON DRAWINGS TAKE PRECEDENCE OVER THESE NOTES.

G2. ALL DISCREPANCIES SHALL BE REFEREED TO THE SUPERINTENDENT BEFORE PROCEEDING WITH THE WORK.

G3. 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 BESCALED.

G4. MINIMUM DESIGN LIFE OF THIS STRUCTURE IS 25 YEARS. ALL WORKMANSHIP AND MATERIALS SHALL BE IN ACCORDANCE WITH THE RELEVANT S.A.A. 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 DOCUMENTS.

G5. NO SUBSTITUTIONS SHALL BE MADE OR SIZES OF STRUCTURAL MEMBERS VARIED WITHOUT OBTAINING THE PRIOR APPROVAL OF THE PRINCIPAL.

G6. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS STATED OTHERWISE.

G7. ANY VARIATION TO THE DETAILS SHOWN ON THE DRAWINGS MUST BE AUTHORIZED BY THE PRINCIPAL PRIOR TO FABRICATION AND CONSTRUCTION.

G8. 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 SUPERINTENDENT. ANY SOFT SPOTS SHALL BE REMOVED AND REPLACED WITH APPROVED FILL AND COMPACTED

G9. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE DEWATERING OF ALL TRENCHES WHERE REQUIRED

G10. THE CONTRACTOR SHALL DISPOSE OF EXCESS SPOIL AS DIRECTED BY THE PRINCIPAL

G11. ALL ASSETS MODIFIED OR DAMAGED BY THE PROPOSED WORKS SHALL BE REINSTATED TO THE SATISFACTION OF SHIRE OF JERRAMUNGUP.

G12. PRIOR TO COMMENCING WORK, THE CONTRACTOR SHALL PREPARE AND FORWARD TO PRINCIPAL, A REPORT ON THE CONDITION OF ANY EXISTING COUNCIL AND DEPARTMENT OF TRANSPORT CONTROLLED INFRASTRUCTURE IN THE VICINITY OF THE WORK SITE. THE REPORT SHALL LIST THE LOCATION AND EXTENT OF ANY EXISTING DAMAGE TO INFRASTRUCTURE 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.

DEMOLITION

D1. 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.

D2. MATERIAL MAY BE DISPOSED OF AT THE BREMER BAY WASTE FACILITY UNLESS OTHERWISE DIRECTED.

D3. THE EXISTING RAMP FORMATION (ROCK) IS TO BE LEFT IN PLACE AND REFURBISHED AS PART OF THESE WORKS.

D4. THE SHIRE OF JERRAMUNGUP MAY SEEK TO REUSE THE JETTY SUBSTRUCTURE, DECKING AND FENDERS SUBJECT TO THEIR CONDITION FOLLOWING REMOVAL.

D5. THE PRINCIPAL WILL CONSIDER RE-USE OF THE EXISTING CONCRETE PILES PROVIDED TESTING AND INSPECTIONS CONFIRM DEMONSTRATE THEY ARE ABLE TO ACHIEVE THE REQUIRED 25 YEAR MINIMUM DESIGN LIFE. THE CONTRACTOR SHOULD CONFIRM THE REQUIREMENT TO DEMOLISH OR REUSE EXISTING PILES WITH THE PRINCIPAL PRIOR TO DEMOLITION

REINFORCEMENT

R1. THE CONTRACTOR SHALL SUPPLY ALL NECESSARY BAR CHAIRS, SUPPORT AND SPACER BARS TO ENSURE REINFORCING STEEL IS PLACED IN ITS CORRECT POSITION DURING CONSTRUCTION.

R2. ALL REINFORCEMENT TO BE HOT DIP GALVANIZED UNLESS OTHERWISE NOTED.

R3. REINFORCEMENT IS SHOWN DIAGRAMMATICALLY AND NOT NECESSARILY IN TRUE PROJECTION.

R4. SET REINFORCEMENT OUT AT EQUAL CENTRES WHERE SPACING IS NOT SPECIFIED.

MAINTENANCE

M1. PRINCIPAL IS TO TIGHTEN ALL BOLTS AT 3 AND 12 MONTHS AFTER PRACTICAL COMPLETION. CORROSION PROTECTION IS TO BE INSPECTED AND RE-INSTATED AS REQUIRED (I.E. 12 MONTHS DEFECTS LIABILITY).

M2. 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

M3. WHERE NECESSARY REPLACE ITEMS THAT APPEAR TO LACK STRUCTURAL INTEGRITY IN CONSULTATION WITH ENGINEER.

M4. WHERE NECESSARY REPLACE/IMPROVE CORROSION PROTECTION SYSTEM.

CONCRETE WORK INCLUDING PRE-CAST CONCRETE

C1. ALL CONCRETE AND REINFORCEMENT SHALL BE IN ACCORDANCE WITH THE CURRENT EDITION OF AS 3600.

C2. 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 PRINCIPAL.

C3. CLEAR COVER TO ALL REINFORCEMENT AND CONCRETE GRADE SHALL BE AS FOLLOWS UNLESS NOTED OTHERWISE :

ELEMENT		COVER (mm)	GRADE (MIN)
ABUTMENT	AGAINST GROUND	70	N40
	FORMED	65	S50
PRECAST SLABS		65	S50
RAMP TOE BEAM TOP		70	S50
RAMP TOE BEAM BOTTOM/SIDES		50	S50

C4. BLINDING CONCRETE COMPRESSIVE STRENGTH SHALL BE f'c = 15 MPa

C5. ALL CONCRETE SHALL BE SUBJECT TO PROJECT ASSESSMENT OF STRENGTH AND SLUMP.

C6. ADDITIVES OTHER THAN SPECIFIED ARE NOT PERMITTED WITHOUT WRITTEN APPROVAL FROM THE SUPERINTENDENT.

C7. FREE DROPPING OF CONCRETE FROM A HEIGHT GREATER THAN 1200mm SHALL NOT BE PERMITTED.

C8. CONCRETE SHALL BE COMPACTED WITH SUITABLE VIBRATOR DURING PLACEMENT.

C9. ALL CONCRETE IN EACH SEPARATE POUR SHALL BE PLACED AND MECHANICALLY VIBRATED IN ONE CONTINUOUS OPERATION.

C10. 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.

C11. 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.

C12. 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.

PRECAST CONCRETE SLABS

PC1. 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.

PC2. 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 SUPERINTENDENT. ALL EMBEDDED LIFTING FIXINGS SHALL BE DESIGNED FOR A 25 YEAR LIFE SPAN IN A SPLASH ZONE.

PC3. MESH REINFORCING SHALL BE ONE CONTINUOUS SHEET PER SLAB.

PILING AND GEOTECHNICAL

P/G1. 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 TO CONFIRM THE REQUIRED PILE DESIGN.

P/G2. GEOTECHNICAL REPORTS ARE AVAILABLE FROM THE ADJACENT QUARRY FROM WHICH THE BREAKWATER ROCK WAS SOURCED. THIS MATERIAL WAS IDENTIFIED AS GNEISS WITH DENSITY OF 2.6T/M3 AND UCS INFERRED OF 160-210.

P/G3. THE MINIMUM PILE DEPTHS ARE 2.5m FOR COMPETENT ROCK AND 5.5M FOR SAND.

P/G4. PROOF LATERAL LOAD TESTING OF SELECTED PILE(S) MAY BE REQUIRED BY THE CONTRACTOR TO ENSURE THEY CAN WITHSTAND THE DESIGN LOADS (PROVISIONAL).

NOT FOR CONSTRUCTION

EARTHWORKS/FOUNDATION

E1. FOUNDATION IS TO BE PREPARED IN ACCORDANCE WITH THE DRAWINGS. EACH STAGE OF PREPARATION IS TO BE DOCUMENTED IN THE INSPECTION AND TEST PLANS (ITP), COMMENCEMENT OF SUBSEQUENT STAGES IS NOT TO PROCEED WITHOUT THE PRIOR WRITTEN APPROVAL OF THE PREVIOUS STAGE BY THE PRINCIPAL.

TIMBER

T1. ALL TIMBERWORK TO BE IN ACCORDANCE WITH AS1720.1
T2. USE ONLY SUITABLE QUALITY FINISH JARRAH, F11 STRUCTURAL GRADE 2, UNSEASONED MILL SAWN FINISH.

FORMWORK

F1. ALL FORMWORK TO BE IN ACCORDANCE WITH AS3610.

F2. FORMWORK SHALL NOT BE STRIPPED UNTIL THE CONCRETE STRENGTH IS SUFFICIENT TO SUPPORT THE LOADS WITHOUT EXCESSIVE DISTORTION OR CRACKING. NOT WITHSTANDING THIS REQUIREMENT, THE MINIMUM STRIPPING TIMES SHALL BE 7 DAYS.

F3. PROVIDE ALL EXPOSED EDGES AND CORNERS WITH 25MM CHAMFERS UNLESS NOMINATED OTHERWISE.

F4. ALL FORMWORK TO CONFORM TO ALL "WORKSAFE" WA REQUIREMENTS. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE STRUCTURAL SUFFICIENCY OF ALL FORMWORK.

STEELWORK SURFACE TREATMENT

ST1. ALL STEELWORK, INCLUDING NUTS, BOLTS AND WASHERS, IS TO BE SUITABLY TREATED FOR CORROSION PROTECTION AFTER FABRICATION, HAVING REGARD FOR THE HIGHLY CORROSIVE ENVIRONMENT. NO WORK (DRILLING ETC) TO BE CARRIED OUT SUBSEQUENT TO TREATMENT. STEELWORK EDGES AND CORNERS ARE TO BE SUITABLY BEVELED TO ENSURE PAINT ADHESION AND LIMIT PAINT CHIPPING.

ST2. ALL HOT DIP GALVANIZING, INCLUDING SURFACE PREPARATION, IS TO COMPLY WITH "AFTER-FABRICATION HOT DIP GALVANIZING" BY GALVANIZERS OF AUSTRALIA.

ST3. 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).

ST4. 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).

STEELWORK

S1. ALL WORKMANSHIP AND MATERIALS SHALL BE IN ACCORDANCE WITH AS4100/AS1554. STEEL SHALL BE ORDINARY WELDABLE GRADE TO AS3678 AND AS3679 UNLESS NOTED OTHERWISE.

S2. UNLESS NOTED OTHERWISE MATERIALS SHALL BE AS FOLLOWS :

ANGLE SECTIONS & PLATE	AS3678/3679	GRADE 250
UB, UC & PFC SECTIONS	BHP SPEC	GRADE 300 PLUS
HOLLOW SECTIONS	AS1163	GRADE 350

S3. 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 SUPERINTENDENT AND APPROVAL OF THE SAME OBTAINED BEFORE COMMENCING FABRICATION. APPROVAL WILL NOT COVER DIMENSIONS OR LAYOUT

S4. 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 SUPERINTENDENT. 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,

S6. 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.

S7. 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.

S8. UNLESS NOTED OTHERWISE WELDS SHALL BE 6 mm CONTINUOUS FILLET. MINIMUM OF 2M20 8.8/TB BOLTS PER CONNECTION U.N.O. THE ERECTION 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.

S10. 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.

SUMMARY OF OPTIONS TABLE

DESCRIPTION	OPTION 1	OPTION 2	OPTION 3	DRAWING REF.
JETTY				
GENERAL	36.6M X 2.0M.	36.6M X 2.0M.	28.6M X 1.2M.	SE064-04-03
PILES	DEMOLISH EXISTING. INSTALL 9 X NEW STEEL PILES AND PILE CAP.	DEMOLISH EXISTING. 9 X NEW CONCRETE PILES	REFURBISH 7 X EXISTING CONCRETE PILES.	SE064-04-10
CHAFER	STEEL C-SECTION WITH RUBBER FENDERS	TIMBER CHAFFER WITH RUBBER FENDERS	TIMBER CHAFFER WITH RUBBER FENDERS	SE064-04-11
BOAT RAMP				
GENERAL	DEMOLISH EXISTING. 2 LANES (32M, 20 UNITS)	DEMOLISH EXISTING. 2 LANES (32M, 20 UNITS)	DEMOLISH EXISTING. 2 LANES (32M, 20 UNITS)	SE064-04-04
PRE-CAST CONCRETE BOAT RAMP UNITS - SURFACE	12 X WAFFLE PATTERN PER RAMP (BELOW WATER) 8 X CHEVRON PATTERN PER RAMP (ABOVE WATER)	20 X WAFFLE PATTERN (PER RAMP)	20 X WAFFLE PATTERN (PER RAMP)	SE064-04-05 SE064-04-06

2	04/10/2021	REVISED ISSUED FOR TENDER	HD	SB
1	04/05/2021	ISSUED FOR TENDER	DF	SB
0	16/03/2018	FINAL	OS	SB
A	05/02/2018	PRELIMINARY	OS	SB
REVN	DATE	AMENDMENT	DRN	DESIGN APPROVAL

ORIG SIZE A3
ARCHIVE /Volumes/Seashore/2 Seashore Projects/SE064 Fishery Beach Marina - Boat Ramps and Jetty Refurbishment Designs/3. Design/Drawings/3. Work in Progress
PROJECT No SE064-04

NOTES

DATUM

VERTICAL AUSTRALIAN HEIGHT DATUM 1971 (AHD71) WHICH IS 0.884m ABOVE CHART DATUM (CD) AND 4.683m BELOW TIDAL BENCHMARK DMH093

HORIZONTAL MAP GRID OF AUSTRALIA, BASED ON GDA94

ACTION	NAME	SIGNATURE	DATE
ENGINEER	SB/TM		04/10/2021
DRAWN	HD/DF		04/10/2021
ENGINEERING CHECK	MJE		04/10/2021
DRAFTING CHECK	SB/DF		04/10/2021
APPROVED PROJECT MGR			

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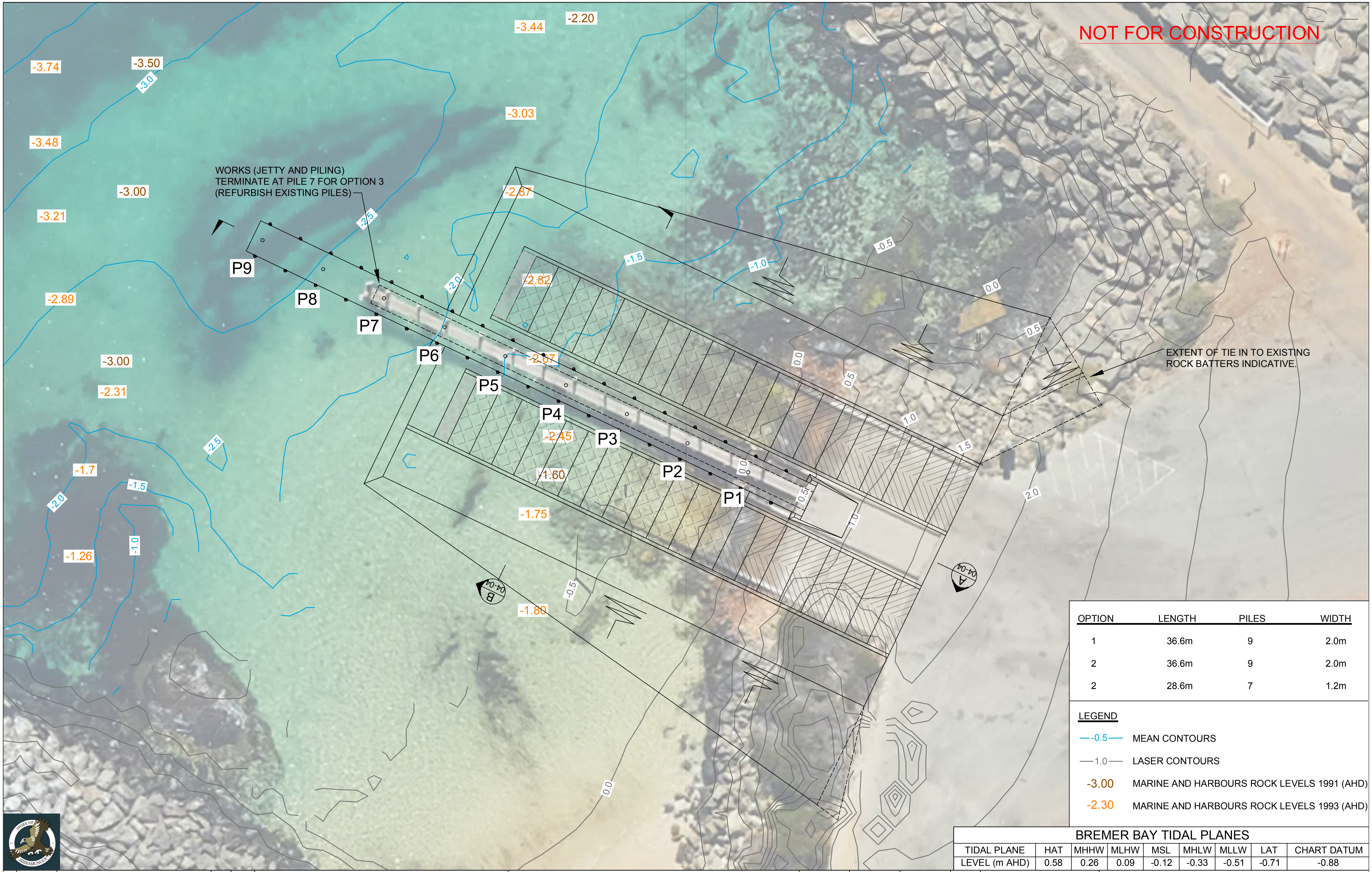
SHIRE OF JERRAMUNGUP
FISHERY BEACH MARINA - BOAT RAMP AND JETTY CONSTRUCTION
DRAWING NOTES

DRAWING NUMBER SE 064-04-02
REVN 2



OPTION	LENGTH	PILES	WIDTH
1	36.6m	9	2.0m
2	36.6m	9	2.0m
2	28.6m	7	1.2m

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

2	04/10/2021	REVISED ISSUED FOR TENDER	HD	SB
1	04/05/2021	ISSUED FOR TENDER	DF	SB
0	16/03/2018	FINAL	OS	SB
A	30/01/2018	PRELIMINARY	OS	SB
REVN	DATE	AMENDMENT	DRN	DESIGN APPROVAL

ORIG SIZE A3

ARCHIVE /Volumes/Seashore/2 Seashore Projects/SE064 Fishery Beach Marina - Boat Ramps and Jetty Refurbishment Designs/3. Design/Drawings/3. Work in Progress

PROJECT No SE064-04

NOTES
1. AERIAL 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 IFC.
5. BOAT RAMPS MAY BE MOVED CLOSER TO JETTY FOR OPTION 3 IN IFC DRAWINGS

SCALE 1 : 200
2 0 10
METERS

DATUM
VERTICAL AUSTRALIAN HEIGHT DATUM 1971 (AHD71) WHICH IS 0.884m ABOVE CHART DATUM (CD) AND 4.683m BELOW TIDAL BENCHMARK DMH093
HORIZONTAL MAP GRID OF AUSTRALIA, BASED ON GDA94

GDA

ACTION	NAME	SIGNATURE	DATE
ENGINEER	SB/TM		04/10/2021
DRAWN	HD/DF		04/10/2021
ENGINEERING CHECK	MJE		04/10/2021
DRAFTING CHECK	SB/DF		04/10/2021
APPROVED PROJECT MGR			

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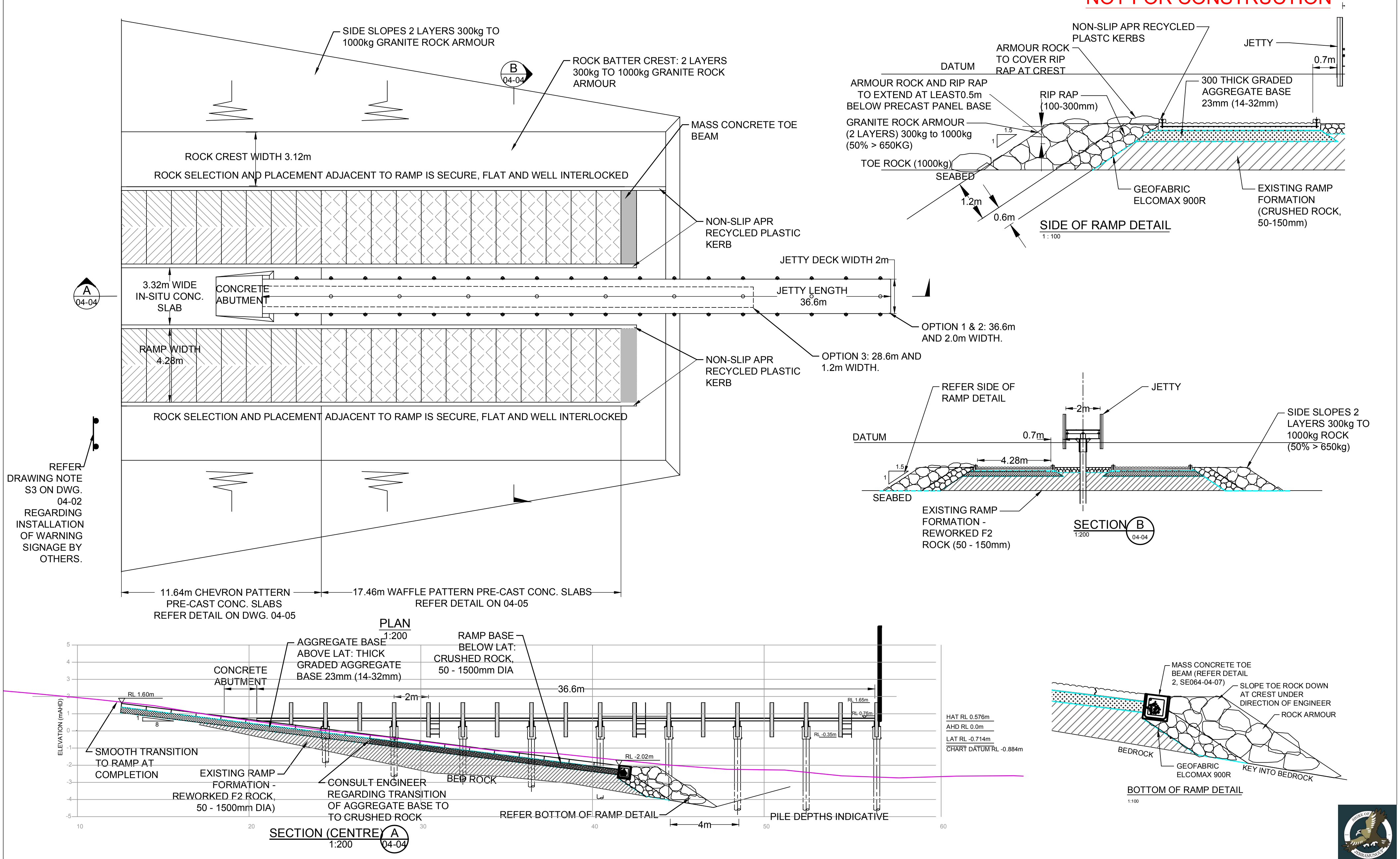
SHIRE OF JERRAMUNGUP
FISHERY BEACH MARINA - BOAT RAMP AND
JETTY CONSTRUCTION
SITE LAYOUT

DRAWING NUMBER SE 064-04-03

REVN 2

NOT FOR CONSTRUCTION


PLAN
1:200

SECTION (CENTRE) A 04-04
1:200

SIDE OF RAMP DETAIL
1 : 100

SECTION B 04-04
1:200

BOTTOM OF RAMP DETAIL
1:100

1	04/10/2021	REVISED ISSUED FOR TENDER	HD	SB
1	04/05/2021	ISSUED FOR TENDER	DF	SB
0	16/03/2018	FINAL	OS	SB
A	05/02/2018	PRELIMINARY	OS	SB
REVN	DATE	AMENDMENT	DRN	DESIGN APPROVAL

ORIG SIZE A3
ARCHIVE /Volumes/Seashore/2 Seashore Projects/SE064 Fishery Beach Marina - Boat Ramps and Jetty Refurbishment Designs/3. Design/Drawings/3. Work in Progress
PROJECT No SE064-04

NOTES
1. NATURAL SURFACE LEVELS BASED ON INTERPOLATION OF 18/12/2011 SURVEY BY DoT
2. ROCK LEVELS BASED ON DRAWING 3779-09

SCALE 1 : 200
2 0 10 METERS
UNLESS OTHERWISE NOTED

DATUM
VERTICAL AUSTRALIAN HEIGHT DATUM 1971 (AHD71) WHICH IS 0.884m ABOVE CHART DATUM (CD) AND 4.683m BELOW TIDAL BENCHMARK DMH093
HORIZONTAL MAP GRID OF AUSTRALIA, BASED ON GDA94 GDA

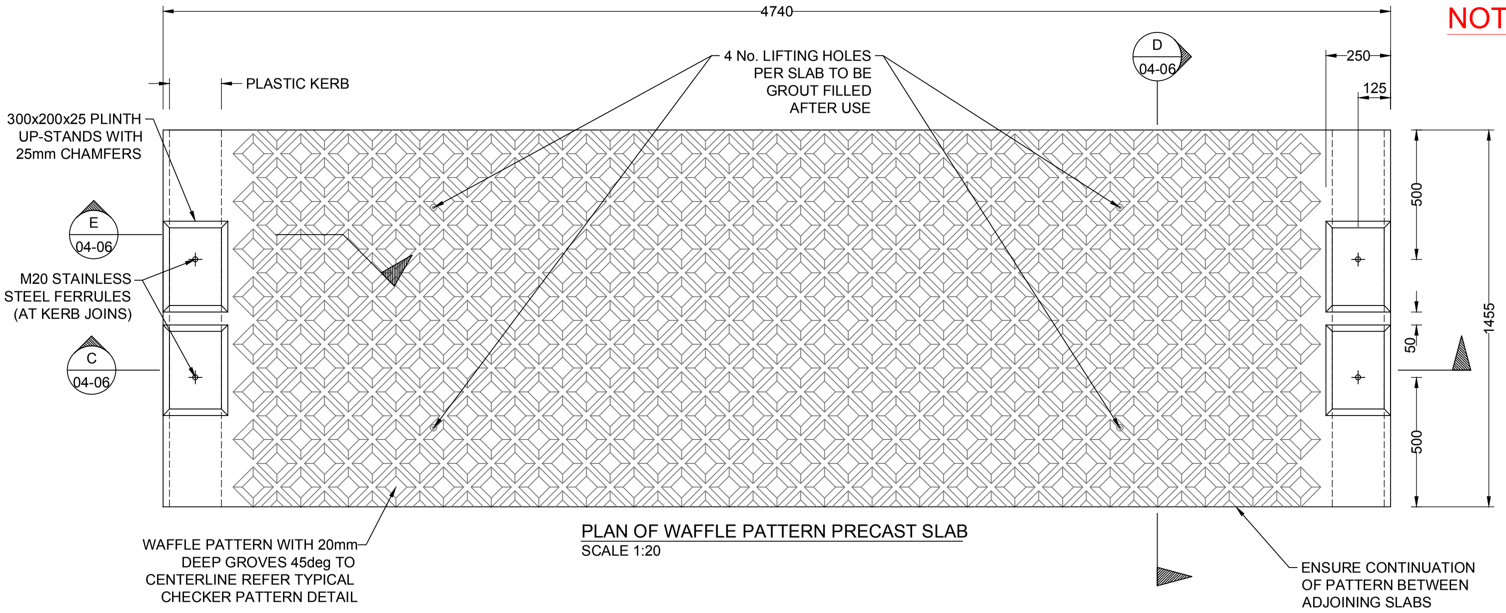
ACTION	NAME	SIGNATURE	DATE
ENGINEER	SB/TM		04/10/2021
DRAWN	HD/DF		04/10/2021
ENGINEERING CHECK	MJE		04/10/2021
DRAFTING CHECK	SB/DF		04/10/2021
APPROVED PROJECT MGR			

Civil/Structural Consulting Pty Ltd
Seashore Engineering

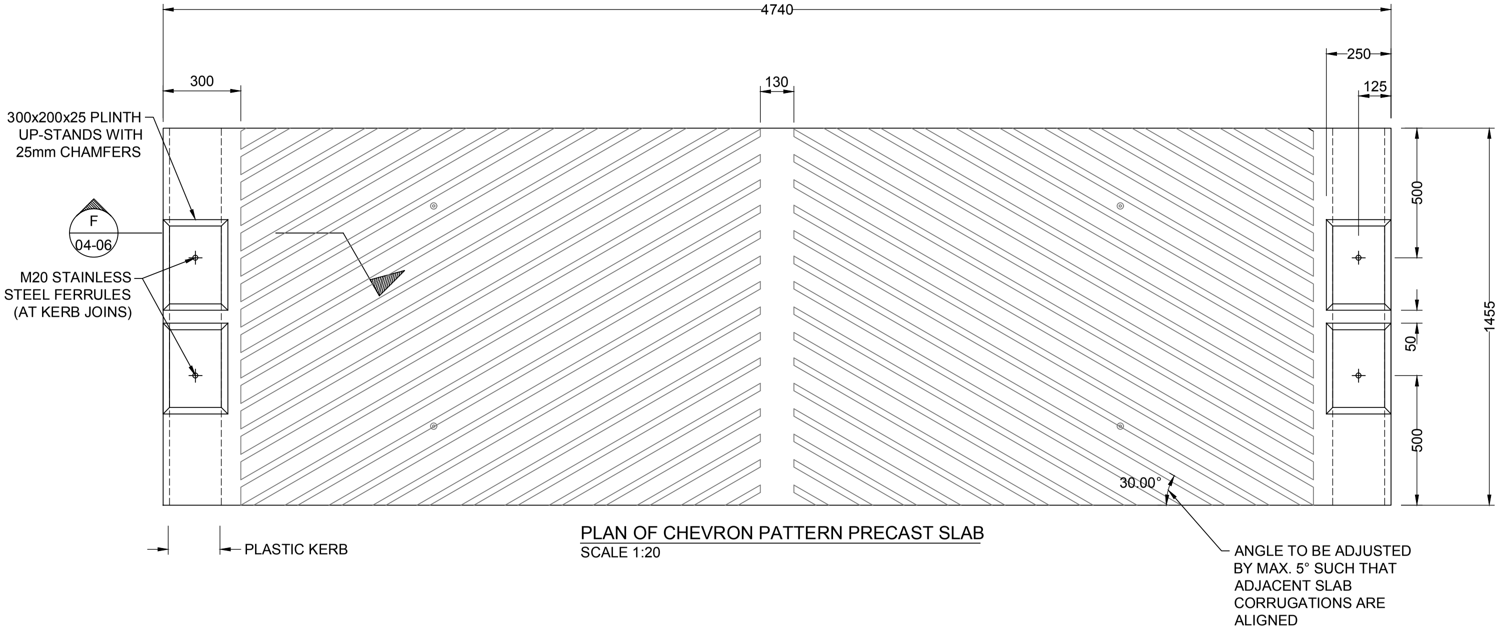
SHIRE OF JERRAMUNGUP
FISHERY BEACH MARINA- BOAT RAMP AND JETTY CONSTRUCTION
BOAT RAMP DETAILS

DRAWING NUMBER SE 064-04-04
REVN 2

NOT FOR CONSTRUCTION



PLAN OF WAFFLE PATTERN PRECAST SLAB
SCALE 1:20



PLAN OF CHEVRON PATTERN PRECAST SLAB
SCALE 1:20

REVN	DATE	AMENDMENT	DRN	DESIGN APPROVAL
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0	16/03/2018	FINAL	OS	SB
A	05/02/2018	PRELIMINARY	OS	SB

ORIG SIZE A3
ARCHIVE /Volumes/Seashore/2 Seashore Projects/SE064 Fishery Beach Marina - Boat Ramps and Jetty Refurbishment Designs/3. Design/Drawings/3. Work in Progress
PROJECT No SE064

NOTES

1. NATURAL SURFACE LEVELS BASED ON INTERPOLATION OF 18/12/2011 SURVEY BY DoT
2. ROCK LEVELS BASED ON DRAWING 3779-09

SCALE 1 : 20
0.2 0 1 METERS

DATUM
VERTICAL AUSTRALIAN HEIGHT DATUM 1971 (AHD71) WHICH IS 0.884m ABOVE CHART DATUM (CD) AND 4.683m BELOW TIDAL BENCHMARK DMH093
HORIZONTAL MAP GRID OF AUSTRALIA, BASED ON GDA94

ACTION	NAME	SIGNATURE	DATE
ENGINEER	SB/TM		04/10/2021
DRAWN	HD/DF		04/10/2021
ENGINEERING CHECK	MJE		04/10/2021
DRAFTING CHECK	SB/DF		04/10/2021
APPROVED PROJECT MGR			

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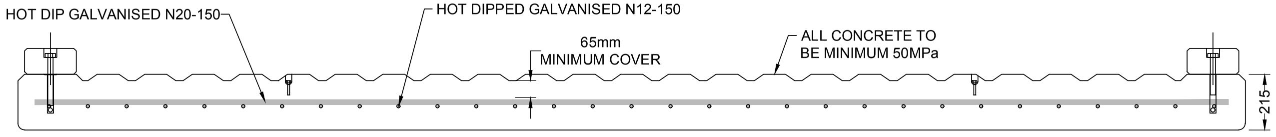
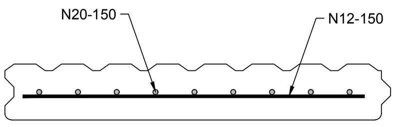
SHIRE OF JERRAMUNGUP
FISHERY BEACH MARINA- BOAT RAMP AND JETTY CONSTRUCTION
PRE-CAST PANEL DETAILS SHEET 1 OF 2

DRAWING NUMBER SE 064-04-05
REVN 1

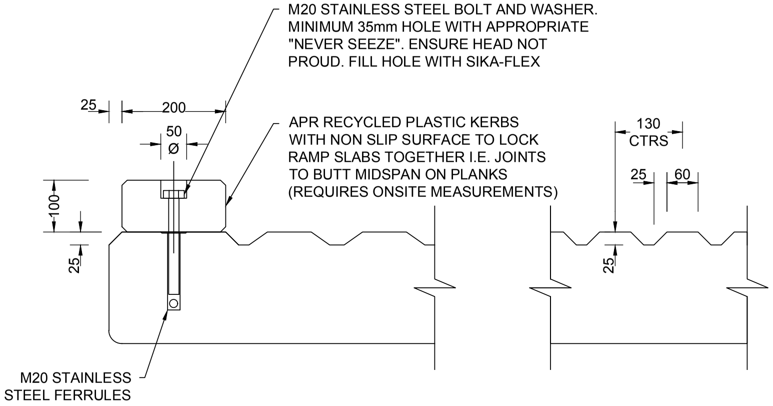
NOT FOR CONSTRUCTION



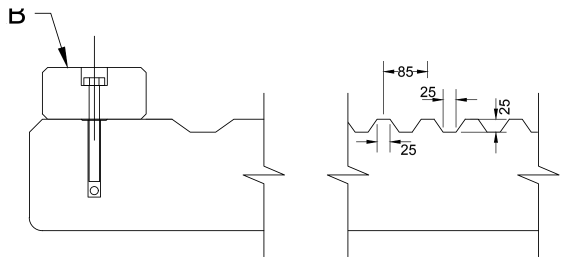
SECTION C
1:20
04-05



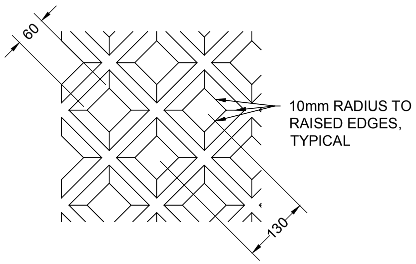
SECTION D
1:20
04-05



SECTION E
1:10
04-05



SECTION F
1:10
04-05



TYPICAL WAFFLE PATTERN DETAIL PLAN
SCALE 1:10

1	04/05/2021	ISSUED FOR TENDER	DF	SB
0	16/03/2018	FINAL	OS	SB
A	05/02/2018	PRELIMINARY	OS	SB
REVN	DATE	AMENDMENT	DRN	DESIGN APPROVAL

ORIG SIZE A3
ARCHIVE /Volumes/Seashore/2 Seashore Projects/SE064 Fishery Beach Marina - Boat Ramps and Jetty Refurbishment Designs/3. Design/Drawings/3. Work in Progress
PROJECT No SE064

NOTES
1. NATURAL SURFACE LEVELS BASED ON INTERPOLATION OF 18/12/2011 SURVEY BY DoT
2. ROCK LEVELS BASED ON DRAWING 3779-09

SCALE 1 : 20
0.2 0 1
METERS
UNLESS
OTHERWISE
NOTED

DATUM
VERTICAL AUSTRALIAN HEIGHT DATUM 1971 (AHD71) WHICH IS 0.884m ABOVE CHART DATUM (CD) AND 4.683m BELOW TIDAL BENCHMARK DMH093
HORIZONTAL MAP GRID OF AUSTRALIA, BASED ON GDA94

ACTION	NAME	SIGNATURE	DATE
ENGINEER	SB/TM		04/10/2021
DRAWN	HD/DF		04/10/2021
ENGINEERING CHECK	MJE		04/10/2021
DRAFTING CHECK	SB/DF		04/10/2021
APPROVED PROJECT MGR			

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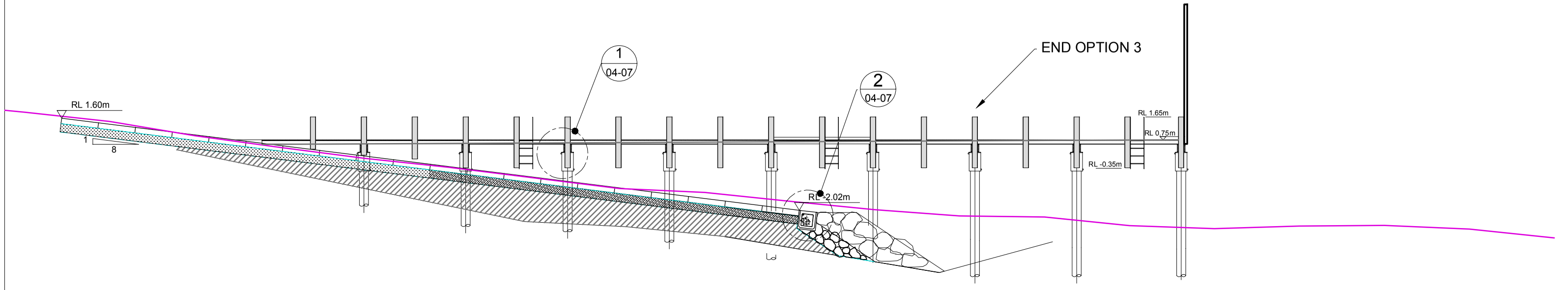
SHIRE OF JERRAMUNGUP
FISHERY BEACH MARINA - BOAT RAMP AND
JETTY CONSTRUCTION
PRE-CAST PANEL DETAILS

DRAWING NUMBER SE 064-04-06
REVN 1

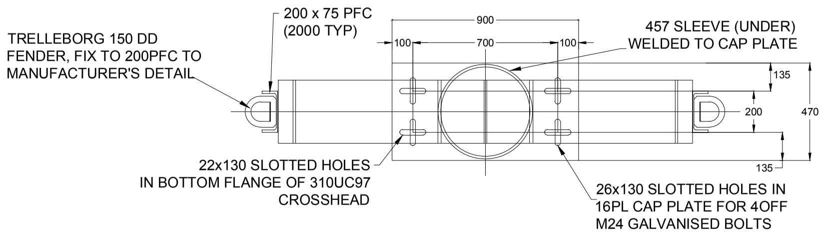
DESIGN VESSEL:
8.0m LONG
0.9m DRAFT

DESIGN MAX WATER LEVEL:
1.0mAHD

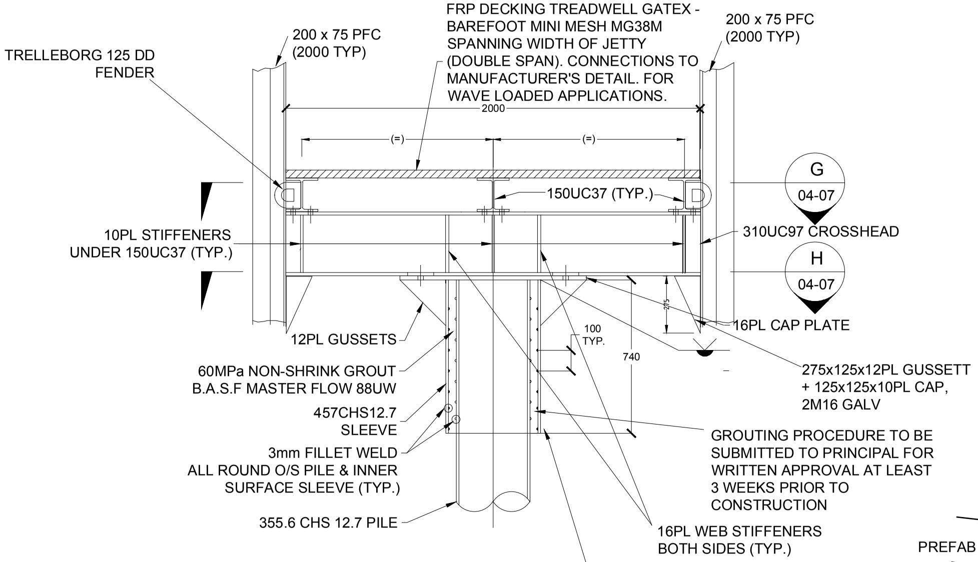
DESIGN LIFE:
25 YRS



SECTION A
1:200
04-04

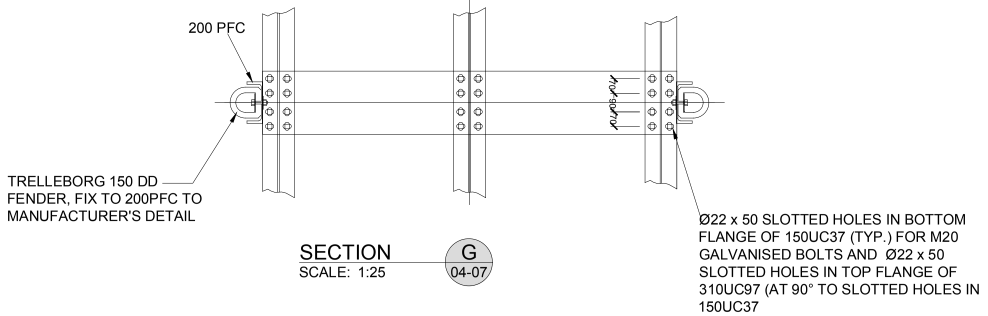


SECTION H
SCALE: 1:25
04-07

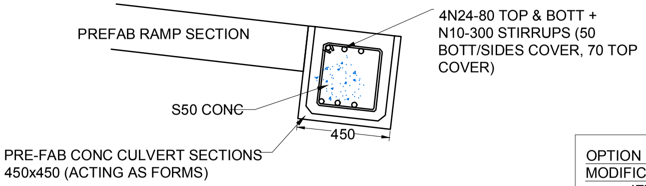


DETAIL 1
SCALE: 1:25
04-07

PILE CAPS FOR PILES 1 AND 2 (LANDWARD END) ARE 500MM LONG DUE TO LIMITED OFFSET TO THE RAMP FORMATION AT THE LANDWARD END. PILE CAPS FOR PILES 3 TO 9 ARE 740MM LONG AS PER DETAIL 1 ON SE064-04-07



SECTION G
SCALE: 1:25
04-07



ALL REINFORCEMENT HD GALVANISED

DETAIL 2
SCALE: 1:25
04-07

OPTION 3: JETTY DESIGN IS AS PER DRAWING SHOWN WITH THE FOLLOWING MODIFICATIONS:

- JETTY LENGTH IS 28.6M WITH EXISTING 7 PILES REFURBISHED.
- PILE DESIGN AS PER DWG 04-10 OPTION 3.
- 310UC97 CROSSHEAD OF 1.2M LENGTH AS PER DWG 04-11.
- FRP DECKING 1.2M WIDTH AS PER DWG 04-11.
- CHAFER DETAIL (TIMBER) AS PER DWG 04-11.
- CONCRETE ABUTMENT 1.2M WIDTH.

NOT FOR CONSTRUCTION

REVN	DATE	AMENDMENT	DRN	DESIGN APPROVAL
3	04/10/2021	REVISED ISSUED FOR TENDER	HD	SB
2	04/05/2021	ISSUED FOR TENDER	DF	SB
1	01/09/2020	REV 1	HD	SB
0	16/03/2018	FINAL	OS	SB
A	05/02/2018	PRELIMINARY	OS	SB

ORIG SIZE A3
ARCHIVE /Volumes/Seashore/2 Seashore Projects/SE064 Fishery Beach Marina - Boat Ramps and Jetty Refurbishment Designs/3. Design/Drawings/3. Work in Progress
PROJECT No SE064-04

NOTES

SCALE 1 : 50
0.5 0 2
METERS
UNLESS OTHERWISE STATED

DATUM
VERTICAL AUSTRALIAN HEIGHT DATUM 1971 (AHD71) WHICH IS 0.884m ABOVE CHART DATUM (CD) AND 4.683m BELOW TIDAL BENCHMARK DMH093
HORIZONTAL N/A

ACTION	NAME	SIGNATURE	DATE
ENGINEER	SB/TM		04/10/2021
DRAWN	TM		04/10/2021
ENGINEERING CHECK	MJE		04/10/2021
DRAFTING CHECK	SB/DF		04/10/2021
APPROVED PROJECT MGR			

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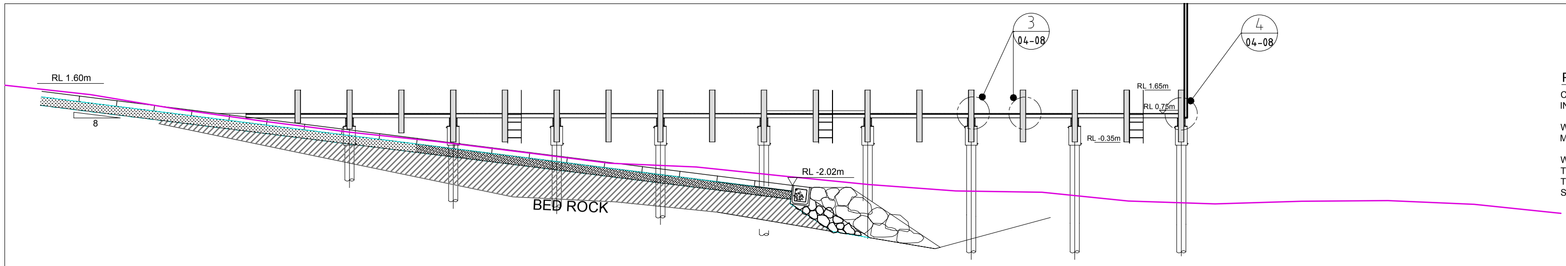
SHIRE OF JERRAMUNGUP
FISHERY BEACH MARINA- BOAT RAMPS AND
JETTY CONSTRUCTION
JETTY DETAILS SHEET 1 OF 3

DRAWING NUMBER SE064-04-07
REVN 3



SECTION A
1:200 04-04

PILE INSTALLATION

CHS PILES SHALL BE DRILLED MINIMUM 2.5m INTO COMPETENT ROCK LAYER (>500kPa).

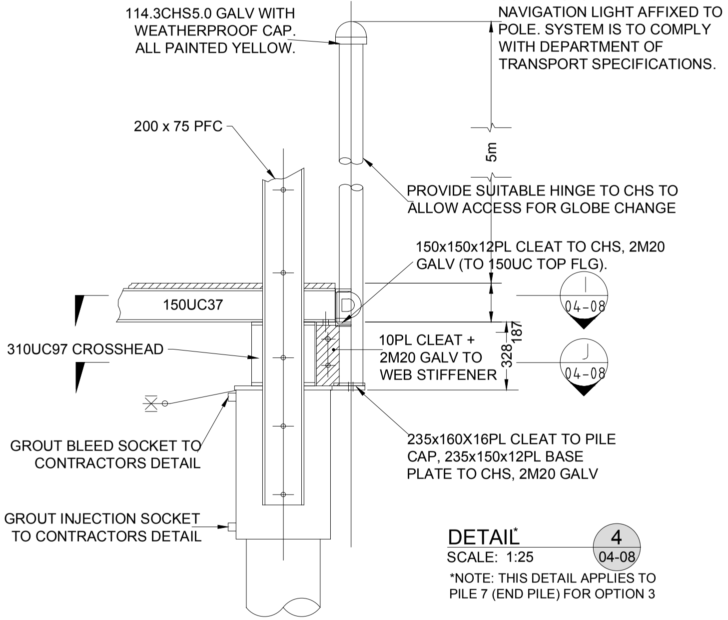
WHERE ROCK IS NOT PRESENT DRILL MINIMUM 5.5m INTO SAND (>150kPa).

WHERE CAVITIES ARE CREATED AROUND THE PILE(S) DURING THE DRILLING PROCESS THESE ARE TO BE GROUT FILLED TO THE SATISFACTION OF THE SUPERINTENDENT.

DESIGN VESSEL:
8.0m LONG
0.9m DRAFT

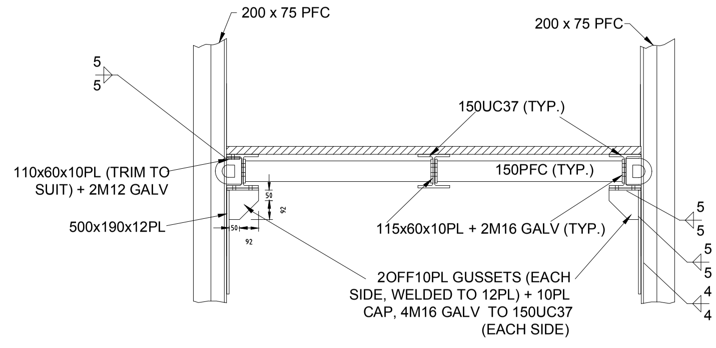
DESIGN MAX WATER LEVEL:
1.0mAHD

DESIGN LIFE:
25 YRS

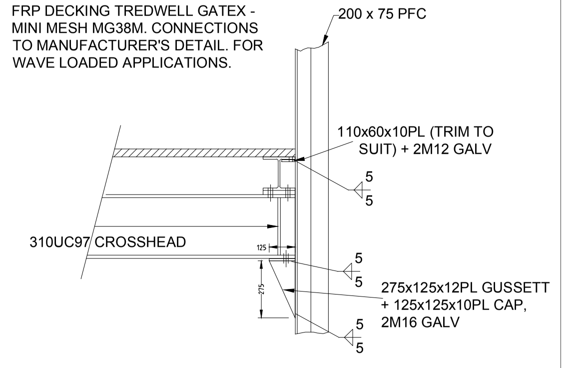


DETAIL* 4
SCALE: 1:25 04-08

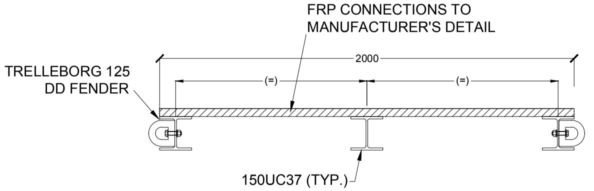
*NOTE: THIS DETAIL APPLIES TO PILE 7 (END PILE) FOR OPTION 3



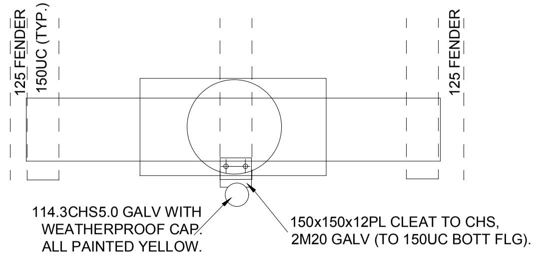
DETAIL 3
SCALE: 1:25 04-08



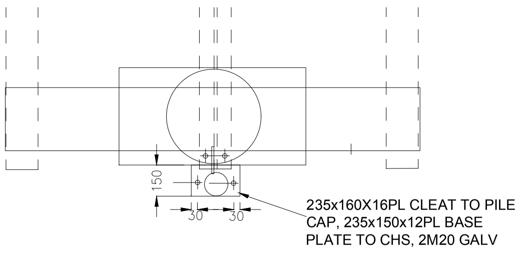
DETAIL 3
SCALE: 1:25 04-08



FENDER DETAIL TO END BAY
SCALE: 1:25



SECTION I
SCALE: 1:25 04-08



SECTION J
SCALE: 1:25 04-08

OPTION 3: JETTY DESIGN IS AS PER DRAWING SHOWN WITH THE FOLLOWING MODIFICATIONS:
- JETTY LENGTH IS 28.6M WITH EXISTING 7 PILES REFURBISHED.
- PILE DESIGN AS PER DWG 04-10 OPTION 3.
- 310UC97 CROSSHEAD OF 1.2M LENGTH AS PER DWG 04-11.
- FRP DECKING 1.2M WIDTH AS PER DWG 04-11.
- CHAFER DETAIL (TIMBER) AS PER DWG 04-11.
- CONCRETE ABUTMENT 1.2M WIDTH.

NOT FOR CONSTRUCTION

REVN	DATE	AMENDMENT	DRN	DESIGN APPROVAL
3	04/10/2021	REVISED ISSUED FOR TENDER	HD	SB
2	04/05/2021	ISSUED FOR TENDER	DF	SB
1	01/09/2020	REV 1	HD	SB
0	16/03/2018	FINAL	OS	SB
A	05/02/2018	PRELIMINARY	OS	SB

ORIG SIZE A3
ARCHIVE /Volumes/Seashore/2 Seashore Projects/SE064 Fishery Beach Marina - Boat Ramps and Jetty Refurbishment Designs/3. Design/Drawings/3. Work in Progress
PROJECT No SE064-04

NOTES

SCALE 1 : 50
0.5 0 2
METERS
UNLESS OTHERWISE STATED

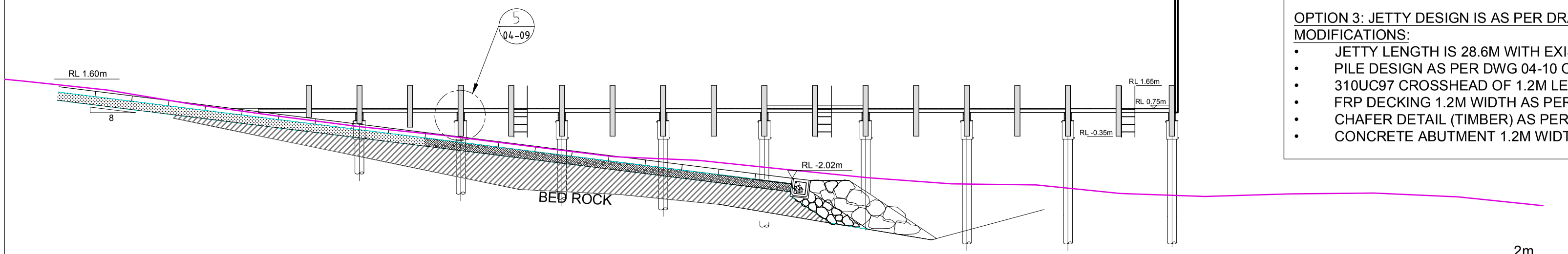
DATUM
VERTICAL AUSTRALIAN HEIGHT DATUM 1971 (AHD71) WHICH IS 0.884m ABOVE CHART DATUM (CD) AND 4.683m BELOW TIDAL BENCHMARK DMH093
HORIZONTAL N/A

ACTION	NAME	SIGNATURE	DATE
ENGINEER	SB/TM		04/10/2021
DRAWN	TM		04/10/2021
ENGINEERING CHECK	MJE		04/10/2021
DRAFTING CHECK	SB/DF		04/10/2021
APPROVED PROJECT MGR			

Civil/Structural Consulting Pty Ltd
Seashore Engineering

SHIRE OF JERRAMUNGUP
FISHERY BEACH MARINA - BOAT RAMPS AND JETTY CONSTRUCTION
JETTY DETAILS SHEET 2 OF 3

DRAWING NUMBER SE064-04-08
REVN 3



SECTION A
1:200 04-04

OPTION 3: JETTY DESIGN IS AS PER DRAWING SHOWN WITH THE FOLLOWING MODIFICATIONS:

- JETTY LENGTH IS 28.6M WITH EXISTING 7 PILES REFURBISHED.
- PILE DESIGN AS PER DWG 04-10 OPTION 3.
- 310UC97 CROSSHEAD OF 1.2M LENGTH AS PER DWG 04-11.
- FRP DECKING 1.2M WIDTH AS PER DWG 04-11.
- CHAFER DETAIL (TIMBER) AS PER DWG 04-11.
- CONCRETE ABUTMENT 1.2M WIDTH.

DESIGN VESSEL:
8.0m LONG
0.9m DRAFT

DESIGN MAX WATER LEVEL:
1.0mAHD

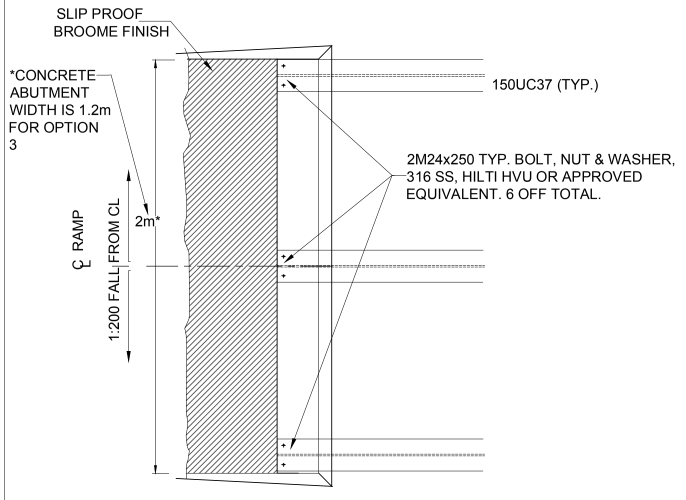
DESIGN LIFE:
25 YRS

PILE INSTALLATION

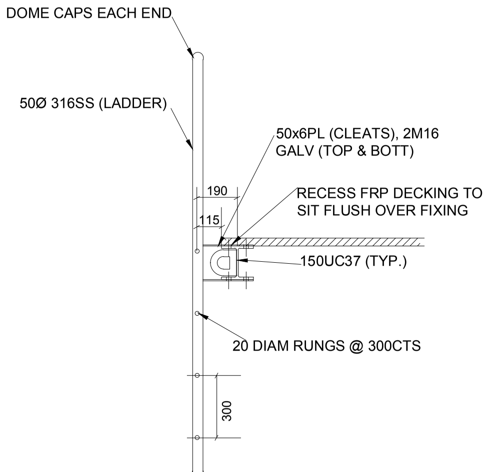
CHS PILES SHALL BE DRILLED MINIMUM 2.5m INTO COMPETENT ROCK LAYER (>500kPa).

WHERE ROCK IS NOT PRESENT DRILL MINIMUM 5.5m INTO SAND (>150kPa).

WHERE CAVITIES ARE CREATED AROUND THE PILE(S) DURING THE DRILLING PROCESS THESE ARE TO BE GROUT FILLED TO THE SATISFACTION OF THE SUPERINTENDENT.

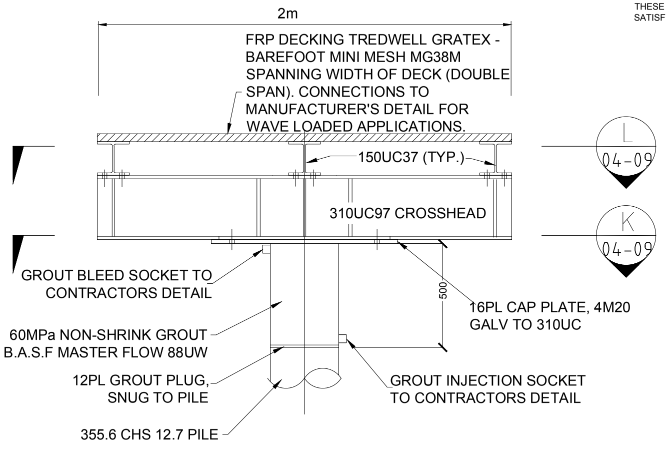


CONCRETE ABUTMENT - PART PLAN



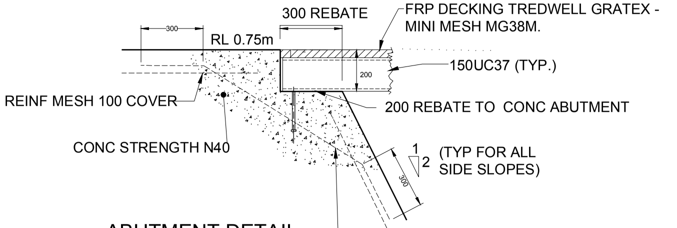
LADDER DETAIL
SCALE: 1:25

NOTE:
ALL COMPONENTS TO BE 316 STAINLESS STEEL UNLESS OTHERWISE NOTED



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

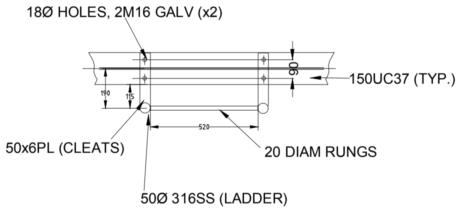
DETAIL 5
SCALE: 1:25 04-09



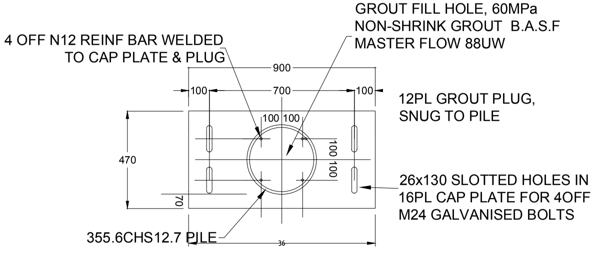
ABUTMENT DETAIL
SCALE: 1:25

N12-200, COG AS REQUIRED, 300 MIN LAP, 70 COVER AT REBATE

ALL REINFORCEMENT HD GALVANISED
REINFORCING MESH: SL102, 100 EDGE COVER



SECTION L
SCALE: 1:25 04-09



SECTION K
SCALE: 1:25 04-09

NOT FOR CONSTRUCTION

3	04/10/2021	REVISED ISSUED FOR TENDER	HD	SB
2	04/05/2021	ISSUED FOR TENDER	DF	SB
1	01/09/2020	REV 1	HD	SB
0	16/03/2018	FINAL	OS	SB
A	30/01/2018	PRELIMINARY	OS	SB
REVN	DATE	AMENDMENT	DRN	DESIGN APPROVAL

ORIG SIZE A3
ARCHIVE /Volumes/Seashore/2 Seashore Projects/SE064 Fishery Beach Marina - Boat Ramps and Jetty Refurbishment Designs/3. Design/Drawings/3. Work in Progress
PROJECT No SE064-04

NOTES

SCALE 1 : 50
0.5 0 2
METERS
UNLESS OTHERWISE STATED

DATUM
VERTICAL AUSTRALIAN HEIGHT DATUM 1971 (AHD71) WHICH IS 0.884m ABOVE CHART DATUM (CD) AND 4.683m BELOW TIDAL BENCHMARK DMH093
HORIZONTAL N/A

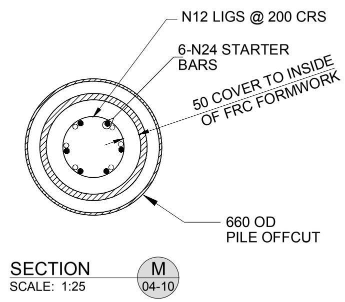
ACTION	NAME	SIGNATURE	DATE
ENGINEER	SB/TM		04/10/2021
DRAWN	HD/DF		04/10/2021
ENGINEERING CHECK	MJE		04/10/2021
DRAFTING CHECK	SB/DF		04/10/2021
APPROVED PROJECT MGR			

Civil/Structural Consulting Pty Ltd
Seashore Engineering

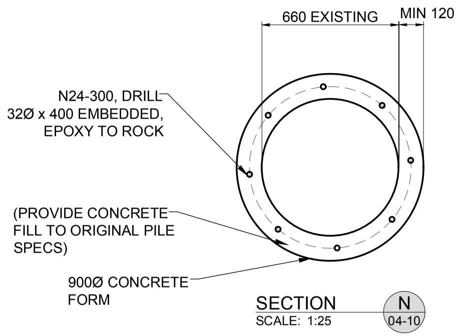
SHIRE OF JERRAMUNGUP
FISHERY BEACH MARINA - BOAT RAMPS AND JETTY CONSTRUCTION
JETTY DETAILS SHEET 3 OF 3

DRAWING NUMBER SE064-04-09
REVN 3

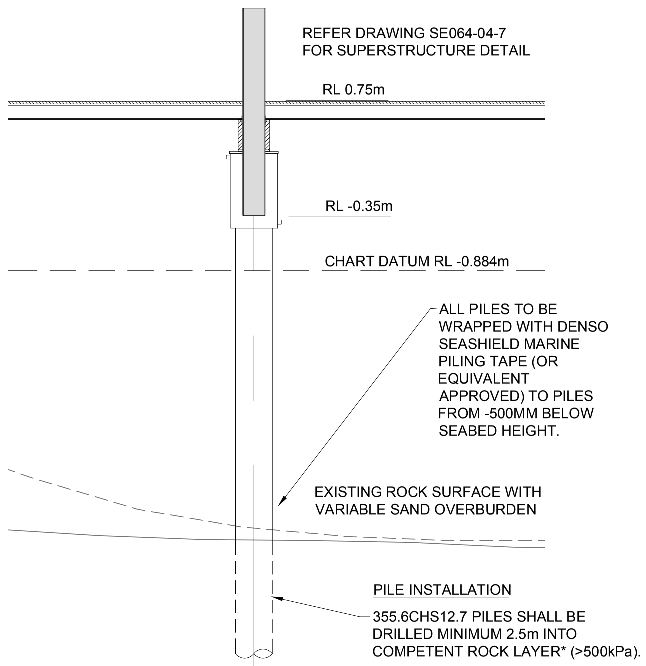
NOT FOR CONSTRUCTION



SECTION M 04-10
SCALE: 1:25



SECTION N 04-10
SCALE: 1:25



ALL PILES TO BE WRAPPED WITH DENSO SEASHIELD MARINE PILING TAPE (OR EQUIVALENT APPROVED) TO PILES FROM -500MM BELOW SEABED HEIGHT.

PILE INSTALLATION

355.6CHS12.7 PILES SHALL BE DRILLED MINIMUM 2.5m INTO COMPETENT ROCK LAYER* (>500kPa).

WHERE ROCK IS NOT PRESENT DRILL MINIMUM 5.5m INTO SAND (>150kPa).

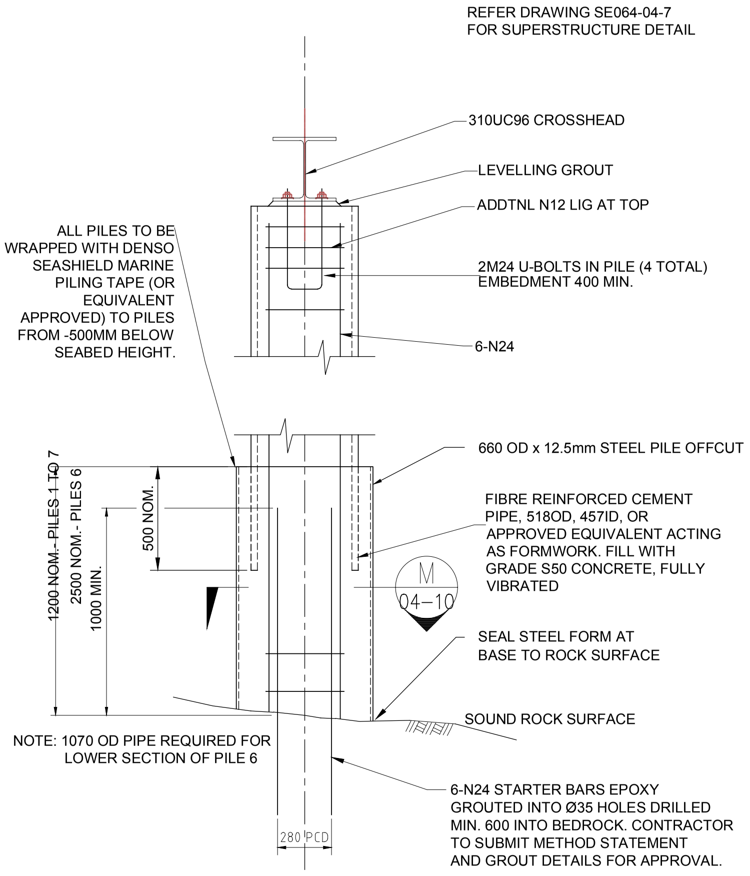
WHERE CAVITIES ARE CREATED AROUND THE PILE(S) DURING THE DRILLING PROCESS THESE ARE TO BE GROUT FILLED TO THE SATISFACTION OF THE SUPERINTENDENT.

*DETERMINATION OF ROCK COMPETENCE WILL REQUIRE STEADY, MODERATE-STRONG RESISTANCE THROUGHOUT THE DRIVING PROCESS AND NO EVIDENCE OF SUBSTANTIAL ROCK FRACTURE.

CRITERIA INDICATING ACCEPTABLE STRENGTH OF FOUNDING MATERIAL WILL IN PART BE DEPENDENT ON THE CONTRACTORS PILING METHODOLOGY AND WILL BE DOCUMENTED IN THE ACCEPTED PILING ITP PRIOR TO COMMENCEMENT.

OPTION 1 - STEEL

SCALE 1 : 50



ALL PILES TO BE WRAPPED WITH DENSO SEASHIELD MARINE PILING TAPE (OR EQUIVALENT APPROVED) TO PILES FROM -500MM BELOW SEABED HEIGHT.

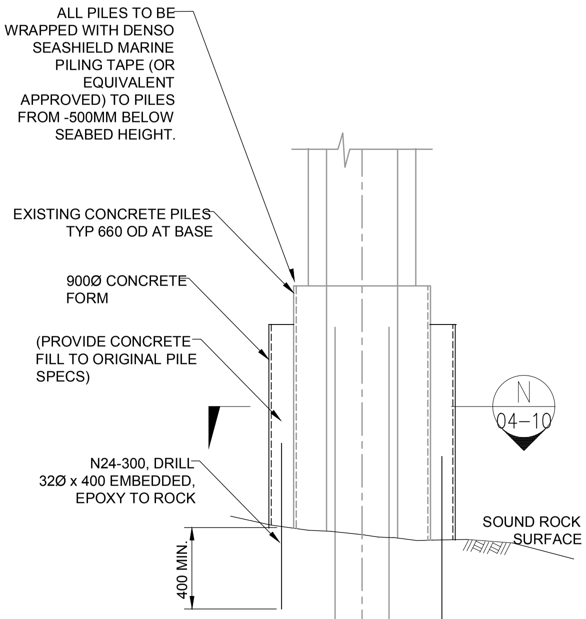
FIBRE REINFORCED CEMENT PIPE, 518OD, 457ID, OR APPROVED EQUIVALENT ACTING AS FORMWORK. FILL WITH GRADE S50 CONCRETE, FULLY VIBRATED

NOTE: 1070 OD PIPE REQUIRED FOR LOWER SECTION OF PILE 6

6-N24 STARTER BARS EPOXY GROUTED INTO Ø35 HOLES DRILLED MIN. 600 INTO BEDROCK. CONTRACTOR TO SUBMIT METHOD STATEMENT AND GROUT DETAILS FOR APPROVAL.

OPTION 2 - CONCRETE

SCALE 1 : 25



ALL PILES TO BE WRAPPED WITH DENSO SEASHIELD MARINE PILING TAPE (OR EQUIVALENT APPROVED) TO PILES FROM -500MM BELOW SEABED HEIGHT.

NOTE: EXISTING PILE 7 (END PILE) OD ~800 (APPROX). PILE 7 IS TO BE INSPECTED AND REFURBISHED USING LARGER OUTER CONCRETE FORM.

OPTION 3 - REFURBISH EXISTING CONCRETE

SCALE 1 : 25

2	04/10/2021	REVISED ISSUED FOR TENDER	HD	SB
1	04/05/2021	ISSUED FOR TENDER	DF	SB
REVN	DATE	AMENDMENT	DRN	DESIGN APPROVAL

ORIG SIZE A3

ARCHIVE /Volumes/Seashore/2 Seashore Projects/SE064 Fishery Beach Marina - Boat Ramps and Jetty Refurbishment Designs/3. Design/Drawings/3. Work in Progress

PROJECT No SE064-04

NOTES

SCALE 1 : 50
0.5 0 2
METERS

UNLESS OTHERWISE STATED

DATUM

VERTICAL AUSTRALIAN HEIGHT DATUM 1971 (AHD71) WHICH IS 0.884m ABOVE CHART DATUM (CD) AND 4.683m BELOW TIDAL BENCHMARK DMH093

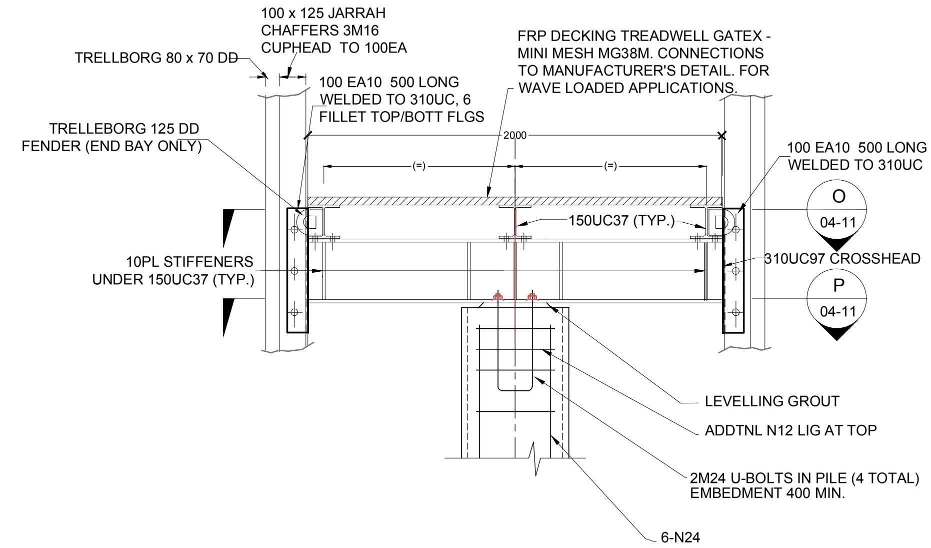
HORIZONTAL N/A

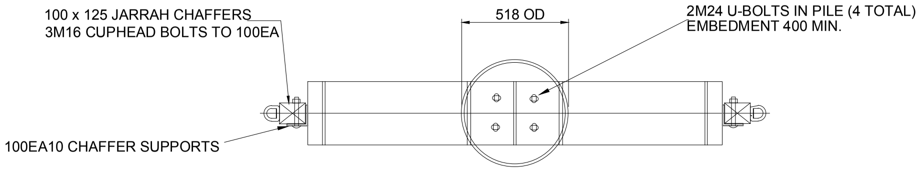
ACTION	NAME	SIGNATURE	DATE
ENGINEER	SB/TM		04/10/2021
DRAWN	HD/DF		04/10/2021
ENGINEERING CHECK	MJE		04/10/2021
DRAFTING CHECK	SB/DF		04/10/2021
APPROVED PROJECT MGR			

Civil/Structural Consulting Pty Ltd
Seashore Engineering

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

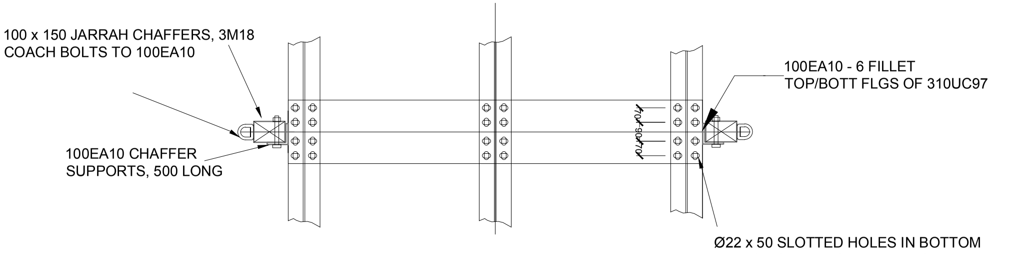
DRAWING NUMBER SE064-04-10
REVN 2





SECTION P 04-11 -
SCALE: 1:25

NOT FOR CONSTRUCTION



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

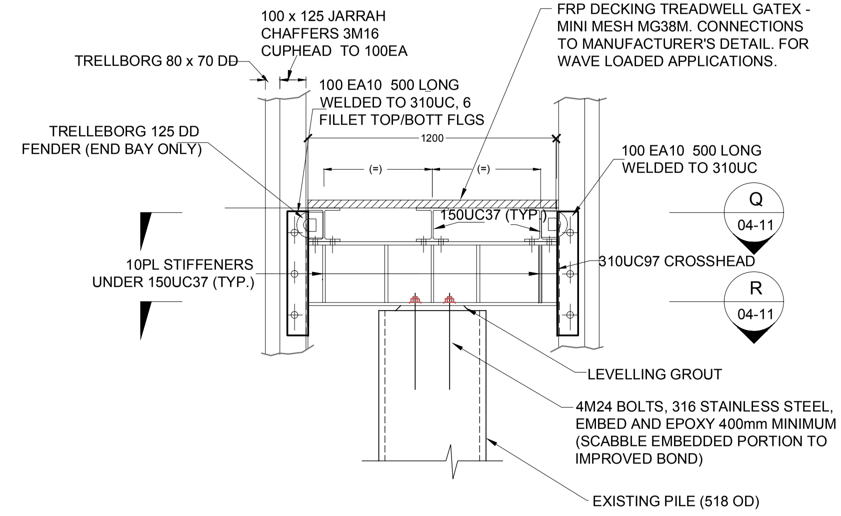
SECTION O 04-11
SCALE: 1:25

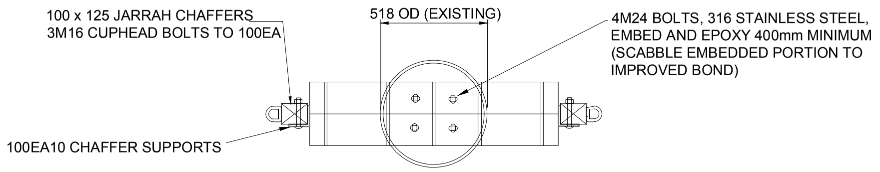
OPTION 2 - NEW CONCRETE PILES, 2m DECK WIDTH
100EA10.0/JARRAH CHAFFERS + TRELLEBORG 80x70 DD

DESIGN VESSEL:
8.0m LONG
0.9m DRAFT

DESIGN MAX WATER LEVEL:
1.0mAHD

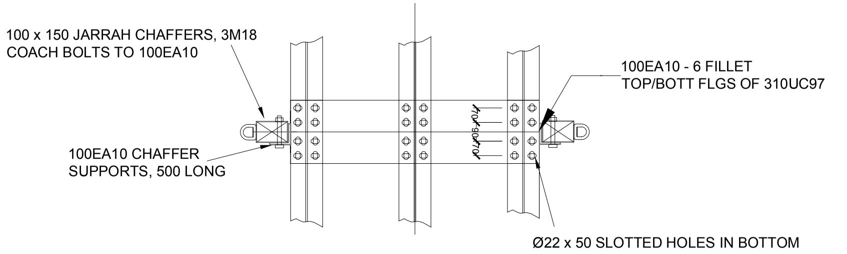
DESIGN LIFE:
25 YRS





SECTION R 04-11 -
SCALE: 1:25

NOT FOR CONSTRUCTION



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

SECTION Q 04-11
SCALE: 1:25

OPTION 3 - REFURBISHED CONCRETE PILES, 1.2m DECK WIDTH
100EA10.0/JARRAH CHAFFERS + TRELLEBORG 80x70 DD

2	04/10/2021	REVISED ISSUED FOR TENDER	HD	SB
1	04/05/2021	ISSUED FOR TENDER	DF	SB
0	16/03/2018	FINAL	OS	SB
A	05/02/2018	PRELIMINARY	OS	SB
REVN	DATE	AMENDMENT	DRN	DESIGN APPROVAL

ORIG SIZE A3
ARCHIVE /Volumes/Seashore/2 Seashore Projects/SE064 Fishery Beach Marina - Boat Ramps and Jetty Refurbishment Designs/3. Design/Drawings/3. Work in Progress
PROJECT No SE064-04

NOTES

SCALE 1 : 50
0.5 0 2
METERS

UNLESS OTHERWISE STATED

DATUM
VERTICAL AUSTRALIAN HEIGHT DATUM 1971 (AHD71) WHICH IS 0.884m ABOVE CHART DATUM (CD) AND 4.683m BELOW TIDAL BENCHMARK DMH093
HORIZONTAL N/A

ACTION	NAME	SIGNATURE	DATE
ENGINEER	SB/TM		04/10/2021
DRAWN	HD/TM		04/10/2021
ENGINEERING CHECK	MJE		04/10/2021
DRAFTING CHECK	SB/DF		04/10/2021
APPROVED PROJECT MGR			

Civil/Structural Consulting Pty Ltd
Seashore Engineering

SHIRE OF JERRAMUNGUP
FISHERY BEACH MARINA - BOAT RAMPS AND JETTY CONSTRUCTION
CROSS SECTION AND CHAFFER OPTIONS

DRAWING NUMBER SE064-04-11
REVN 2

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

Baot ramps looking towards harbour - Dec 2020

Boat ramps and jetty - Dec 2020

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

OCTOBER

	Time	m		Time	m		Time	m		Time	m
1 FR *	0745 1600 2356	0.91 0.35 0.78	9 SA	0711 1310 1547	0.41 0.58 0.55	17 SU	0331 0936 1618 2228	0.62 0.91 0.40 0.80	25 MO	0750 1109 1531 2351	0.47 0.52 0.45 1.06
2 SA	0233 0830 1608 2303	0.76 0.97 0.33 0.75	10 SU	0001 1200	1.05 0.43	18 MO	0352 1005 1615 2229	0.55 0.88 0.45 0.85	26 TU	0851 1006 1520	0.51 0.51 0.43
3 SU	0254 0907 1621 2243	0.67 1.02 0.32 0.77	11 MO	0010 1405	1.06 0.32	19 TU	0419 1028 1617 2228	0.49 0.84 0.48 0.91	27 WE	0011 1508	1.02 0.41
4 MO	0324 0944 1636 2244	0.59 1.05 0.34 0.80	12 TU	0014 1446	1.03 0.25	20 WE ○	0448 1043 1611 2231	0.45 0.78 0.51 0.97	28 TH	0029 1500	0.97 0.39
5 TU	0400 1021 1651 2254	0.51 1.03 0.38 0.86	13 WE ◑	0025 1519	0.98 0.22	21 TH	0519 1100 1600 2244	0.43 0.73 0.51 1.02	29 FR ◐	0041 1458	0.91 0.37
6 WE ●	0440 1100 1705 2308	0.44 0.97 0.43 0.92	14 TH *	0025 1545 2358	0.91 0.23 0.83	22 FR	0553 1116 1553 2257	0.42 0.67 0.51 1.06	30 SA *	0007 1503 2245	0.84 0.36 0.79
7 TH	0525 1140 1713 2325	0.40 0.87 0.50 0.98	15 FR	0326 0816 1603 2313	0.79 0.91 0.28 0.78	23 SA	0628 1126 1535 2312	0.42 0.61 0.49 1.08	31 SU	0236 0754 1514 2159	0.74 0.87 0.36 0.80
8 FR	0615 1221 1704 2344	0.39 0.73 0.55 1.03	16 SA	0323 0900 1615 2246	0.70 0.92 0.34 0.77	24 SU	0706 1115 1533 2330	0.44 0.56 0.47 1.08			

NOVEMBER

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

DECEMBER

	Time	m		Time	m		Time	m		Time	m
1 WE	0354 0933 1435 2114	0.48 0.73 0.50 1.04	9 TH	0009 1318 2359	1.02 0.29 0.93	17 FR	0538 1140 1320 2135	0.37 0.56 0.55 1.14	25 SA	0046 0939	0.99 0.43
2 TH	0439 1035 1448 2135	0.36 0.69 0.54 1.13	10 FR	1405 2335	0.36 0.85	18 SA	0552 1203 1330 2200	0.33 0.54 0.54 1.17	26 SU	0104 1026	0.91 0.46
3 FR	0529 1139 1453 2203	0.26 0.63 0.57 1.21	11 SA ◑	1429 2233	0.44 0.81	19 SU ○	0616 1229 1351 2226	0.30 0.53 0.52 1.18	27 MO ◐	0100 1124 2031	0.81 0.50 0.79
4 SA ●	0625 2234	0.19 1.25	12 SU	0641 0736 1430 2135	0.62 0.63 0.52 0.82	20 MO	0646 1255 1410 2254	0.30 0.51 0.50 1.17	28 TU	1211 2010	0.54 0.88
5 SU	0730 2307	0.16 1.24	13 MO	0611 1002 1344 2059	0.57 0.61 0.56 0.88	21 TU	0717 1321 1422 2323	0.31 0.49 0.48 1.15	29 WE	0430 0916 1242 2020	0.53 0.60 0.57 0.99
6 MO	0845 2341	0.17 1.19	14 TU	0557 1051 1317 2055	0.52 0.59 0.58 0.95	22 WE	0749 2353	0.33 1.11	30 TH	0445 1112 1308 2045	0.39 0.61 0.60 1.10
7 TU	1030	0.21	15 WE	0538 1119 1309 2100	0.47 0.58 0.57 1.03	23 TH	0823	0.36	31 FR	0520 1245 1317 2118	0.26 0.61 0.61 1.19
8 WE	0009 1209	1.11 0.24	16 TH	0534 1123 1321 2114	0.42 0.57 0.56 1.09	24 FR	0021 0859	1.05 0.39			

Datum of Predictions is Lowest Astronomical Tide

*** Extra Tides**

Moon Phase Symbols ● **New Moon** ◑ **First Quarter** ○ **Full Moon** ◐ **Last Quarter**

ALBANY – WESTERN AUSTRALIA

LAT 35° 2' S LONG 117° 54' E

Times and Heights of High and Low Waters

2022

Local Time

JANUARY

	Time	m
1 SA	0602	0.15
	2156	1.25
2 SU	0647	0.10
	2235	1.27
3 MO ●	0735	0.10
	2315	1.24
4 TU	0824	0.14
	2351	1.18
5 WE	0915	0.23
6 TH	0020	1.08
	1010	0.33
7 FR	0030	0.97
	1212	0.43
	2356	0.88
8 SA	1320	0.52
	2340	0.82
9 SU	0737	0.54
	2244	0.79
10 MO ◑	0647	0.49
	2100	0.82
11 TU	0638	0.45
	2020	0.88
12 WE	0632	0.41
	2022	0.95
13 TH	0618	0.39
	2036	1.02
14 FR	0600	0.35
	2100	1.08
15 SA	0559	0.32
	2128	1.13
16 SU	0606	0.28
	2158	1.16
17 MO	0619	0.26
	2229	1.17
18 TU ○	0640	0.26
	2301	1.17
19 WE	0702	0.28
	1303	0.54
	1521	0.52
	2331	1.15
20 TH	0724	0.30
	1315	0.55
	1550	0.52
21 FR	0000	1.10
	0746	0.34
	1333	0.57
	1615	0.53
22 SA	0026	1.03
	0806	0.38
	1358	0.60
	1642	0.57
23 SU	0045	0.95
	0823	0.43
	1434	0.64
	1709	0.62
24 MO	0045	0.85
	0825	0.48
	2356	0.74
25 TU ◐	0801	0.51
	1857	0.79
26 WE	0623	0.49
	1916	0.90
27 TH	0508	0.39
	1953	1.01
28 FR	0512	0.27
	2036	1.11
29 SA	0534	0.17
	2119	1.19
30 SU	0603	0.10
	2204	1.24
31 MO	0637	0.09
	2246	1.24

FEBRUARY

	Time	m
1 TU ●	0710	0.13
	1423	0.57
	1512	0.57
	2323	1.20
2 WE	0740	0.21
	1413	0.55
	1549	0.54
	2353	1.12
3 TH	0757	0.32
	1357	0.55
	1618	0.54
4 FR	0010	1.01
	0748	0.41
	1400	0.59
	1642	0.56
5 SA	0010	0.91
	0743	0.48
	2337	0.83
6 SU	0651	0.50
	1314	0.72
	1727	0.65
	2322	0.78
7 MO	0620	0.46
	1323	0.79
	1753	0.72
	2244	0.76
8 TU ◑	0602	0.42
	1400	0.83
9 WE	0605	0.39
	1925	0.85
10 TH	0601	0.37
	1951	0.92
11 FR	0550	0.35
	2022	0.99
12 SA	0540	0.33
	2054	1.05
13 SU	0541	0.30
	2127	1.10
14 MO	0546	0.28
	2159	1.14
15 TU	0556	0.27
	1222	0.64
	1517	0.60
	2230	1.16
16 WE	0611	0.28
	1219	0.64
	1552	0.56
	2300	1.15
17 TH ○	0628	0.30
	1224	0.66
	1627	0.53
	2329	1.12
18 FR	0644	0.34
	1234	0.69
	1702	0.53
	2357	1.05
19 SA	0659	0.38
	1248	0.74
	1741	0.54
20 SU	0021	0.96
	0709	0.44
	1305	0.79
	1825	0.57
21 MO	0034	0.85
	0702	0.48
	1325	0.84
	1926	0.62
22 TU	0002	0.73
	0639	0.51
	1349	0.89
23 WE	0536	0.47
	1421	0.92
24 TH ◐	0446	0.39
	1533	0.94
25 FR	0444	0.29
	1944	1.01
26 SA	0458	0.21
	2040	1.10
27 SU	0517	0.16
	2128	1.16
28 MO	0541	0.16
	1247	0.71
	1512	0.68
	2211	1.19

MARCH

	Time	m
1 TU	0605	0.19
	1235	0.69
	1554	0.62
	2249	1.17
2 WE	0626	0.27
	1227	0.69
	1629	0.57
	2320	1.11
3 TH ●	0633	0.36
	1234	0.71
	1701	0.55
	2339	1.02
4 FR	0633	0.44
	1235	0.75
	1731	0.55
	2349	0.92
5 SA	0632	0.50
	1224	0.81
	1800	0.57
	2341	0.83
6 SU	0556	0.52
	1226	0.88
	1830	0.60
	2313	0.76
7 MO	0530	0.50
	1231	0.94
	1909	0.65
	2301	0.73
8 TU	0509	0.46
	1243	0.98
	2024	0.70
	2230	0.71
9 WE	0512	0.42
	1306	0.99
10 TH ◑	0514	0.40
	1332	0.97
11 FR	0509	0.39
	1401	0.94
12 SA	0501	0.38
	2002	0.96
13 SU	0458	0.36
	2043	1.03
14 MO	0500	0.35
	2117	1.08
15 TU	0503	0.34
	1151	0.76
	1521	0.69
	2150	1.12
16 WE	0513	0.35
	1134	0.77
	1550	0.63
	2221	1.13
17 TH	0527	0.37
	1134	0.80
	1623	0.57
	2251	1.11
18 FR ○	0540	0.40
	1141	0.85
	1659	0.53
	2322	1.05
19 SA	0552	0.45
	1153	0.91
	1740	0.52
	2353	0.96
20 SU	0558	0.50
	1207	0.97
	1826	0.52
21 MO	0020	0.84
	0553	0.55
	1225	1.02
	1921	0.55
22 TU	0033	0.70
	0523	0.56
	1243	1.06
23 WE	0423	0.51
	1257	1.08
24 TH	0336	0.42
	1309	1.08
25 FR ◐	0346	0.33
	1328	1.04
26 SA	0406	0.28
	1348	0.97
	1519	0.96
	1944	1.02
27 SU	0426	0.26
	2041	1.08
28 MO	0445	0.27
	1202	0.83
	1513	0.78
	2127	1.11
29 TU	0503	0.32
	1139	0.82
	1543	0.69
	2206	1.11
30 WE	0515	0.38
	1124	0.84
	1615	0.62
	2239	1.07
31 TH	0519	0.46
	1129	0.88
	1647	0.58
	2305	1.00

APRIL

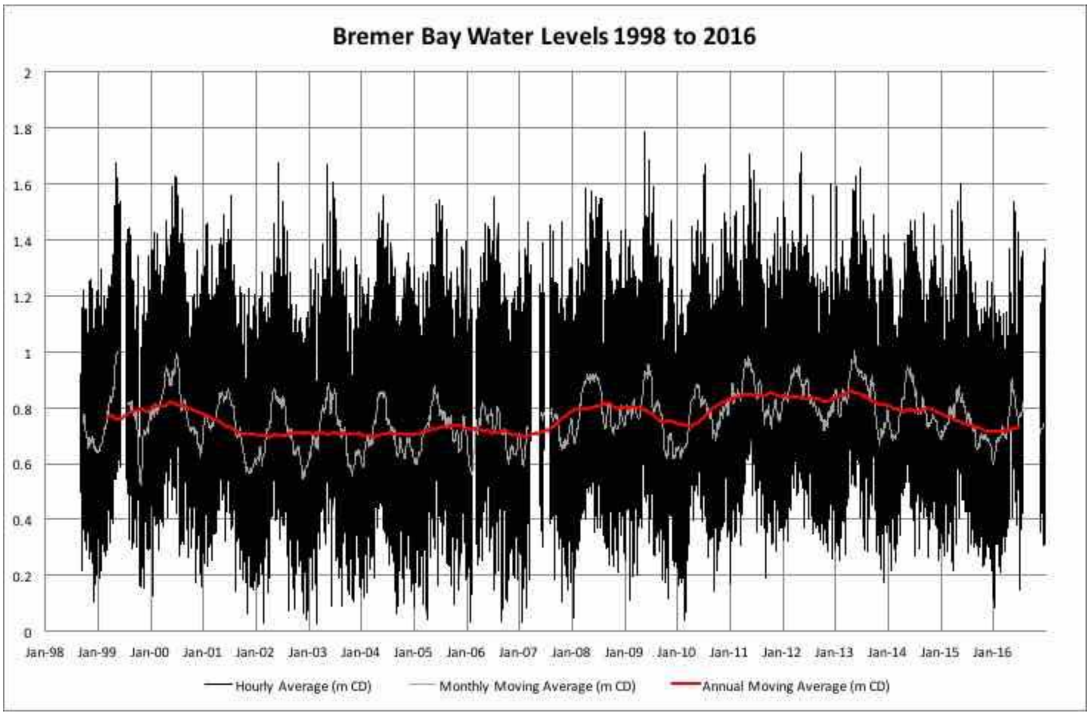
	Time	m
1 FR ●	0520	0.53
	1131	0.93
	1720	0.56
	2320	0.91
2 SA	0517	0.57
	1129	1.00
	1753	0.55
	2327	0.83
3 SU	0449	0.59
	1136	1.06
	1828	0.57
	2320	0.75
4 MO	0430	0.57
	1145	1.11
	1905	0.59
	2256	0.70
5 TU	0408	0.54
	1155	1.14
	1947	0.62
	2249	0.68
6 WE	0411	0.51
	1212	1.14
	2042	0.66
	2213	0.67
7 TH	0415	0.49
	1233	1.12
8 FR	0413	0.48
	1254	1.09
9 SA ◑	0408	0.47
	1311	1.03
10 SU	0404	0.46
	1316	0.97
	1645	0.95
	1907	0.96
11 MO	0402	0.45
	2011	1.01
12 TU	0401	0.45
	1127	0.88
	1505	0.82
	2053	1.06
13 WE	0408	0.45
	1047	0.89
	1528	0.74
	2129	1.08
14 TH	0418	0.47
	1037	0.93
	1559	0.65
	2205	1.07
15 FR	0430	0.50
	1042	1.00
	1636	0.58
	2242	1.03
16 SA	0439	0.55
	1054	1.07
	1717	0.52
	2322	0.95
17 SU ○	0446	0.60
	1110	1.14
	1804	0.49
18 MO	0004	0.84
	0444	0.64
	1131	1.20
	1856	0.49
19 TU	0051	0.71
	0402	0.65
	1153	1.24
	2004	0.51
20 WE	1213	1.24
21 TH	0111	0.46
	1227	1.22
22 FR	0217	0.39
	1237	1.16
23 SA ◐	0255	0.35
	1250	1.09
24 SU	0324	0.36
	1228	1.00
	1602	0.97
	1932	1.02
25 MO	0346	0.40
	1135	0.93
	1524	0.88
	2034	1.03
26 TU	0401	0.46
	1054	0.92
	1538	0.79
	2119	1.02
27 WE	0408	0.53
	1028	0.95
	1559	0.71
	2157	0.99
28 TH	0405	0.59
	1026	1.01
	1626	0.65
	2228	0.94
29 FR	0403	0.64
	1029	1.07
	1656	0.61
	2252	0.87
30 SA	0354	0.66
	1030	1.14
	1727	0.58
	2308	0.81

Datum of Predictions is Lowest Astronomical Tide

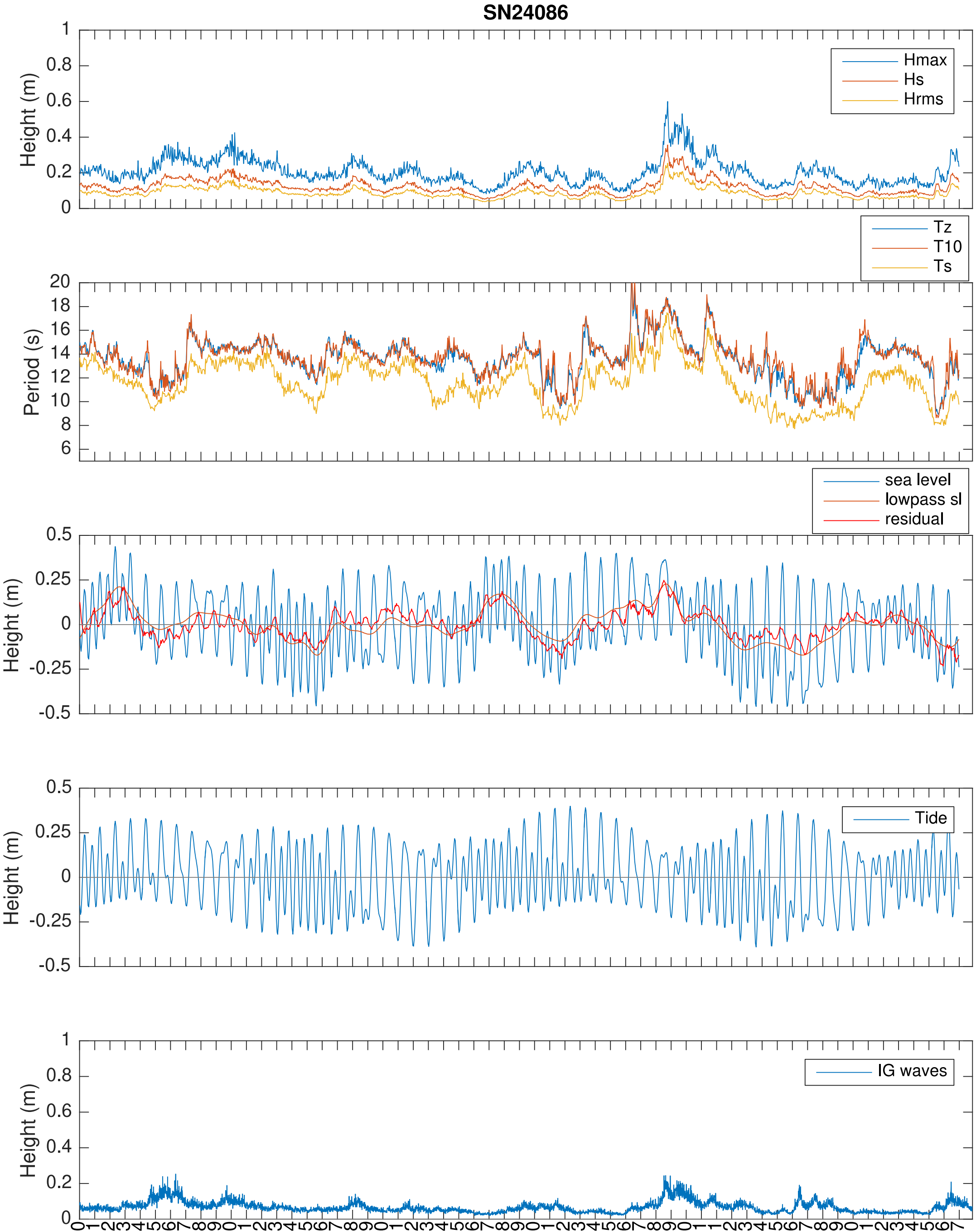
Times are in local standard time (Time Zone UTC +08:00)

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

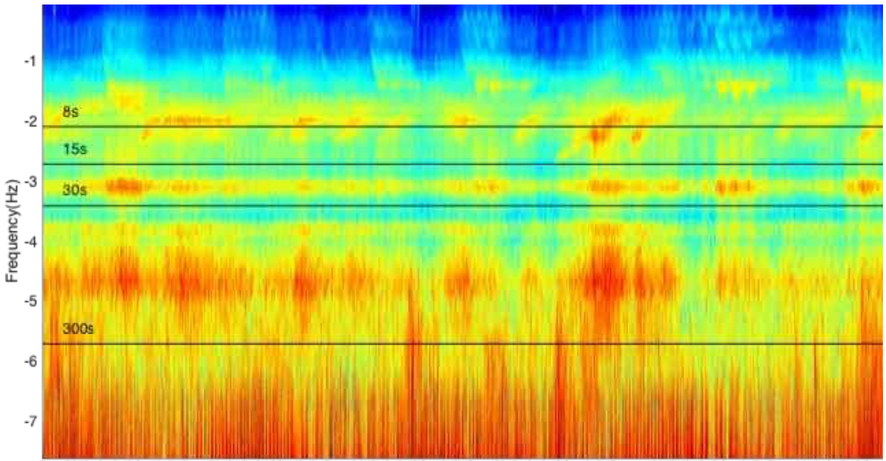
Attachment E Metocean Analysis

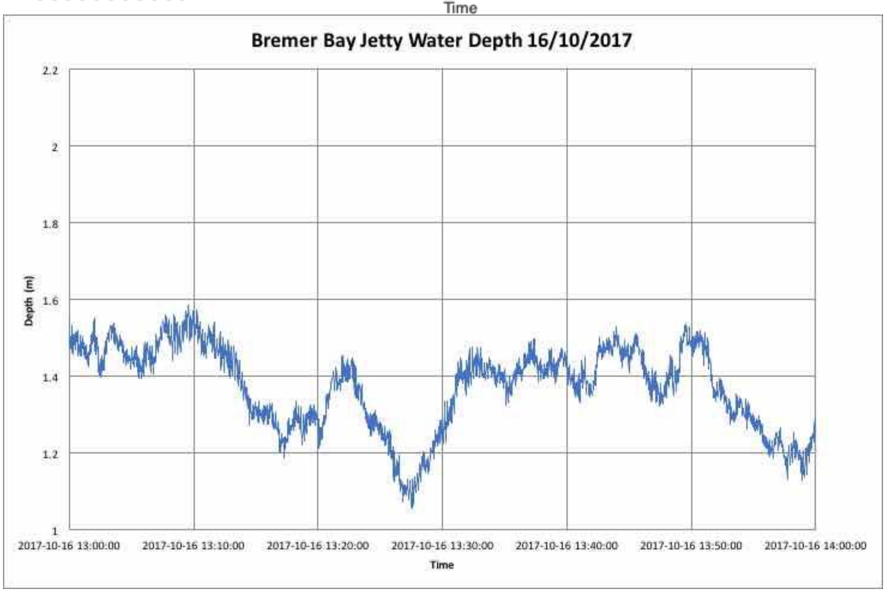


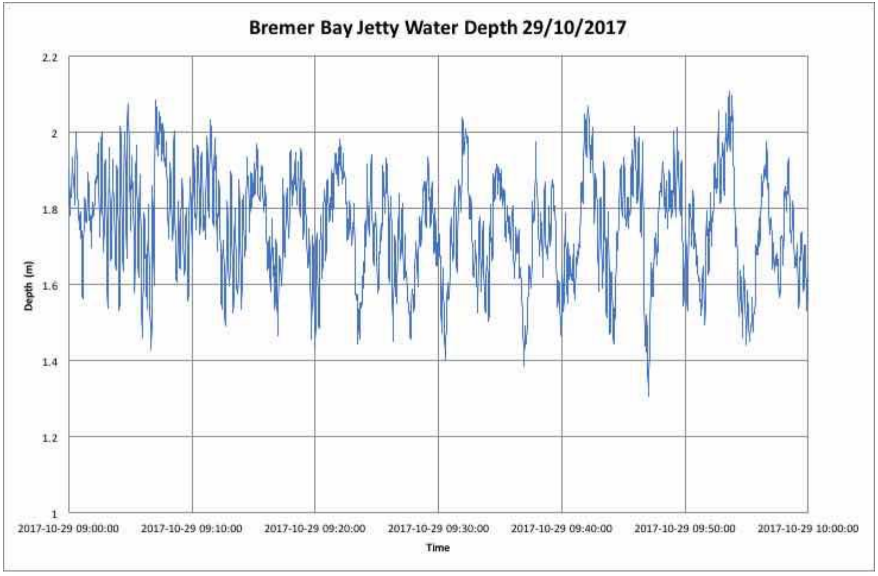
Water Levels from Tide Gauge



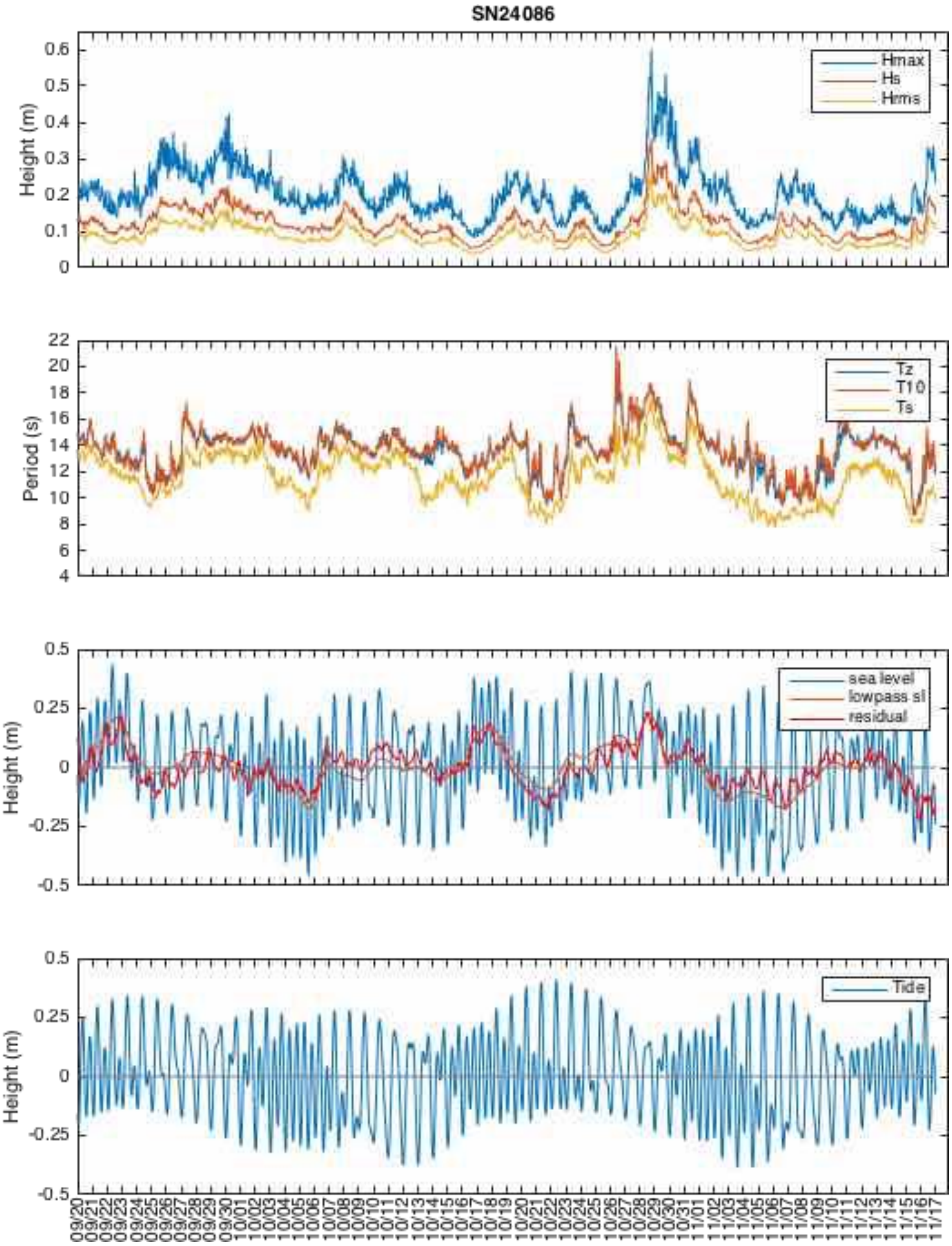
Wave Heights at Jetty




Bremer Bay Jetty Water Depth 16/10/2017


Bremer Bay Jetty Water Depth 29/10/2017

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
1 WE	0800 1711	0.90 0.40
2 TH	0837 1659	0.98 0.36
3 FR *	0909 1701 2322	1.05 0.32 0.67
4 SA	0249 0940 1707 2305	0.61 1.12 0.30 0.68
5 SU	0324 1010 1718 2307	0.53 1.17 0.28 0.71
6 MO	0357 1040 1735 2318	0.46 1.19 0.28 0.75
7 TU ●	0431 1110 1755 2334	0.41 1.16 0.30 0.79
8 WE	0508 1139 1814 2352	0.38 1.09 0.34 0.84
9 TH	0549 1204 1830	0.38 0.98 0.40
10 FR	0014 0634 1225 1830	0.89 0.42 0.85 0.45
11 SA	0038 0725 1230 1757	0.93 0.48 0.70 0.46
12 SU	0104 0827 1058 1717	0.95 0.57 0.62 0.42
13 MO	0129 1636	0.95 0.34
14 TU ◑	0144 1641	0.91 0.27
15 WE	0155 0249 0741 1641	0.85 0.85 0.91 0.23
16 TH	0836 1645 2354	0.99 0.22 0.69
17 FR	0211 0918 1700 2326	0.66 1.05 0.23 0.67
18 SA	0301 0954 1715 2304	0.56 1.08 0.26 0.69
19 SU	0339 1024 1717 2309	0.48 1.07 0.30 0.73
20 MO	0413 1043 1720 2306	0.42 1.04 0.34 0.77
21 TU ○	0445 1054 1730 2307	0.38 0.99 0.37 0.84
22 WE	0513 1109 1733 2322	0.37 0.93 0.40 0.90
23 TH	0539 1127 1717 2341	0.38 0.86 0.41 0.95
24 FR	0606 1135 1714 2357	0.41 0.79 0.40 0.98
25 SA	0637 1130 1714	0.45 0.73 0.39
26 SU	0011 0713 1133 1711	0.99 0.50 0.68 0.38
27 MO	0030 0756 1122 1710	0.98 0.56 0.64 0.38
28 TU	0054 0900 1029 1705	0.95 0.62 0.63 0.37
29 WE ◐	0117 1647	0.90 0.37
30 TH	0142 0606 0716 1622	0.83 0.80 0.80 0.35

OCTOBER

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

NOVEMBER

	Time	m
1 MO	0249 0851 1526 2139	0.55 0.90 0.30 0.83
2 TU	0326 0931 1541 2151	0.44 0.91 0.31 0.92
3 WE	0405 1011 1557 2209	0.34 0.88 0.34 1.02
4 TH	0446 1050 1612 2230	0.26 0.80 0.37 1.10
5 FR ●	0530 1129 1615 2253	0.22 0.69 0.41 1.16
6 SA	0617 1201 1600 2320	0.22 0.55 0.42 1.18
7 SU	0709 1216 1542 2349	0.27 0.42 0.39 1.16
8 MO	0820 0905 1410	0.34 0.34 0.31
9 TU	0017 1435	1.09 0.24
10 WE	0029 1502	1.00 0.22
11 TH ◑	0015 1517	0.91 0.24
12 FR *	0027 1520 2245	0.81 0.29 0.75
13 SA	0326 0758 1529 2220	0.67 0.75 0.34 0.74
14 SU	0338 0844 1529 2131	0.59 0.74 0.39 0.80
15 MO	0347 0917 1507 2134	0.52 0.72 0.41 0.87
16 TU	0353 0943 1511 2139	0.45 0.70 0.41 0.95
17 WE	0415 0957 1517 2146	0.39 0.68 0.41 1.03
18 TH	0445 1012 1515 2203	0.34 0.65 0.41 1.09
19 FR ○	0515 1034 1521 2226	0.31 0.63 0.40 1.14
20 SA	0545 1100 1533 2248	0.29 0.59 0.39 1.15
21 SU	0617 1122 1544 2312	0.30 0.56 0.38 1.15
22 MO	0650 1138 1552 2335	0.32 0.52 0.38 1.12
23 TU	0726 1148 1600	0.36 0.50 0.38
24 WE	0000 0804 1156 1600	1.08 0.40 0.47 0.38
25 TH	0027 0856 1148 1552	1.02 0.44 0.45 0.39
26 FR	0056 1510	0.95 0.41
27 SA ◐	0129 1422	0.87 0.40
28 SU	0224 1358 2137	0.78 0.39 0.72
29 MO	0150 0700 1406 2052	0.67 0.74 0.39 0.80
30 TU	0248 0822 1423 2058	0.55 0.74 0.39 0.91

DECEMBER

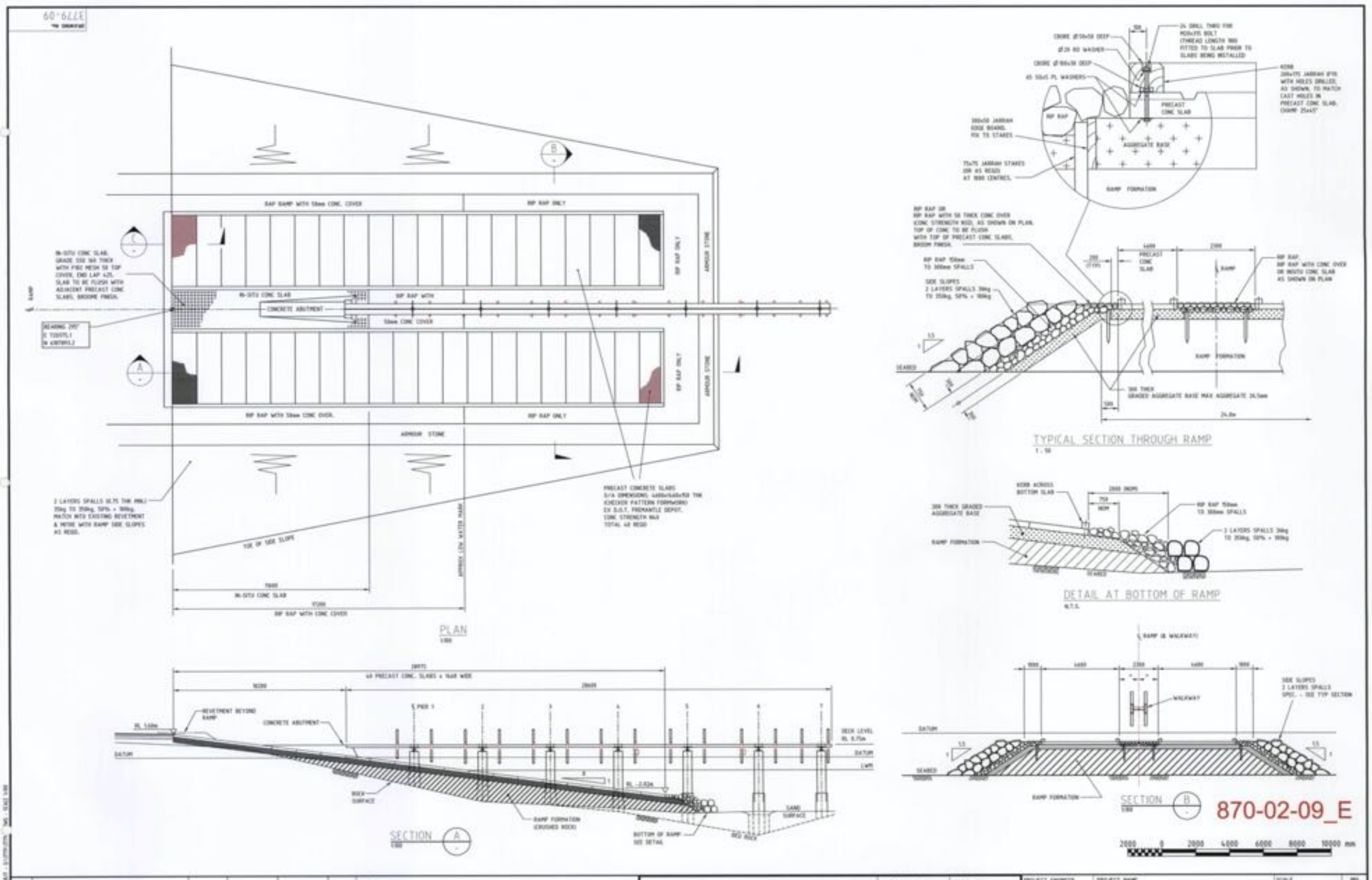
	Time	m
1 WE	0334 0921 1443 2117	0.42 0.73 0.40 1.02
2 TH	0419 1015 1502 2143	0.31 0.68 0.42 1.13
3 FR	0505 1108 1517 2210	0.22 0.61 0.43 1.21
4 SA ●	0555 1204 1516 2241	0.17 0.53 0.44 1.25
5 SU	0648 1311 1510 2314	0.17 0.44 0.42 1.24
6 MO	0800 2349	0.21 1.18
7 TU	1016	0.25
8 WE	0024 1350	1.10 0.28
9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

Datum of Predictions is Lowest Astronomical Tide

*** Extra Tides**

Moon Phase Symbols ● **New Moon** ◑ **First Quarter** ○ **Full Moon** ◐ **Last Quarter**

ATTACHMENT 4 AVAILABLE DRAWINGS OF EXISITNG STRUCTURES



870-02-09_E

REV	ISSUE DESCRIPTION	DRAWN BY	CHECKED DESIGNED	PROJ. ENG	DATE
E	SETOUT POINT AND WALKWAY PILES MODIFIED	P.EWING			
D	R.L.'S AMENDED	S. YATES			26/3/96
C	ISSUED FOR CONSTRUCTION	S. YATES	R. LAMONT-SMITH	C.R. HARRAP	22/3/96
B	ISSUED FOR TENDER	S. YATES	R. LAMONT-SMITH	C.R. HARRAP	15/2/96
A	FIRST ISSUE FOR APPROVAL	S. YATES	R. LAMONT-SMITH	C.R. HARRAP	9/2/96

CLIENT

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HGM PROJ. No.	CAD No.
CM3779	3779-09

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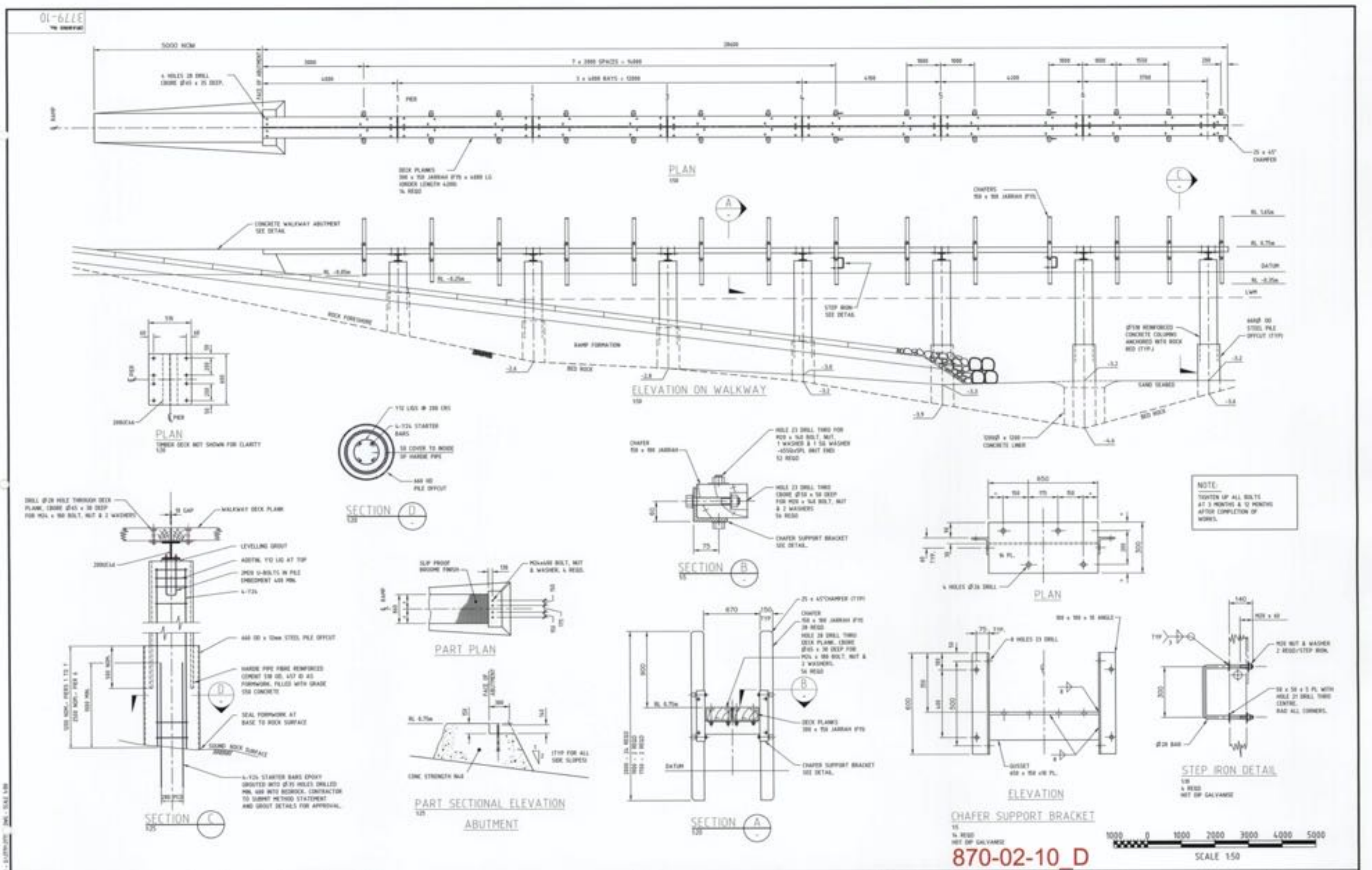
PROJECT ENGINEER: C.R. HARRAP
DESIGNED: DEPT. OF TRANSPT/ R.B. LAMONT-SMITH
DRAWN: P. EWING
DATE: 23-05-96
PROJECT NAME: BREMER BAY BOAT HARBOUR
DRAWING TITLE: LAUNCHING RAMPS GENERAL ARRANGEMENT
SCALE: 1:100, 1:50
DATUM: A.H.D
DRG SIZE: A1
DRAWING No.: 3779-09
REV.: E

3779-10



NOTE:
TIGHTEN UP ALL BOLTS AT 3 MONTHS & 12 MONTHS AFTER COMPLETION OF WORKS.

870-02-10_D

REV	ISSUE DESCRIPTION	DRAWN BY	CHECKED (SIGNED)	PROJ. ENG	DATE
D	WALKWAY PILES MODIFIED	P. EWING			
C	ISSUED FOR CONSTRUCTION	S. YATES	R. LAMONT-SMITH	C.R. HARRAP	22/3/96
B	ISSUED FOR TENDER	S. YATES	R. LAMONT-SMITH	C.R. HARRAP	15/2/96
A	FIRST ISSUE FOR APPROVAL	S. YATES	R. LAMONT-SMITH	C.R. HARRAP	9/2/96

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HGM PROJ. No.: CM3779
CAD No.: 3779-10

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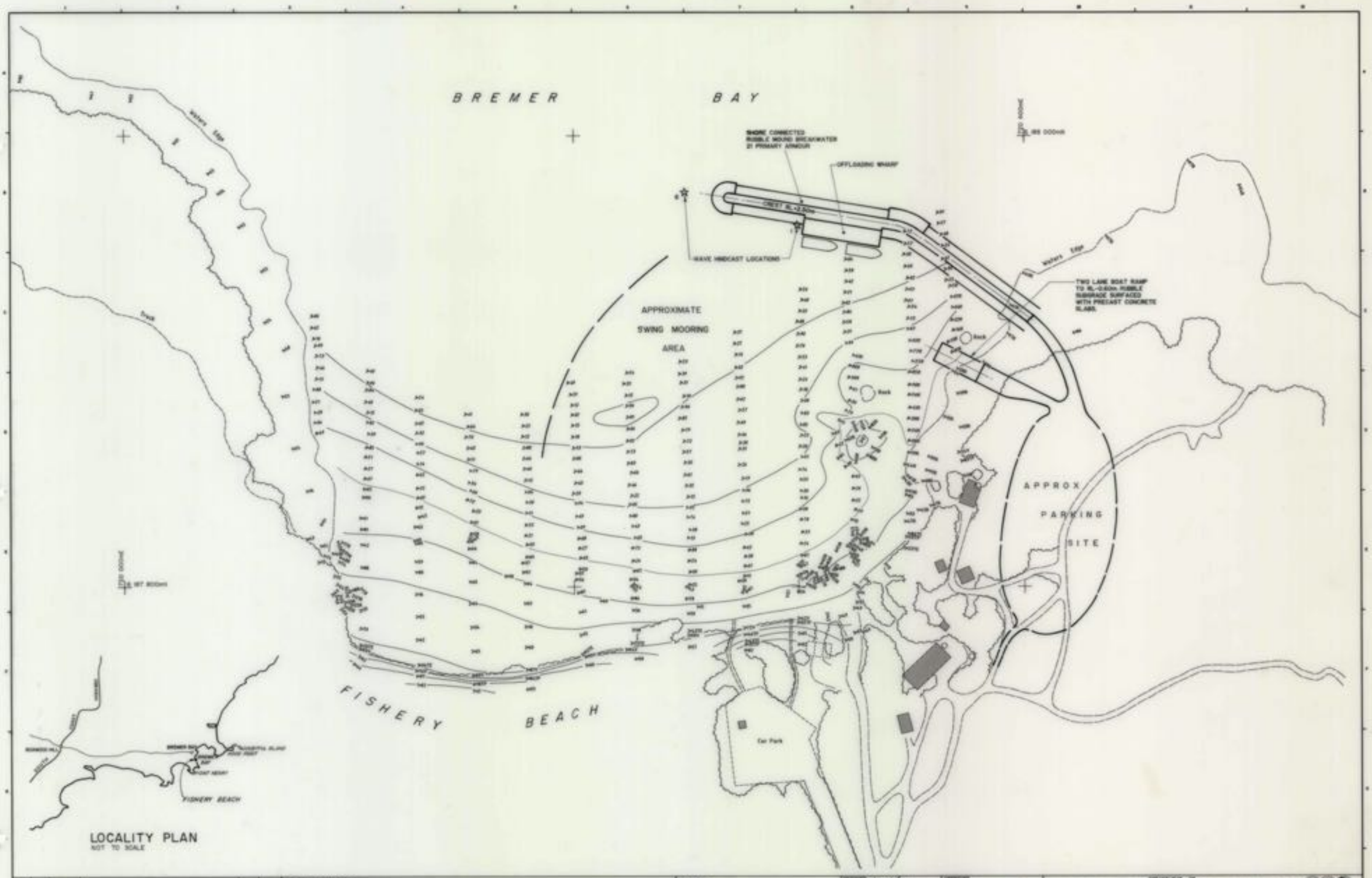
PROJECT ENGINEER: C.R. HARRAP
DESIGNED: DEPT. OF TRANSPT/ R. LAMONT-SMITH
DRAWN: P. EWING
23-01-96

PROJECT NAME: BREMER BAY BOAT HARBOUR
DRAWING TITLE: LAUNCHING RAMP WALKWAY

SCALE: AS SHOWN
DRG SIZE: A1
DATUM: A.H.D.
DRAWING No.: 3779-10
REV.: D

ATTACHMENT 5 GEOTECHNICAL DATA



GENERAL NOTES:
1. THIS DRG. DERIVED FROM DRG. NO. 460 - 03 - 01.
2. AUSTRALIAN MAP GRID BASED ON A.G.D. 1984.

SCALE:
1 : 750

UNLESS OTHERWISE STATED DIMENSIONS IN mm

DATUM:
3.387m BELOW BM DMH 08,24.633m BELOW DOLA BM BBY 20 AND 0.660m BELOW A.H.D.

DRG SIZE A1

DEPARTMENT OF
MARINE & HARBOURS - WESTERN AUSTRALIA

BREMER BAY - FISHERY BEACH
PROPOSED FISHING INDUSTRY FACILITY
PRELIMINARY LAYOUT

DRAWING NUMBER 617 - 1 - 1

TO SCHURA [illegible] prelim

FILE EG_418.DOC

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

LIST OF FIGURES

APPENDICES

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^{o} 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^{o}, 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^{o} 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^{o}) 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^{o} 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:

Borehole	***Mean $I_s(50)$***	***Strength Class***	***Estimated UCS***
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 25,000m^3 of rock will be required to construct the breakwater and ancillary works, of which some 7,000m^3 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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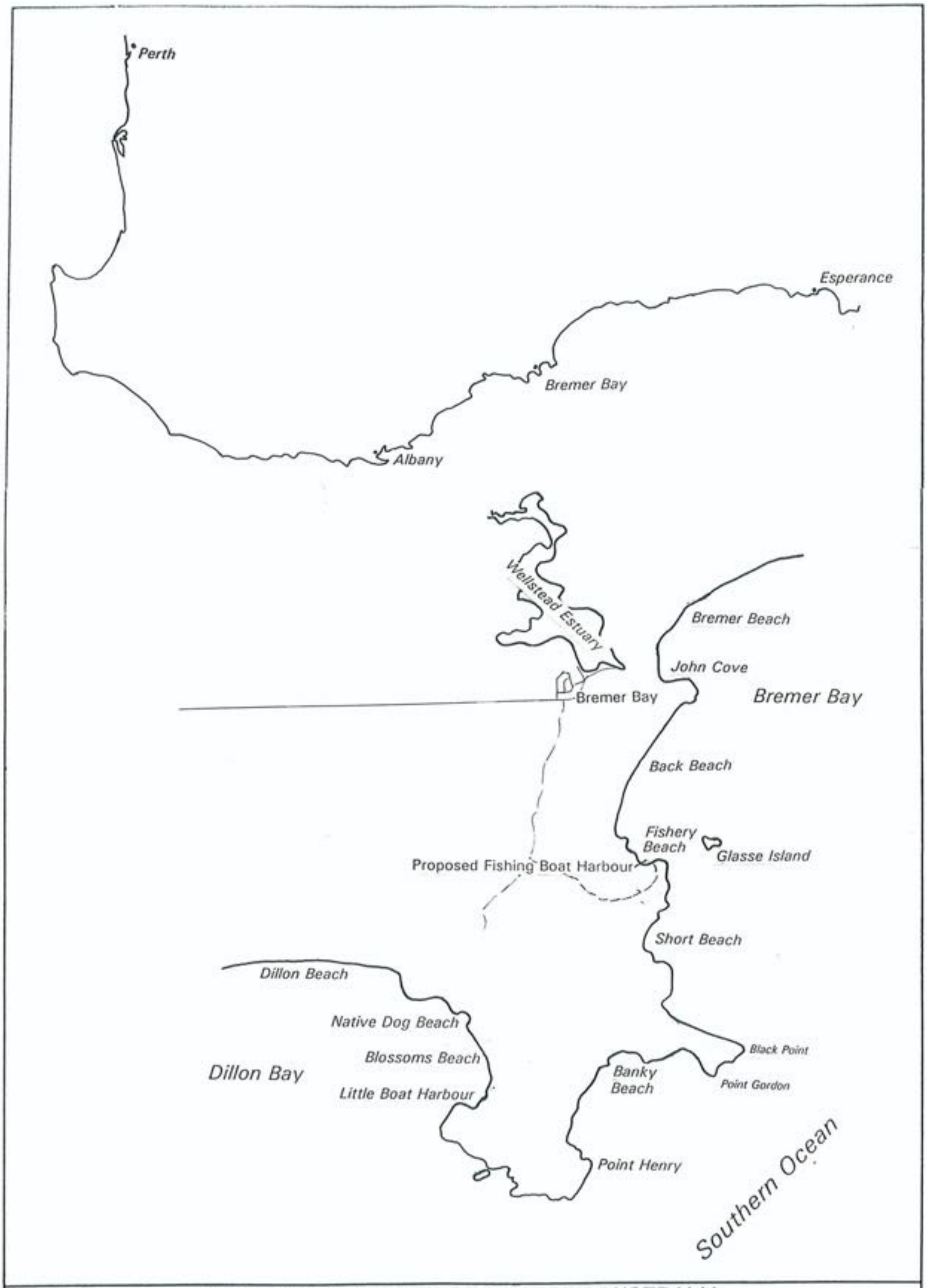


GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

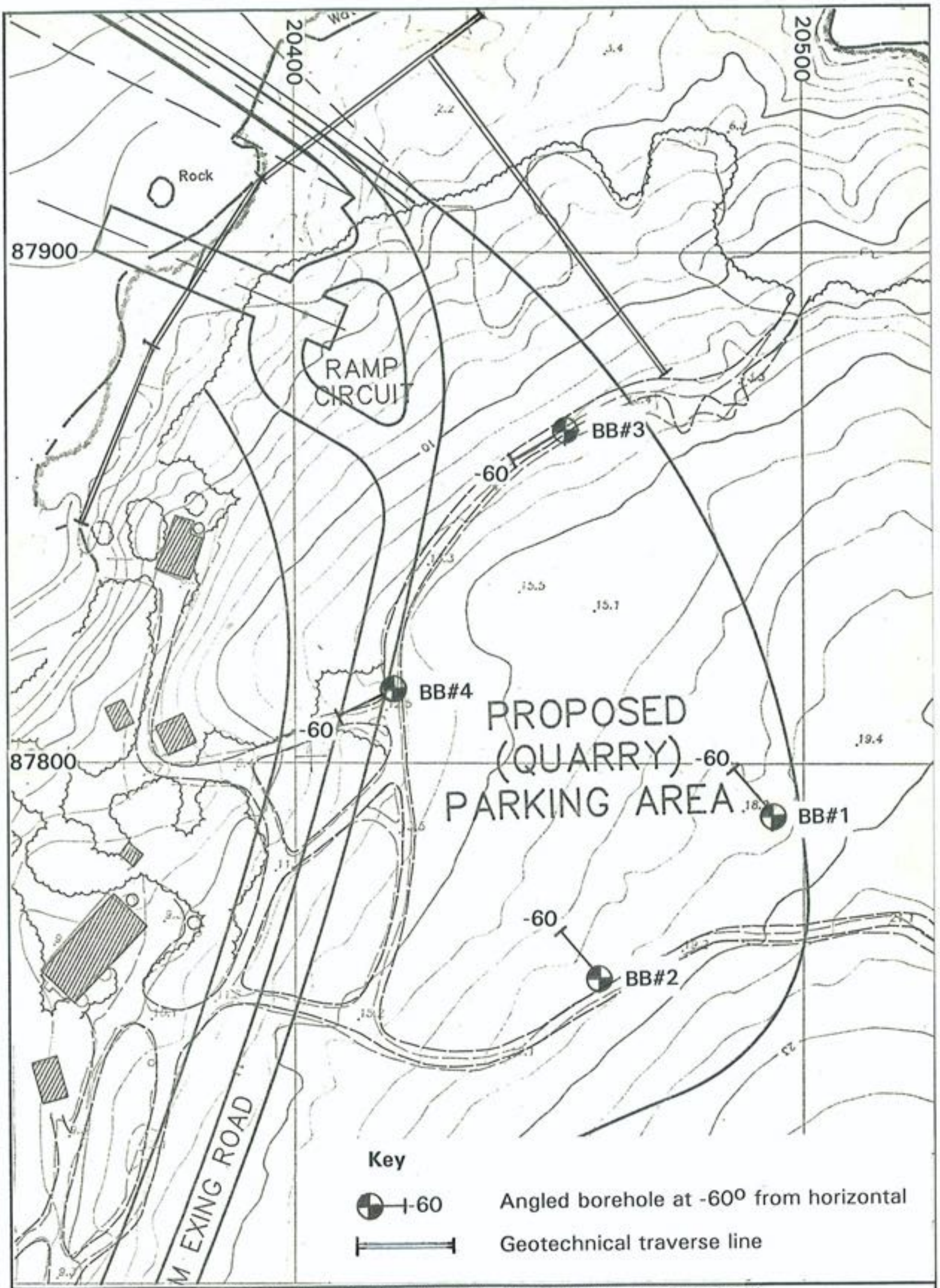
	INITIAL	DATE
COMP	PIM	8/94
DRAWN	PIM	8/94
CHKD	PIM	8/94
APVD	AF	12/94

FIGURE 1

Location of proposed fishing boat harbour
Fishery Beach-Bremer Bay

TO ACCOMPANY **EG 424**

MAP INDEX



GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

	INITIAL	DATE
COMP	PIM	8/94
DRAWN	CIES	94
CHKD	PIM	8/94
APVD	AF	12/94

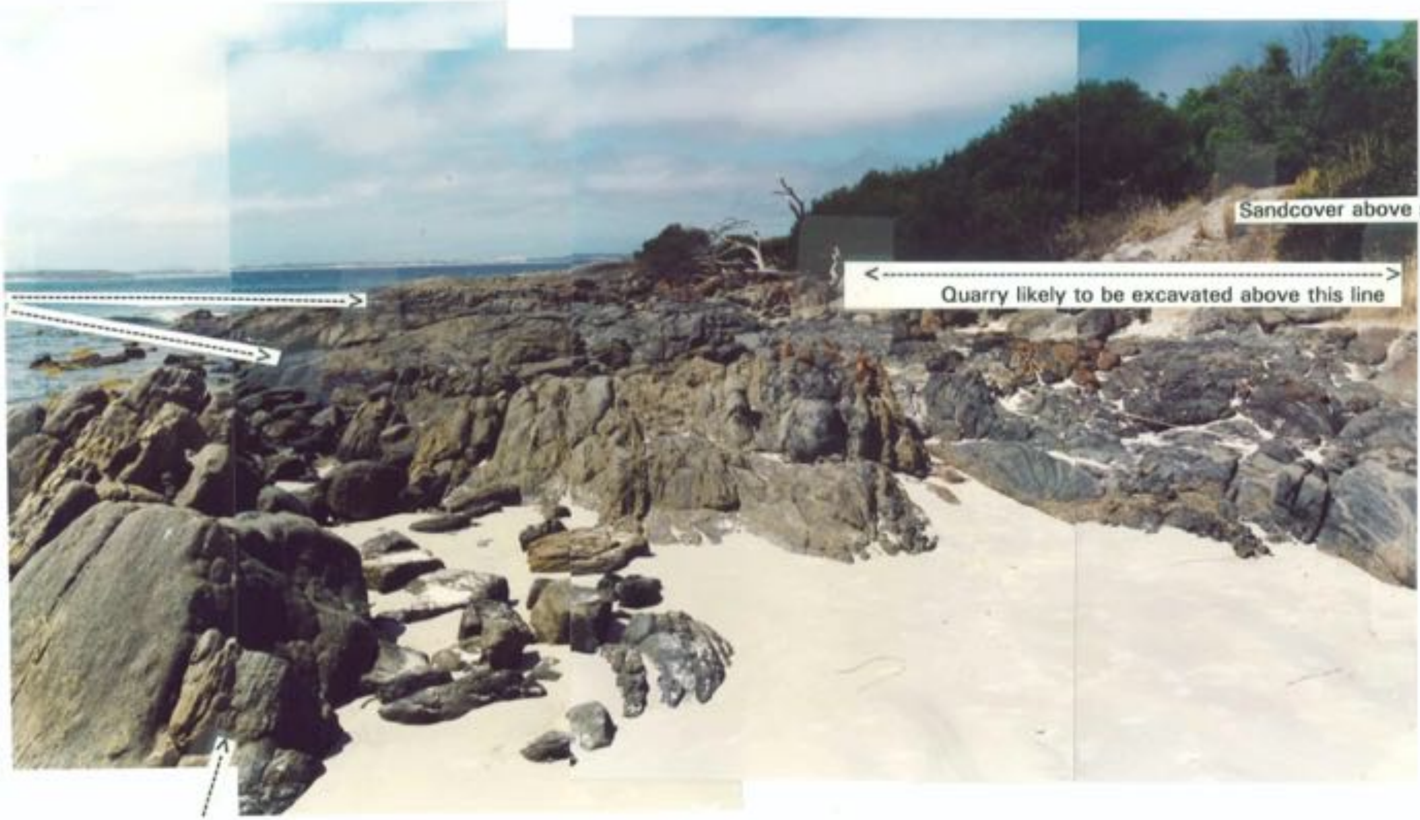
FIGURE 2

Location of boreholes

TO ACCOMPANY EG 424

MAP INDEX

24780/3/83—2500—H/1995



Photographs looking east

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

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

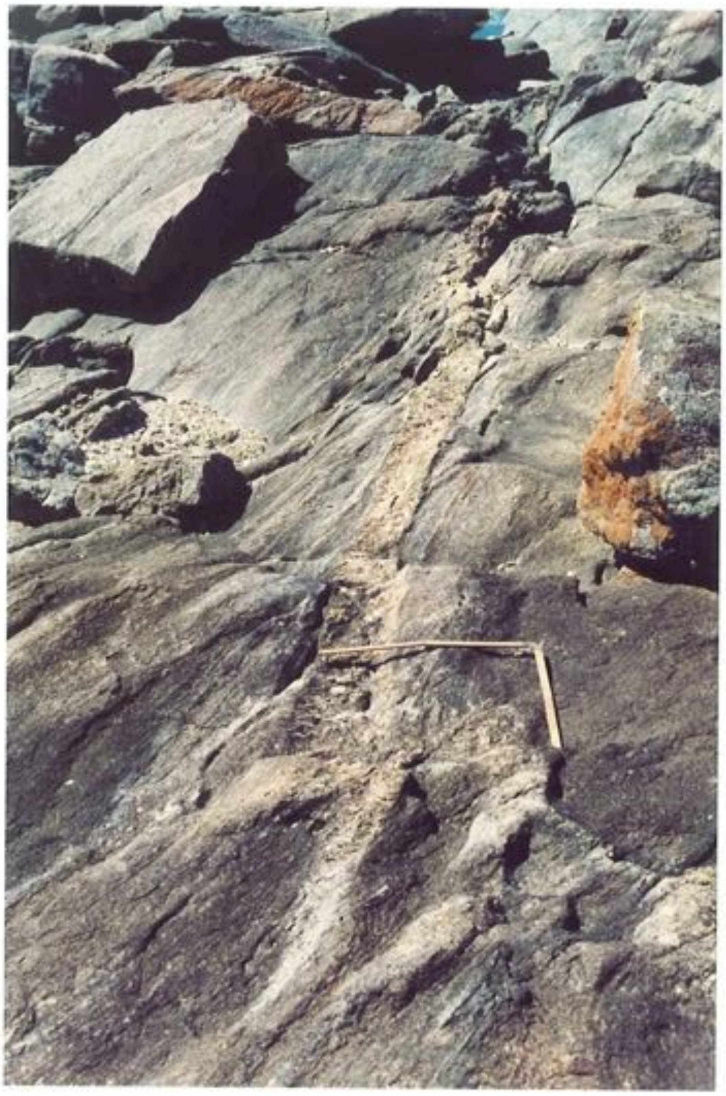
	Initial	Date
Comp	PJM	8/94
Drawn	PJM	8/94
Chkd	PJM	8/94
Apvd	AF	19/8/94

FIGURE 3

Photographs showing distinctive foliation throughout the rockmass

To accompany EG 424

Map Index



GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

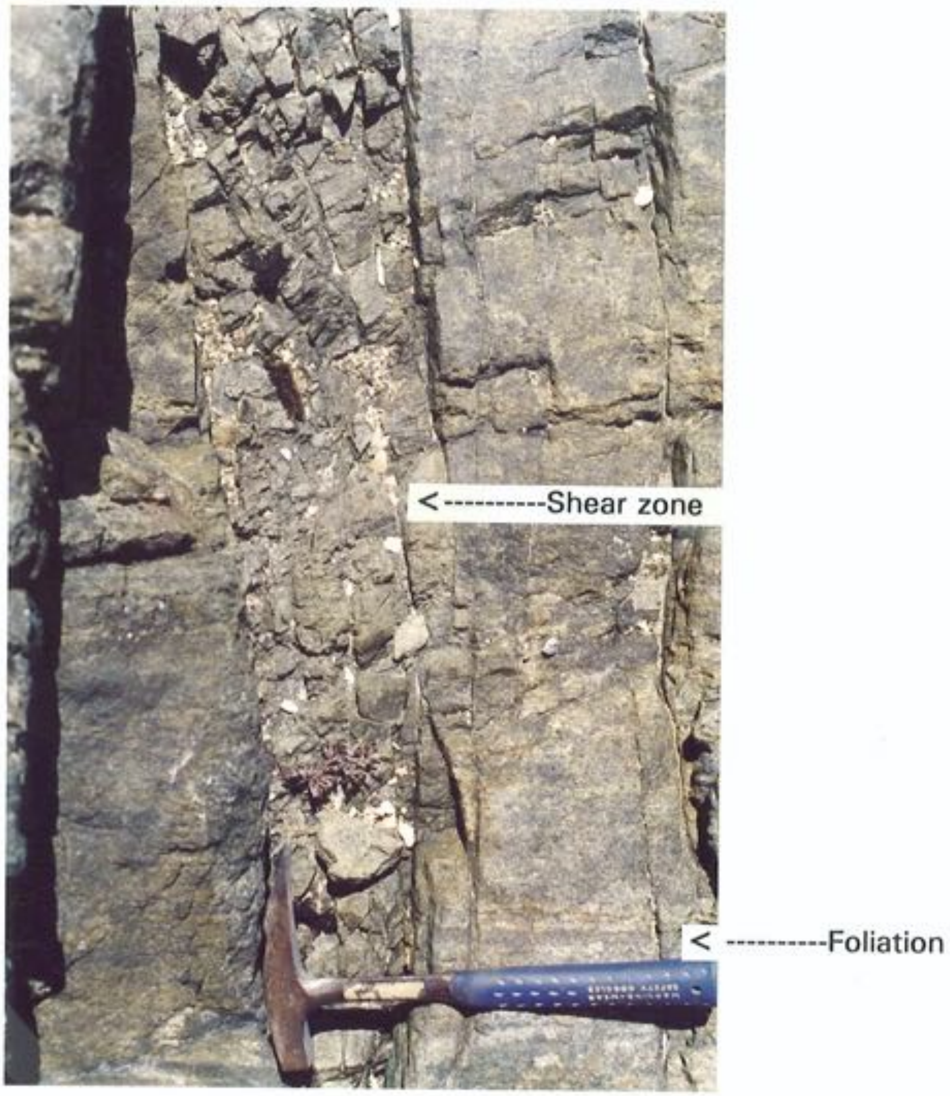
	INITIAL	DATE
COMP	PIM	8/94
DRAWN	PIM	8/94
CHKD	PIM	8/94
APVD		12/94

FIGURE 4

Photograph of quartzo-feldspathic dyke

MAP INDEX

TO ACCOMPANY EG 424



GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

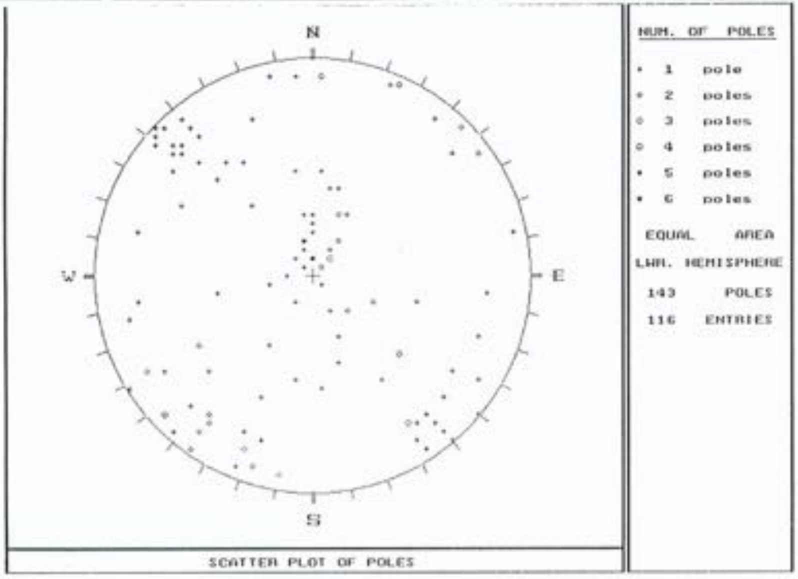
	INITIAL	DATE
COMP	PIM	8/94
DRAWN	PIM	8/94
CHKD	PIM	8/94
APVD	AF	12/94

FIGURE 5

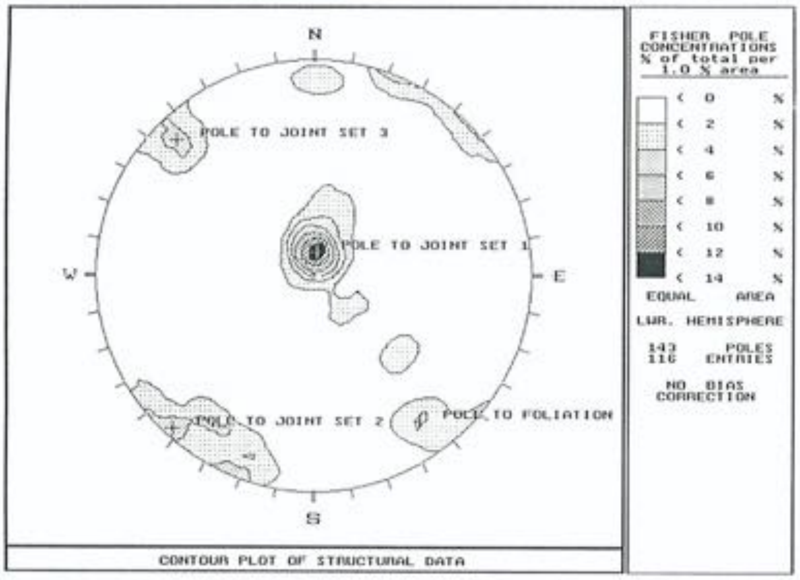
Photograph of shear surface in the vicinity of proposed boat ramp

TO ACCOMPANY EG 424

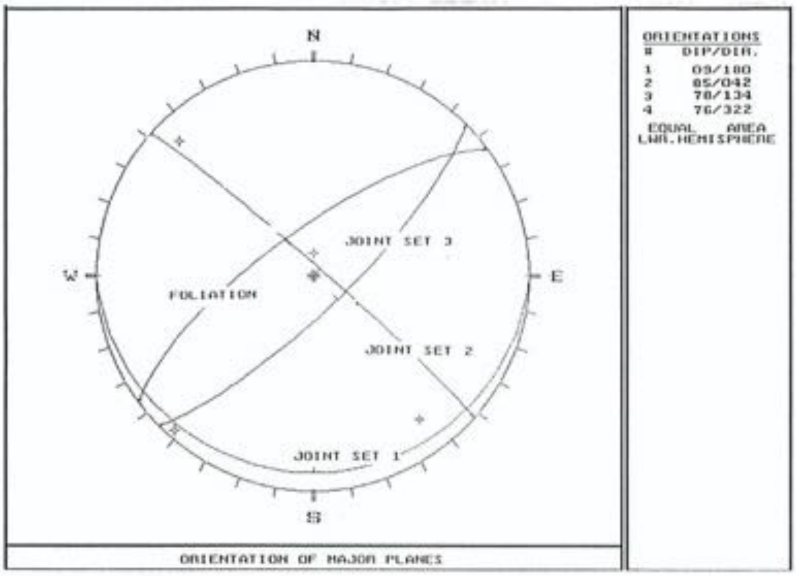
MAP INDEX



SCATTER PLOT OF POLES



CONTOUR PLOT OF STRUCTURAL DATA



ORIENTATION OF MAJOR PLANES

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

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

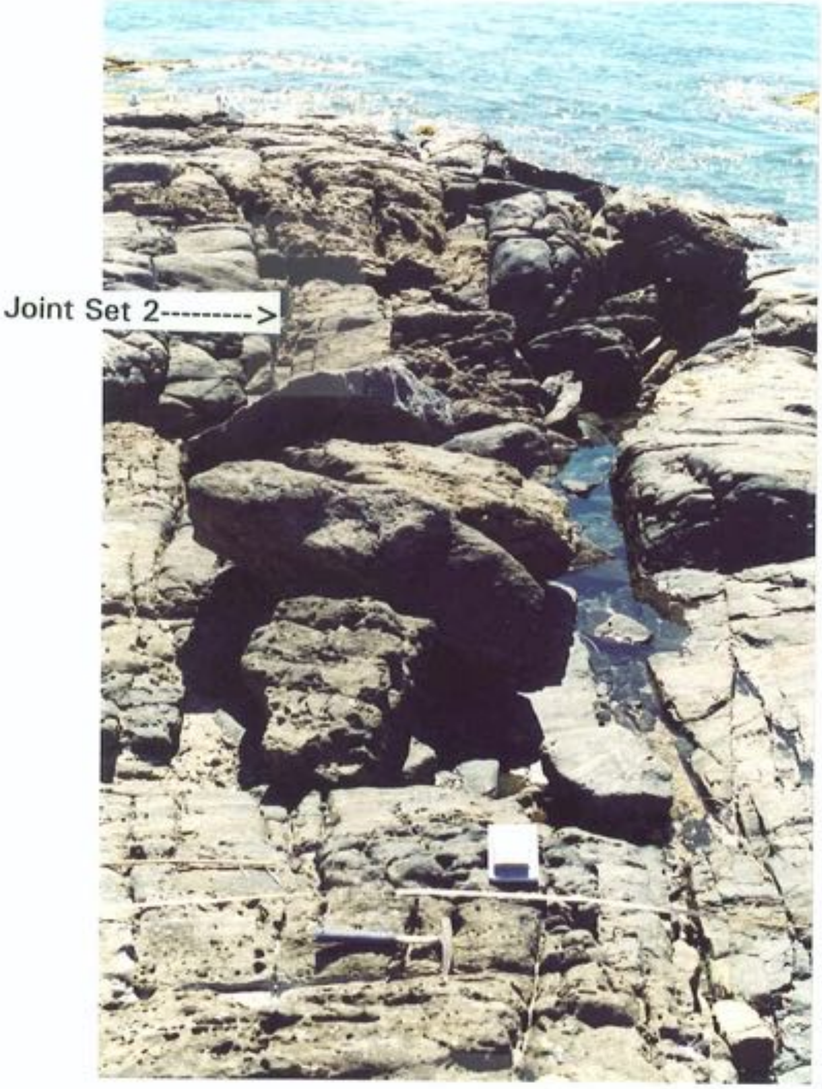
FIGURE 6

Stereographic analysis of structural data

TO ACCOMPANY EG 424

MAP INDEX

24780 3 83 - 2500 - H 1995



GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

	INITIAL	DATE
COMP	PoM	8/94
DRAWN	PoM	8/94
CHKD	PoM	8/94
APVD	AF	12/94

FIGURE 7 Photograph of clustered joints

MAP INDEX

TO ACCOMPANY EG 424

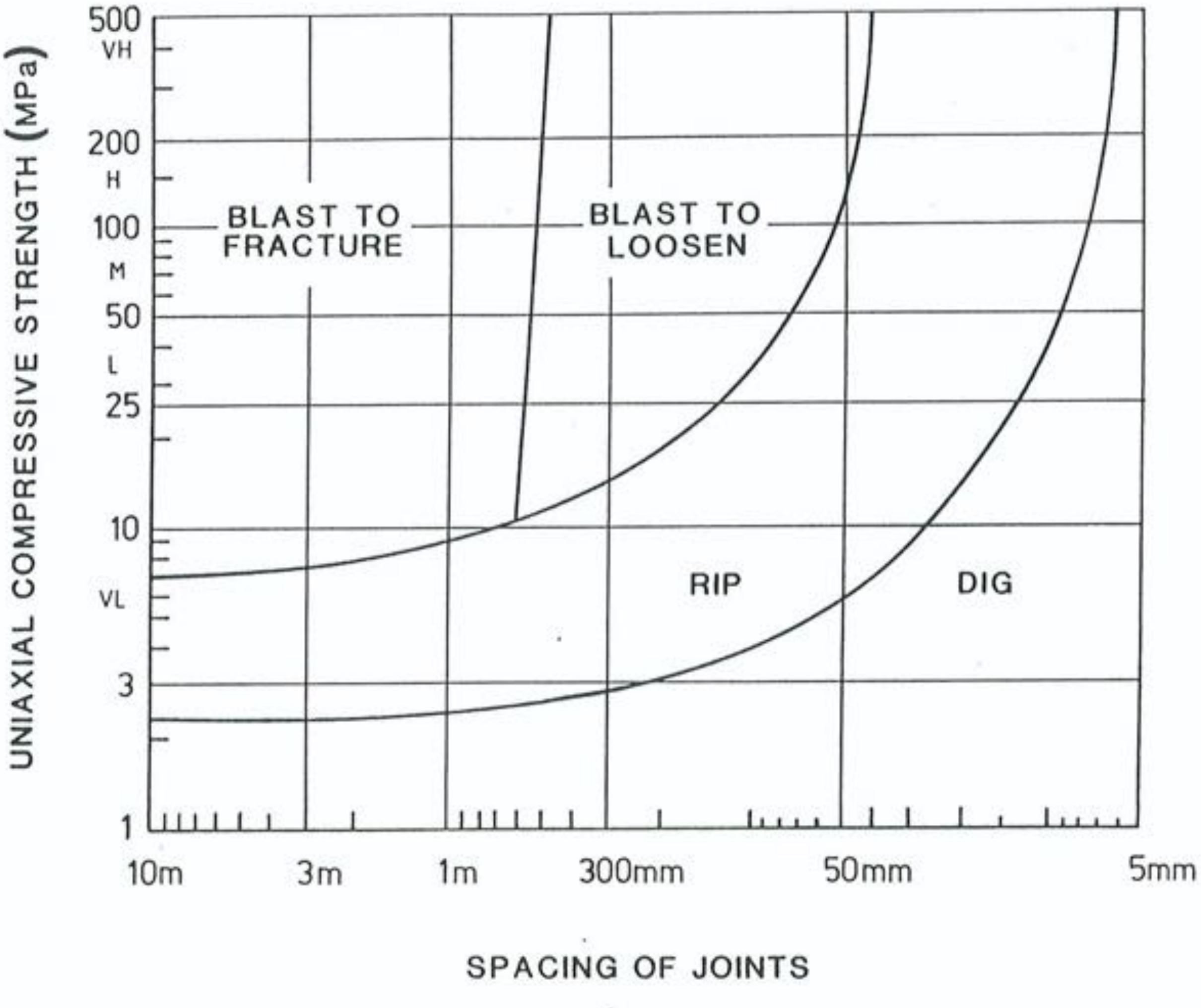
Approximate location of proposed boat ramp

Approximate location of proposed breakwater

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

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

	Initial	Date		
Comp	AM	8/4/94	**FIGURE 8** Photograph of joint set 3 to east of proposed breakwater	Map Index
Drawn	AM	8/4/94		
Chkd	AM	8/4/94		
Apvd	AS	12/4/94	To accompany EG 424	



Compiled from Franklin et al (1971)

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

	INITIAL	DATE
COMP	-	-
DRAWN	-	-
CHKD	P+U	10/94
APVD	AF	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

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

PETROLOGICAL REPORT

No.

MATERIAL: Four thin sections and hand specimens

LOCALITY: Fisherman's Beach, Bremer Bay

REQUISITION: **Date:**

COLLECTOR: Phil Manning **Project No.:**

REQUIREMENTS: Petrographic description

SAMPLE NUMBERS: 98425 - 98428

NUMBER OF PAGES IN REPORT:

Signed:
J.D Lewis

J.D.Lewis, Petrologist
25 Nov. 1994

DISTRIBUTION:

4052-93	Petrology Report File
	(Project File)
Phil Manning	(Author of requisition)
	(Other)

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 som microcline. Probabaly 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 hornblendescattered 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 obviosly 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 realated 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 specimento 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 (GSWA)

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 (O) 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 - O) 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:

Type

Joint	J
Bedding	B
Fault	F
Foliation	X
Cleavage	L
Vein	V
Shear	H
Schistosity	S

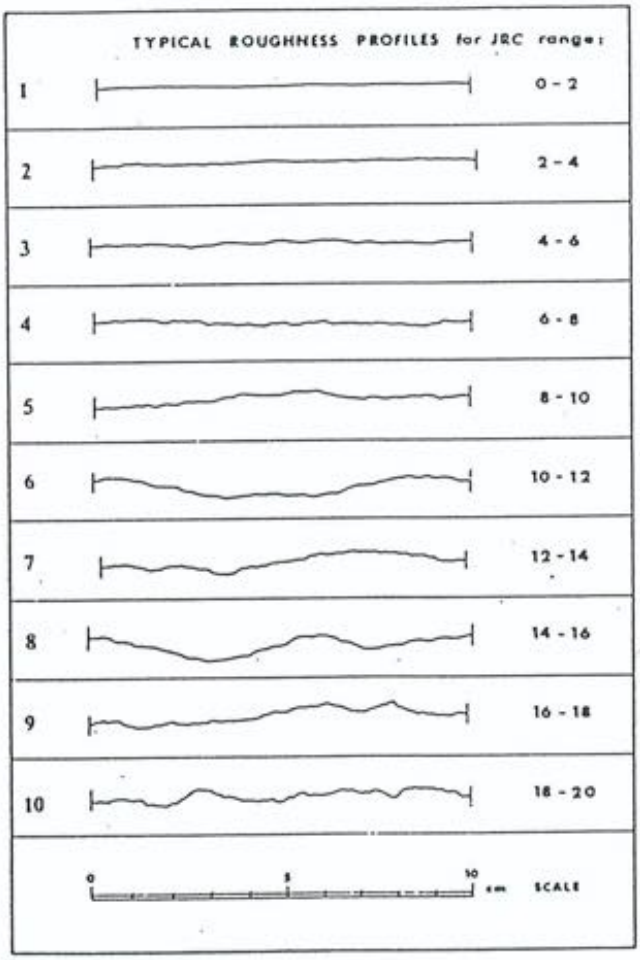
Roughness

S	Smooth
SR	Slightly rough
R	Rough
VR	Very rough
ST	Stepped
K	Slickensided

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

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. BB#1	Sheet 1 of 2
FISHERY BEACH	BREMER BAY-JERRAMUNGUP SHIRE		

BOREHOLE LOCATION: NORTH EAST OF PROPOSED QUARRY

DRILLING RIG:	TRH200	**DATE COMMENCED:**	14.06.94	**AMG GRID REFERENCE:**	E N	720496 6187792
DRILLER:	B EDWARDS	**DATE COMPLETED:**	15.06.94	**ANGLE FROM HORIZONTAL**		-60
BARREL TYPE & LENGTH:	NQ 1.5M	**SUPERVISED BY:**	PIM	**BEARING:**		320
BIT TYPE: GOLDFIELDS DIAMOND IMPREG.		**CHECKED BY:**	PIM	**R.L. SURFACE:**		18.87
DRILLING FLUID:	WATER			**DATUM:**		DMH 051

GRAPHIC LOG ☐☒ RL (m) DEPTH (m) DEFECT SPACING (mm)

GEOLOGICAL UNIT	DESCRIPTION OF CORE	WEATHERING	ESTIMATED STRENGTH	CEMENTATION	DESCRIPTION AND ORIENTATION OF ROCK DEFECTS & COMMENTS (Particular / General)	WATER LEVEL	LIFT AND CORE RECOVERY	R. Q. D.	TESTS	METHOD	CASING
	GNEISS: Dark brown, medium to coarse grained banded quartz, feldspar and micas, gneissic foliation	SW	H		0.02 Broken core 0.05 J1 65/350 4R FLM OX 0.07 0.21 X3 70/320 4R CLEAN 0.42 J2 60/-3R FLM OX 0.51 J3 65/350 3R FLM OX				Is(50) 8.5		
		FRST			0.70 J1 60/345 2R FLM OX 0.82 X3 60/350 3R CLEAN 1.04 J3 70/345 2R CLEAN		97	94			
					2.2 J1 65/270 6R FLM OX & C1mm 2.45 X3 62/360 5R CLEAN		103	100	Is(50) 6.93		
G R A N O D I O R I T I C G N E I S S	GNEISS: Blue grey, medium to coarse grained, banded quartz feldspar and mica minerals, gneissic foliation		H		3.37 X3 75/310 3R CLEAN 3.90 J1 65/290 3R FLM MI	590	98	100	Is(50) 7.56	NQ	
	QUARTZ VEIN: 3cm wide, white, coarse crystalline with associated biotite on edges of vein. No vugs				5.42 VQ 60/310 2SR		102	100	Is(50) 9.55		
		FRST			6.53 J1 70/350 3R CLEAN 6.56 J1 70/340 2R CLEAN 7.08X2 62/290 4R FLM QZ CLEAN 7.72 J1 (2X) 3R FLM OX (note slight waterloss at this joint)		100	99			

WEATHERING

CW - COMPLETELY WEATHERED
HW - HIGHLY WEATHERED
MW - MODERATELY WEATHERED
SW - SLIGHTLY WEATHERED
FS - FRESH

METHOD

NMLC
NQ - WIRELINE
HQ - WIRELINE
PQ - WIRELINE
R - ROLLER TRICONE

CASING

NW
HW
PW
HQ

ESTIMATED STRENGTH

EL - EXTREMELY LOW
VL - VERY LOW
L - LOW
M - MEDIUM
H - HIGH
VH - VERY HIGH
EH - EXTREMELY HIGH

DEGREE OF CEMENTATION

UC - UNCEMENTED
PC - POORLY CEMENTED
MC - MODERATELY CEMENTED
WC - WELL CEMENTED

N/A NOT APPLICABLE
NC NO CORE RECOVERED
ND NOT DETERMINED
* ESTIMATED

WATER

⊢—┤ WATER INFLOW
⊢—◀ COMPLETE DRILLING WATER LOSS
⊢—◁ PARTIAL DRILLING WATER LOSS
100% WATER RETURN

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TESTS

PM - PRESSUREMETER TEST (MPa)
L - PRESSURE TEST(LUGEONS)
Is(50) - POINT LOAD INDEX
N - S.P.T.
U - TUBE SAMPLE
D - DISTURBED SAMPLE
SM - SCHMIDT REBOUND HAMMER (No.)
UCS - UNCONFINED COMPRESSIVE STRENGTH
DNF - DID NOT FAIL

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:	TRH200	**DATE COMMENCED:**	14.06.94	**AMG GRID REFERENCE:** E	720496
DRILLER:	B EDWARDS	**DATE COMPLETED:**	15.06.94	N	6187792
BARREL TYPE & LENGTH:	NQ 1.5M	**SUPERVISED BY:**	PIM	**ANGLE FROM HORIZONTAL**	-60
BIT TYPE: GOLDFIELDS DIAMOND IMPREG.		**CHECKED BY:**	PIM	**BEARING:**	320
DRILLING FLUID:	WATER			**R.L. SURFACE:**	18.87
				DATUM:	DMH051

GEOLOGICAL UNIT	DESCRIPTION OF CORE	WEATHERING	ESTIMATED STRENGTH	CEMENTATION	GRAPHIC LOG	RL (m) ☐	DEPTH (m) ☒	DESCRIPTION AND ORIENTATION OF ROCK DEFECTS & COMMENTS (Particular / General)	WATER LEVEL	LIFT AND CORE RECOVERY	R. Q. D.	TESTS	METHOD	CASING
	GNEISS - blue grey, medium grained Banded comprising quartz feldspars and dark micas, predominantly biotite		H		~			ND		96	100			
					~		9.0			104	100			
					~		10.0	7.9 V3 70/200 5R CLEAN FLM MI 10.1 J1 63/350 3R FLM OX 10.11 J9 65/020 2R CLEAN		100	91	Is(50) 8.35 Is(50) 5.46		
G R A N O D I O R I T I C G N E I S S	GNDISS blue to whitish grey, coarse crystalline with increase in quartz and feldspars. Biotite banding more obvious.	FR			~		11.0	10.65 J1 58/076 3R FLM OX 10.66 J2 70/330 2R FLM OX Core more massive very few natural discontinuities X2 53/210 3R CLEAN	100				NQ	
					~		12.0	12.25 J1 70/310 25 FLM BI CLEAN		100	100	Is(50) 9.24		
			VH		~		13.0	12.95 J2 62/310 3R CLEAN		100	100	Is(50) DNF		
					~		14.0	EOH 14.2M						

WEATHERING

CW	COMPLETELY WEATHERED
HW	HIGHLY WEATHERED
MW	MODERATELY WEATHERED
SW	SLIGHTLY WEATHERED
FR	FRESH

METHOD

NMLC
NQ - WIRELINE
HQ - WIRELINE
PQ - WIRELINE
R - ROLLER TRICONE

CASING

NW
HW
PW
HQ

ESTIMATED STRENGTH

EL -	EXTREMELY LOW
VL -	VERY LOW
L -	LOW
M -	MEDIUM
H -	HIGH
VH -	VERY HIGH
EH -	EXTREMELY HIGH

DEGREE OF CEMENTATION

UC -	UNCEMENTED
PC -	POORLY CEMENTED
MC -	MODERATELY CEMENTED
WC -	WELL CEMENTED
N/A	NOT APPLICABLE
NC	NO CORE RECOVERED
ND	NOT DETERMINED
*	ESTIMATED

WATER

⊢—⊣	WATER INFLOW
⊢—⊣	COMPLETE DRILLING WATER LOSS
⊢—⊣	PARTIAL DRILLING WATER LOSS
100%	WATER RETURN

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TESTS

PM -	PRESSUREMETER TEST (MPa)
L -	PRESSURE TEST (LUGEONS)
Is(50) -	POINT LOAD INDEX
N -	S.P.T.
U -	TUBE SAMPLE
D -	DISTURBED SAMPLE
SM -	SCHMIDT REBOUND HAMMER (No.)
UCS -	UNCONFINED COMPRESSIVE STRENGTH
DNF -	DID NOT FAIL

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
DRILLER: B EDWARDS
BARREL TYPE & LENGTH: NQ 1.5 m
BIT TYPE: GOLDFIELDS DIAMOND IMPREG.
DRILLING FLUID: WATER

DATE COMMENCED: 15/06/84
DATE COMPLETED: 16/06/84
SUPERVISED BY: PIM
CHECKED BY: PIM

AMG GRID REFERENCE: E 720 456 N 6 187 756
ANGLE FROM HORIZONTAL –60
BEARING: 320
R.L. SURFACE: 18.48
DATUM: DMH 051

GEOLOGICAL UNIT	DESCRIPTION OF CORE	WEATHERING	ESTIMATED STRENGTH	CEMENTATION	GRAPHIC LOG	RL (m)	DEPTH (m)	DESCRIPTION AND ORIENTATION OF ROCK DEFECTS & COMMENTS Particular General	WATER LEVEL	LIFT AND CORE RECOVERY	R.Q.D.	TESTS	METHOD	CASING
	CLAYEY SAND. brown medium grained unconsolidated sand with minor organic material	N J	ND							N/D	N/D			HQ
	NO CORE	N.D	ND		NC			0.9 } } small fragments of rock within sandy/clay 1.1 }		58	18			
	CLAYEY SAND/ROCK FRAGMENTS: dark brown micaceous weathered GNEISS	HW	VL				1.0							
	GNEISS: Dark brown, moderately weathered fragments contained within HIGHLY WEATHERED rock, with bands of weak micaceous clay	MW	M		~							Is(50) 21.62		
		SW	H		~			1.74 X1 65/-5R, OX stained to 10 mm 1.94 X1 65/-5R, OX stained to 10 mm						
					~		2.0	2.18 V1 45/-4R, INF 10 QZ 2.26 H5 15/-4R, INF 2 QZ 2.30 H1 10/-4R, FLM OX 2.53 X2 60/-6R, FLM OX 2.65 X3 60/-5R, FLM OX 2.75 H5 30/-6R, FLM OX, SI 2.85 J2 60/-5R, FLM OX 2.87 broken core		100	88			
GRANODIORITIC		FRST			~		3.0	3.08 X2 70/-6R, FLM OX 3.1 X1 75/-6R, FLM OX 3.17 J1 30/-5R, FLM OX 3.28 J1 30/-5R, FLM OX 3.43 J1 45/-4R, FLM OX 3.48 V3 75/-3R, INF 10 QZ 3.52 broken core 75/- 3.56 J2 X4, 3R, FLM OX 3.6 X3 60/-4R, FLM OX 3.67 J1 55/-4R, FLM OX 3.77 X2 65/-4R CLEAN	100	100	50	Is(50) 8.29	NQ	
					~		4.0	4.05 H1 40/-3R INF C 2 mm 4.10 H1 4.43 X2 65/-3R FLM BI		97	95			
GNEISS	GNEISS: Blue grey, banded medium to fine grained crystalline rock. Alternate banding of silica and micas with fine feldsphatic inclusions. Occasional ox staining on discontinuity surfaces.				~		5.0	5.76 V1 65/030 3R, INF 20 mm granular QZ, FLM OX				Is(50) 9.24 Is(50) DNF		
					~		6.0	6.16 X2 60/340 4R CLEAN		103	94			
					~		7.0	7.11 J3 60/350 3R CLEAN 7.63 X3 50/180 3R CLEAN		87	100	Is(50) 6.32		
					~		8.0							

DEFECT SPACING (mm)

WEATHERING

CW - COMPLETELY WEATHERED
HW - HIGHLY WEATHERED
MW - MODERATELY WEATHERED
SW - SLIGHTLY WEATHERED
FR - FRESH

METHOD

NMLC
NQ - WIRELINE
HQ - WIRELINE
PQ - WIRELINE
R - ROLLER TRICONE

CASING

NW
HW
PW
HQ

ESTIMATED STRENGTH

EL - EXTREMELY LOW
VL - VERY LOW
L - LOW
M - MEDIUM
H - HIGH
VH - VERY HIGH
EH - EXTREMELY HIGH

DEGREE OF CEMENTATION

UC - UNCEMENTED
PC - POORLY CEMENTED
MC - MODERATELY CEMENTED
WC - WELL CEMENTED

N/A NOT APPLICABLE
NC NO CORE RECOVERED
ND NOT DETERMINED
* ESTIMATED

WATER

├─┤ WATER INFLOW
├─┤ COMPLETE DRILLING WATER LOSS
├─┤ PARTIAL DRILLING WATER LOSS
100% WATER RETURN

TESTS

PM - PRESSUREMETER TEST (MPa)
L - PRESSURE TEST (LUGEONS)
Is(50) - POINT LOAD INDEX
N - S.P.T.
U - TUBE SAMPLE
D - DISTURBED SAMPLE
SM - SCHMIDT REBOUND HAMMER (No.)
UCS - UNCONFINED COMPRESSIVE STRENGTH
DNF - DID NOT FAIL

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CORED BOREHOLE LOG

PROPOSED FISHING BOAT HARBOUR — BREMER BAY

LOCATION	TOWN/CITY/SHIRE	BOREHOLE No. BB#2	Sheet 2 of 2
FISHERY BEACH	BREMER BAY – JERRAMUNGUP SHIRE		

BOREHOLE LOCATION: SOUTH EAST OF PROPOSED QUARRY

DRILLING RIG: TRH 200
DRILLER: B EDWARDS
BARREL TYPE & LENGTH: NQ 1.5 m
BIT TYPE: GOLDFIELDS DIAMOND IMPREG.
DRILLING FLUID: WATER

DATE COMMENCED: 15/06/84
DATE COMPLETED: 16/06/84
SUPERVISED BY: PIM
CHECKED BY: PIM

AMG GRID REFERENCE: E 720 456 N 6 187 756
ANGLE FROM HORIZONTAL -60
BEARING: 320
R.L. SURFACE: 18.48
DATUM: DMH 051

GEOLOGICAL UNIT	DESCRIPTION OF CORE	WEATHERING	ESTIMATED STRENGTH	CEMENTATION	DEPTH (m)	DESCRIPTION AND ORIENTATION OF ROCK DEFECTS & COMMENTS (Particular / General)	WATER LEVEL	LIFT AND CORE RECOVERY	R.Q.D.	TESTS	METHOD	CASING
G R A N O D I O R I T I C G N E I S S	GNEISS, brown grey, coarse crystalline with degraded micas within clay matrix	HW	L			8.62 HS 10/180 6R, INF 100 mm CLAY, FLM EP		140	100			
					9.0	9.23 J1 70/340 5R FLM OX, BI		100	98	Is(50) DNF		
	GNEISS: Blue grey, banded medium to fine grained crystalline rock. Alternate banding of silica and micas with fine feldsphatic inclusions.	FR	H		10.0 – 11.0	10.82 J3 50/160 5 VR FLM BI, QZ		100	100	Is(50) 10.37	NQ	
					12.0	11.97 (x2) J1 60/330 6 VR, INF 2 mm	100	100	100	Is(50) DNF		
					13.0 – 14.0	13.4 X1 60/305 3R FLM		100	100			
	GNEISS (quartzose): Distinctive blue grey/ grey granitic gneiss, coarse crystalline quartz within mica/ feldspathic bands.				15.0	14.71 V3] small disc of core 14.83 14.92 V3] core disced into bands,] 1-2 cm thick. Small quartz] veins with vugs 15.22] 15.65 V3] Disced core, increase in 15.68] QZ content in rock.		100	79	Is(50) 6.4 Is(50) 9.66		
					16.0	EOH 15.6 m			9.66			

WEATHERING

CW - COMPLETELY WEATHERED
HW - HIGHLY WEATHERED
MW - MODERATELY WEATHERED
SW - SLIGHTLY WEATHERED
FR - FRESH

METHOD

NMLC
NQ - WIRELINE
HQ - WIRELINE
PQ - WIRELINE
R - ROLLER TRICONE

CASING

NW
HW
PW
HQ

ESTIMATED STRENGTH

EL - EXTREMELY LOW
VL - VERY LOW
L - LOW
M - MEDIUM
H - HIGH
VH - VERY HIGH
EH - EXTREMELY HIGH

DEGREE OF CEMENTATION

UC - UNCEMENTED
PC - POORLY CEMENTED
MC - MODERATELY CEMENTED
WC - WELL CEMENTED

N/A NOT APPLICABLE
NC NO CORE RECOVERED
ND NOT DETERMINED
* ESTIMATED

WATER

⊢—| WATER INFLOW
⊢—◀ COMPLETE DRILLING WATER LOSS
⊢—◁ PARTIAL DRILLING WATER LOSS
100% WATER RETURN

TESTS

PM - PRESSUREMETER TEST (MPa)
L - PRESSURE TEST (LUGEONS)
Is(50) - POINT LOAD INDEX
N - S.P.T.
U - TUBE SAMPLE
D - DISTURBED SAMPLE
SM - SCHMIDT REBOUND HAMMER (No.)
UCS - UNCONFINED COMPRESSIVE STRENGTH
DNF - DID NOT FAIL

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CORED BOREHOLE LOG	PROPOSED FISHING BOAT HARBOUR, BREMER BAY		
LOCATION	**TOWN/CITY/SHIRE**	**BOREHOLE No.** BB#3	**Sheet** 1 of 2
FISHERY BEACH	BREMER BAY - JERRAMUNGUP SHIRE		

BOREHOLE LOCATION: NORTHWEST OF PROPOSED QUARRY

DRILLING RIG:	TRH200	**DATE COMMENCED:**	16.06.94	**AMG GRID REFERENCE:**	E 720453 N 6187864
DRILLER:	B EDWARDS	**DATE COMPLETED:**	17.06.94	**ANGLE FROM HORIZONTAL**	-60
BARREL TYPE & LENGTH:	NQ 1.5M	**SUPERVISED BY:**	PIM	**BEARING:**	240⁰
BIT TYPE: GOLDFIELDS DIAMOND IMPREG.		**CHECKED BY:**	PIM	**R.L. SURFACE:**	12.40
DRILLING FLUID:	WATER			**DATUM:**	DMH 051

GEOLOGICAL UNIT	DESCRIPTION OF CORE	WEATHERING	ESTIMATED STRENGTH	CEMENTATION	GRAPHIC LOG	RL (m)	DEPTH (m)	DEFECT SPACING (mm) 10 30 100 300 1000 3000	DESCRIPTION AND ORIENTATION OF ROCK DEFECTS & COMMENTS Particular General	WATER LEVEL	LIFT AND CORE RECOVERY	R. Q. D.	TESTS	METHOD	CASING
	SAND unconsolidated beach sand. Minor organic material in cuttings.	N/A	N/D				1.0		ND		NA	NA		WASH DRILLED	
	NO CORE	ND	ND		NC				NC						
	GNEISS. brown/yellow. medium grained banded with degradation of micas.	HW	VL		~				1.59						
GRANODIORITIC GNEISS	GNEISS blue/grey, medium grained banded with quartz feldspar and biotite forming gneiss foliation, staining of joints in interval with fe ox.	FRST	H		~		2.0		2.00 X1 50/300 2R INF OX CL 2mm 2.41 J1 60/340 3R INF OZ		91	83	Is(50) 5.11		HQ
		FR	H		~		3.0 4.0				104	100	Is(50) 9.24		
	GNEISS - Blue-grey, medium grained, banded quartz feldspar and mica minerals as major constituents. Distinctive gneissic foliation.				~		5.0		4.80 J2 55/340 2R CLEAN	100	97	100	Is(50) 7.56	NQ	
					~		6.0				103	100			
	QUARTZ VEIN (2cm wide) grey white coarse grained. Biotite on edges of vein. 6.50 6.60	FR	H						6.58 V3 50/080 3R CLEAN				Is(50) 8.19		
					~		7.0 8.0		7.90 J2 50/355 3R CLEAN		100	100			

WEATHERING

CW	-	COMPLETELY WEATHERED
HW	-	HIGHLY WEATHERED
MW	-	MODERATELY WEATHERED
SW	-	SLIGHTLY WEATHERED
FR	-	FRESH

METHOD

NMLC
NQ - WIRELINE
HQ - WIRELINE
PQ - WIRELINE
R - ROLLER TRICONE

CASING

NW
HW
PW
HQ

ESTIMATED STRENGTH

EL	-	EXTREMELY LOW
VL	-	VERY LOW
L	-	LOW
M	-	MEDIUM
H	-	HIGH
VH	-	VERY HIGH
EH	-	EXTREMELY HIGH

DEGREE OF CEMENTATION

UC	-	UNCEMENTED
PC	-	POORLY CEMENTED
MC	-	MODERATELY CEMENTED
WC	-	WELL CEMENTED
N/A		NOT APPLICABLE
NC		NO CORE RECOVERED
ND		NOT DETERMINED
*		ESTIMATED

WATER

⊢—⊣	WATER INFLOW
⊢—⊣	COMPLETE DRILLING WATER LOSS
⊢—⊣	PARTIAL DRILLING WATER LOSS
100%	WATER RETURN

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TESTS

PM	-	PRESSUREMETER TEST (MPa)
L	-	PRESSURE TEST (LUGEONS)
Is(50)	-	POINT LOAD INDEX
N	-	S.P.T.
U	-	TUBE SAMPLE
D	-	DISTURBED SAMPLE
SM	-	SCHMIDT REBOUND HAMMER (No.)
UCS	-	UNCONFINED COMPRESSIVE STRENGTH
DNF	-	DID NOT FAIL

CORED BOREHOLE LOG

PROPOSED FISHING BOAT HARBOUR – BREMER BAY

LOCATION	TOWN/CITY/SHIRE	BOREHOLE No. BB#3	Sheet 2 of 2
FISHERY BEACH	BREMER BAY - JERRAMUNGUP SHIRE		

BOREHOLE LOCATION: NORTHWEST OF PROPOSED QUARRY

DRILLING RIG:	TRH200	**DATE COMMENCED:**	16.06.94	**AMG GRID REFERENCE:**	E 720453 N 6187864
DRILLER:	B EDWARDS	**DATE COMPLETED:**	17.06.94	**ANGLE FROM HORIZONTAL**	-60
BARREL TYPE & LENGTH:	NQ 1.5M	**SUPERVISED BY:**	PIM	**BEARING:**	240^{0}
BIT TYPE: GOLDFIELDS DIAMOND IMPREG.		**CHECKED BY:**	PIM	**R.L. SURFACE:**	12.40
DRILLING FLUID:	WATER			**DATUM:**	DMH 051

GEOLOGICAL UNIT	DESCRIPTION OF CORE	WEATHERING	ESTIMATED STRENGTH	CEMENTATION	☐☒ RL (m) DEPTH (m)	DESCRIPTION AND ORIENTATION OF ROCK DEFECTS & COMMENTS Particular General	WATER LEVEL	LIFT AND CORE RECOVERY	R.Q.D.	TESTS	METHOD	CASING
										Is(50) 9.03		
						8.95 J2 55/045 3R, CLEAN						
					9.0							
								100	100			
					10.0							
										Is(50) DNF		
						10.40 2 RANDOM DRILL BREAKS						
	Gradational change within GNEISS to more distinctive banding Coarser crystalling quartz and feldspar separating micaceous bands							100	100			
					11.0							
							100					
						11.50 4 RANDOM DRILL BREAKS						
G R A N O D I O R I T I C G N E I S S	Increase in percentage of quartz relative to feldspar	FR	H									
					12.0							
								100	100		NQ	
						13.0-13.45 CORE DISCED NORMAL TO DCA				Is(50) 6.30		
					13.0							
	Increase in overall proportion of quartz within gneiss									Is(50) 3.36		
						13.30 V3 90/- 3VR CLEAN						
										Is(50) 5.04		
								100	100			
					14.0							
						14.56 DISCED CORE 3 BREAKS NORMAL TO DCA 14.65 V3 90/-3R				Is(50) 6.30		
								100	82			
					15.0	EOH 15.06						

WEATHERING

CW	-	COMPLETELY WEATHERED
HW	-	HIGHLY WEATHERED
MW	-	MODERATELY WEATHERED
SW	-	SLIGHTLY WEATHERED
FR	-	FRESH

METHOD

NMLC
NQ - WIRELINE
HQ - WIRELINE
HQ - WIRELINE
PQ - WIRELINE
R - ROLLER TRICONE

CASING

NW
HW
PW
HQ

ESTIMATED STRENGTH

EL	-	EXTREMELY LOW
VL	-	VERY LOW
L	-	LOW
M	-	MEDIUM
H	-	HIGH
VH	-	VERY HIGH
EH	-	EXTREMELY HIGH

DEGREE OF CEMENTATION

UC	-	UNCEMENTED
PC	-	POORLY CEMENTED
MC	-	MODERATELY CEMENTED
WC	-	WELL CEMENTED
N/A		NOT APPLICABLE
NC		NO CORE RECOVERED
ND		NOT DETERMINED
*		ESTIMATED

WATER

├──┤	WATER INFLOW
├──┤	COMPLETE DRILLING WATER LOSS
├──┤	PARTIAL DRILLING WATER LOSS
100%	WATER RETURN

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TESTS

PM	-	PRESSUREMETER TEST (MPa)
L	-	PRESSURE TEST (LUGEONS)
Is(50)	-	POINT LOAD INDEX
N	-	S.P.T.
U	-	TUBE SAMPLE
D	-	DISTURBED SAMPLE
UCS	-	UNCONFINED COMPRESSIVE STRENGTH
DNF	-	DID NOT FAIL

CORED BOREHOLE LOG

PROPOSED FISHING BOAT HARBOUR – BREMER BAY

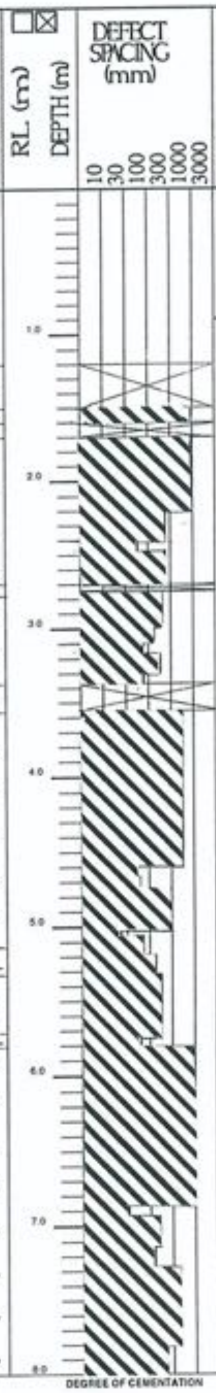
LOCATION	TOWN/CITY/SHIRE	BOREHOLE No.	BB#4	Sheet 1of 3
FISHERY BEACH	BREMER BY – JERRAMUNGUP SHIRE			

BOREHOLE LOCATION: SOUTH WEST OF PROPOSED QUARRY

DRILLING RIG: TRH 200
DRILLER: B EDWARDS
BARREL TYPE & LENGTH: NQ 1.5 m
BIT TYPE: GOLD FIELDS DIAMOND IMPREG.
DRILLING FLUI D: WATER

DATE COMMENCED: 17/06/94
DATE COMPLETED: 18/06/94
SUPERVISED BY: PIM
CHECKED BY: PIM

AMG GRID REFERENCE: E 720 416 N 6 187 811
ANGLE FROM HORIZONTAL –60
BEARING: 230°
R.L. SURFACE: 12.65
DATUM: DMH 051



GEOLOGICAL UNIT	DESCRIPTION OF CORE	WEATHERING	ESTIMATED STRENGTH	CEMENTATION	GRAPHIC LOG	DESCRIPTION AND ORIENTATION OF ROCK DEFECTS & COMMENTS (Particular / General)	WATER LEVEL	LIFT AND CORE RECOVERY	R.Q.D.	TESTS	METHOD	CASING
	SAND, light brown medium-coarse grained beach sands. Organic material at contact with weathered bedrock	ND	ND			Encountered weak rock in wash drilling. Small fragments of moderately weathered rock in core lifter					wash	
	NO CORE											
	GNEISS: Dark brown, medium grained. Weathered to medium strong clays. Distinctive micas within clays and fragmented rock.	ND HW	ND VL		NC △ –			13				
	NO CORE	ND	ND		NC							
GRANODIORITIC	GNEISS: Dark brown, medium grained. Weathered to medium strong clayey, micaceus sand. Bands within fragmental remnant moderately weathered rock.	HW	VL		~ ~ ~	2.2 HI 28/-52, INF OX 2mm		88	14	Is(50) 2.94		HQ
	BANDED GNEISS: Light brown to blue, grey crystalline sheared rock. Fe oxide stained surfaces	SW	H		~	2.4 J1 45/-3R FLM OX 2.46 J1 60/-4R FLM OX 2.70 Lost core in clayey weathered rock						
	NO CORE	ND	ND		NC	2.73						
	GNEISS: Light brown to blue, grey crystalline sheared rock. Fe oxide stained surfaces	SW	H		~ ~	2.97 J5 25/-3R FLM OX 3.08 X1 40/-2R FLM OX 3.16 D1 60/-5R FLM OX 3.31 X1 40/-2R FLM OX 3.38 X1 40/-2R FLM OX		79	79			
	NO CORE/Weathering has occurring down foliation	ND	ND		NC	3.55 X1 40/2.70 3R INF C to 3 mm						
GNEISS	GNEISS: Blue grey, medium grained quartz, feldspar and mica minerals as major constituents of gneissic foliation banding	FRST	H		~ ~ ~ ~ ~	4.15 J3 75-4R FLM OX 1 mm 4.6 J1 45/-3R INF C3 QZ 2 mm 4.66 J1 75/-4R FLM OX 4.73 J1 48/1.70 3R FLM OX 5 mm 5.03J1 50/1.60 3R FLM OX 2 mm 5.05 J1 65/130 2SR FLM OX 1 mm 5.18 J1 50/160 3R INF C 5.32 J1 30/300 3R	100	100	95	Is(50) 4.83		NQ
	CLAYEY SILT: Dark brown highly weathered remnant Gneiss. Coarse grained predominately micaceous clays	HW	L		△ –							
		FRST	H		~	5.74 J1 55/350 5R INF 40 mm C 5.80 ?		100	91			
		HW	L		– –							
	GNEISS A/A	FRST	H		~ ~ ~ ~ ~ ~ ~ ~	6.68 J1 57/070 3R FLM OX 6.92 J1 70/010 3R FLM QZ 7.12 small 1 mm veinlet HS 25/150 4R CLEAN 7.26 J1 40/070 4R CLEAN 7.82 J1 45/030 4R CLEAN		93 100	91 97	Is(50) 8.82 Is(50) DNF		

WEATHERING
CW - COMPLETELY WEATHERED
HW - HIGHLY WEATHERED
MW - MODERATELY WEATHERED
SW - SLIGHTLY WEATHERED
FR - FRESH

METHOD
NMLC
NQ - WIRELINE
HQ - WIRELINE
PQ - WIRELINE
R - ROLLER TRICONE

CASING
NW
HW
PW
HQ

ESTIMATED STRENGTH
EL - EXTREMELY LOW
VL - VERY LOW
L - LOW
M - MEDIUM
H - HIGH
VH - VERY HIGH
EH - EXTREMELY HIGH

DEGREE OF CEMENTATION
UC - UNCEMENTED
PC - POORLY CEMENTED
MC - MODERATELY CEMENTED
WC - WELL CEMENTED

N/A NOT APPLICABLE
NC NO CORE RECOVERED
ND NOT DETERMINED
* ESTIMATED

WATER
WATER INFLOW
COMPLETE DRILLING WATER LOSS
PARTIAL DRILLING WATER LOSS
100% WATER RETURN

TESTS
PM - PRESSUREMETER TEST (MPa)
L - PRESSURE TEST (LUGEONS)
Is(50) - POINT LOAD INDEX
N - S.P.T.
U - TUBE SAMPLE
D - DISTURBED SAMPLE
SM - SCHMIDT REBOUND HAMMER (Rn)
UCS - UNCONFINED COMPRESSIVE STRENGTH
DNF - DID NOT FAIL

C:\TYPING\COREDBORE\BB4-P1.KSN

CORED BOREHOLE LOG

PROPOSED FISHING BOAT HARBOUR – BREMER BAY

LOCATION	TOWN/CITY/SHIRE	BOREHOLE No. BB#4	Sheet 2of 3
FISHERY BEACH	BREMER BY – JERRAMUNGUP SHIRE		

BOREHOLE LOCATION: SOUTH WEST OF PROPOSED QUARRY

DRILLING RIG:	TRH 200	**DATE COMMENCED:**	17/06/94	**AMG GRID REFERENCE:**	E	720 416
DRILLER:	B EDWARDS	**DATE COMPLETED:**	18/06/94		N	6 187 811
BARREL TYPE & LENGTH:	NQ 1.5 m	**SUPERVISED BY:**	PIM	**ANGLE FROM HORIZONTAL**		–60
BIT TYPE:	GOLDFIELDS DIAMOND IMPREG.	**CHECKED BY:**	PIM	**BEARING:**		230°
DRILLING FLUID:	WATER			**R.L. SURFACE:**		12.65
				DATUM:		DMH 051

GEOLOGICAL UNIT	DESCRIPTION OF CORE	WEATHERING	ESTIMATED STRENGTH	CEMENTATION	DESCRIPTION AND ORIENTATION OF ROCK DEFECTS & COMMENTS (Particular / General)	WATER LEVEL	LIFT AND CORE RECOVERY	R. Q. D.	TESTS	METHOD	CASING
	GNEISS Blue grey, banded, medium grained. Quartz, feldspar and mica minerals as major constituents	FRST	H M		8.05 J2 30/290 ZR FLM OX J19.12 45/225 3SR FLM OX 9.44 Ш4 3R 15/ 160, INF QZ, C2-3 mm 9.55 9.65		100	100	Is(50) 1.79		
	NO CORE	ND	ND		9.90						
	GNEISS Blue grey, banded, medium grained. Quartz, feldspar and mica minerals as major constituents	FRST	H		10.30 J1 (2x) 60/SR-INF C.						
	NO CORE	ND	ND		10.40 Driller noted rapid penetration through core. Probably weathered zone between joints.		89	71	Is(50) 8.61		
GRANITIC GNEISS	GNEISS A/A	FR	H		X3 40/270 3R CLEAN	100	93	100	Is(50) 8.75		
							107	100		NQ	
					14.05 J1 45/030 2R FLM OX 14.45 J3 60/005 (X2) 3R CLEAN 14.94 J1 60/030 2 R FLM OX		100	97	Is(50) DNF		
					15.52 J3 55/030 3R CLEAN 15.55				Is(50) 7.56		
	FELSIC DYKE Pink, coarse crystalline feldspathic dyke										

WEATHERING

- CW - COMPLETELY WEATHERED
- HW - HIGHLY WEATHERED
- MW - MODERATELY WEATHERED
- SW - SLIGHTLY WEATHERED
- FR - FRESH

METHOD

- NMLC
- NQ - WIRELINE
- HQ - WIRELINE
- PQ - WIRELINE
- R - ROLLER TRICONE

CASING

- NW
- HW
- PW
- HQ

ESTIMATED STRENGTH

- EL - EXTREMELY LOW
- VL - VERY LOW
- L - LOW
- M - MEDIUM
- H - HIGH
- VH - VERY HIGH
- EH - EXTREMELY HIGH

DEGREE OF CEMENTATION

- UC - UNCEMENTED
- PC - POORLY CEMENTED
- MC - MODERATELY CEMENTED
- WC - WELL CEMENTED

- N/A NOT APPLICABLE
- NC NO CORE RECOVERED
- ND NOT DETERMINED
- * ESTIMATED

WATER

- ⊢─ WATER INFLOW
- ─⊣ COMPLETE DRILLING WATER LOSS
- ⊢─⊣ PARTIAL DRILLING WATER LOSS
- 100% WATER RETURN

TESTS

- PM - PRESSUREMETER TEST (MPa)
- L - PRESSURE TEST (LUGEONS)
- Is(50) - POINT LOAD INDEX
- N - S.P.T.
- U - TUBE SAMPLE
- D - DISTURBED SAMPLE
- SM - SCHMIDT REBOUND HAMMER (Rn)
- UCS - UNCONFINED COMPRESSIVE STRENGTH
- DNF - DID NOT FAIL

C:\TYPING\COREDSOR\BB4-P2.k5N

CORED BOREHOLE LOG

PROPOSED FISHING BOAT HARBOUR – BREMER BAY

LOCATION	**TOWN/CITY/SHIRE**	**BOREHOLE No.** BB#4	Sheet 3 of 3
FISHERY BEACH	**BREMER BY – JERRAMUNGUP SHIRE**		

BOREHOLE LOCATION: SOUTH WEST OF PROPOSED QUARRY

DRILLING RIG: TRH 200
DRILLER: B EDWARDS
BARREL TYPE & LENGTH: NQ 1.5 m
BIT TYPE: GOLD FIELDS DIAMOND IMPREG.
DRILLING FLUID: WATER

DATE COMMENCED: 17/06/94
DATE COMPLETED: 18/06/94
SUPERVISED BY: PIM
CHECKED BY: PIM

AMG GRID REFERENCE: E 720 416 N 6 187 811
ANGLE FROM HORIZONTAL –60
BEARING: 230°
R.L. SURFACE: 12.65
DATUM: DMH 051

GEOLOGICAL UNIT	DESCRIPTION OF CORE	WEATHERING	ESTIMATED STRENGTH	CEMENTATION	GRAPHIC LOG	☐☒ RL (m)	DEPTH (m)	DEFECT SPACING (mm) 10 30 100 300 1000 3000	DESCRIPTION AND ORIENTATION OF ROCK DEFECTS & COMMENTS Particular	General	WATER LEVEL	LIFT AND CORE RECOVERY	R. Q. D.	TESTS	METHOD	CASING
	GNEISS A/A	FR	H		~ ~			▨	EOH 16.55			100	100	Is(50) DNF		

WEATHERING

CW COMPLETELY WEATHERED
HW - HIGHLY WEATHERED
MW - MODERATELY WEATHERED
SW - SLIGHTLY WEATHERED
FR - FRESH

METHOD

NMLC
NQ - WIRELINE
HQ - WIRELINE
PQ - WIRELINE
R - ROLLER TRICONE

CASING

NW
HW
PW
HQ

ESTIMATED STRENGTH

EL - EXTREMELY LOW
VL - VERY LOW
L - LOW
M - MEDIUM
H - HIGH
VH - VERY HIGH
EH - EXTREMELY HIGH

DEGREE OF CEMENTATION

UC - UNCEMENTED
PC - POORLY CEMENTED
MC - MODERATELY CEMENTED
WC - WELL CEMENTED

N/A NOT APPLICABLE
NC NO CORE RECOVERED
ND NOT DETERMINED
* ESTIMATED

WATER

WATER INFLOW
COMPLETE DRILLING WATER LOSS
PARTIAL DRILLING WATER LOSS
100% WATER RETURN

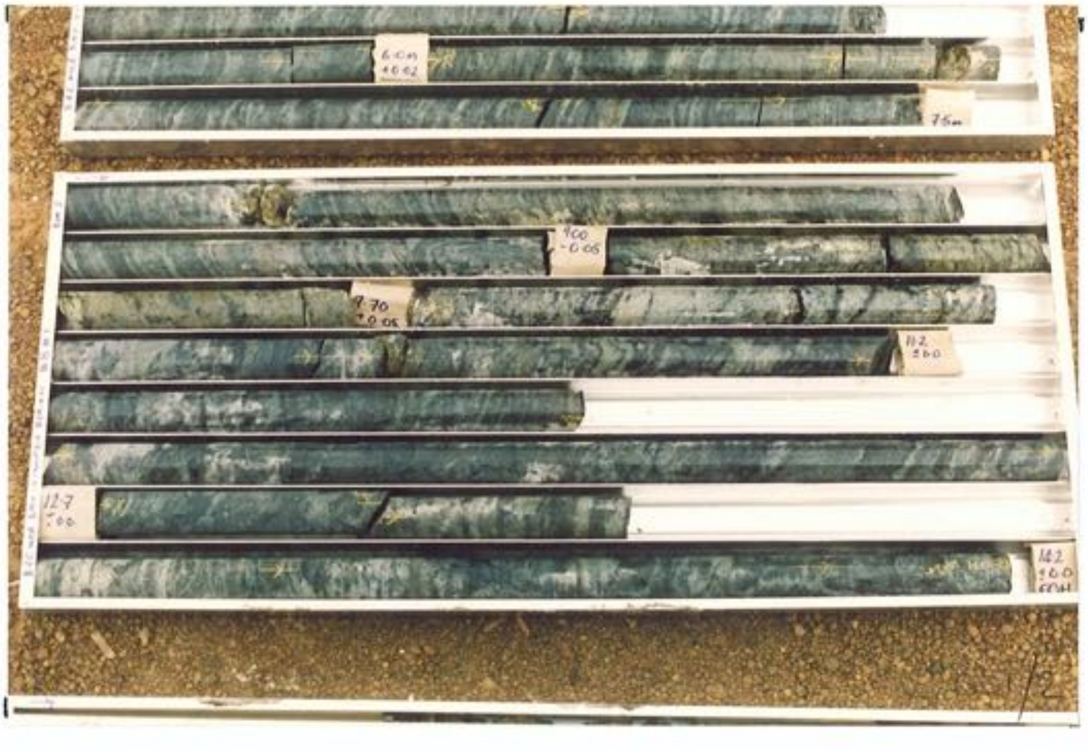
TESTS

PM - PRESSUREMETER TEST (MPa)
L - PRESSURE TEST (LUGEONS)
Is(50) - POINT LOAD INDEX
N - S.P.T.
U - TUBE SAMPLE
D - DISTURBED SAMPLE
SM - SCHMIDT REBOUND HAMMER (No.)
UCS - UNCONFINED COMPRESSIVE STRENGTH
DNF - DID NOT FAIL

C:\TYPING\COREDBOR\BB4-P3.KSN

APPENDIX 3

Core Photography



GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

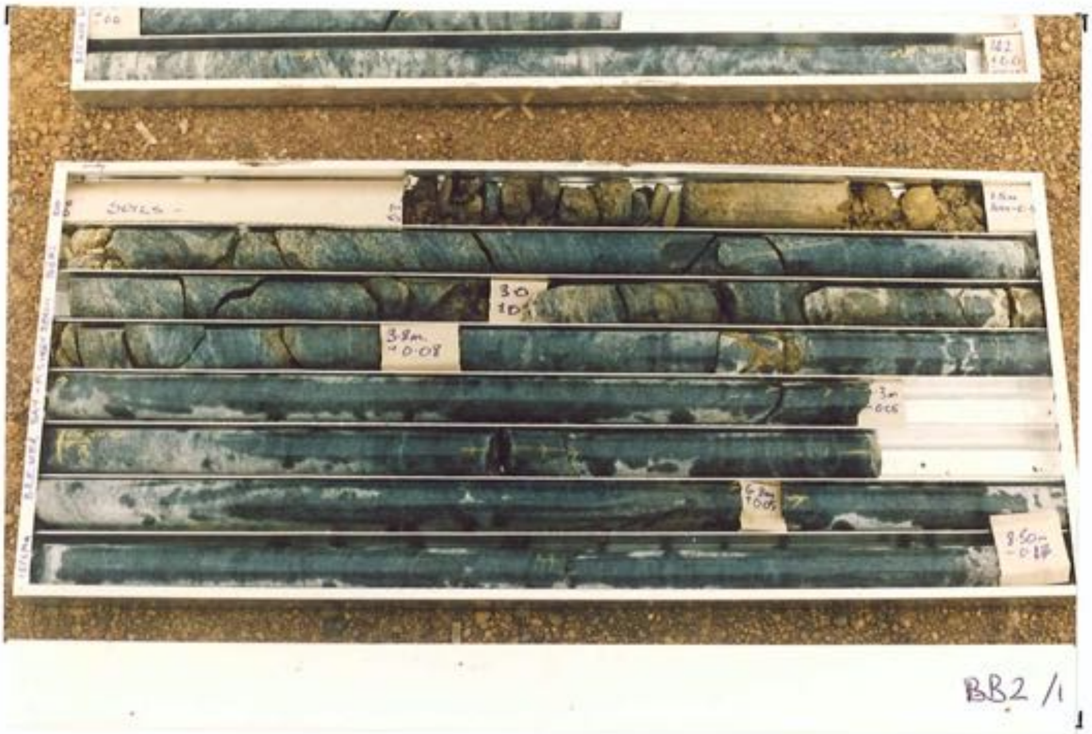
	INITIAL	DATE
COMP	PIM	8/94
DRAWN	—	—
CHKD	PIM	8/94
APVD	AF	12/94

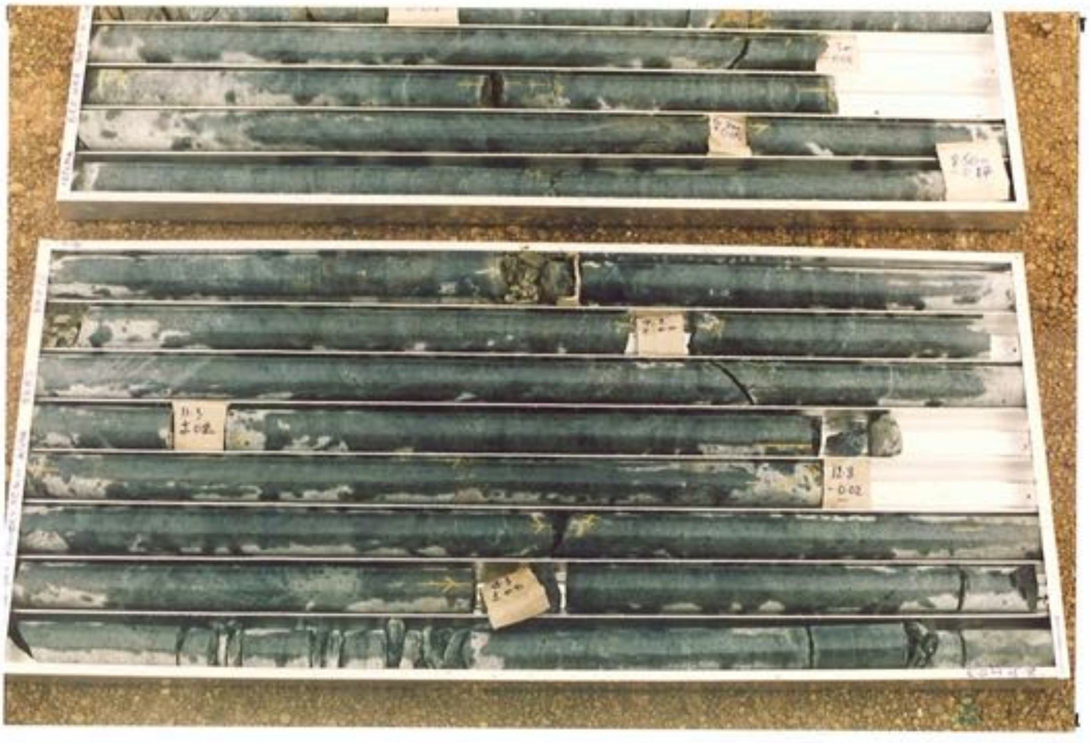
Core Photographs BB#1

TO ACCOMPANY EG 424

MAP INDEX

24780/3/83—2500—H/1995





GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

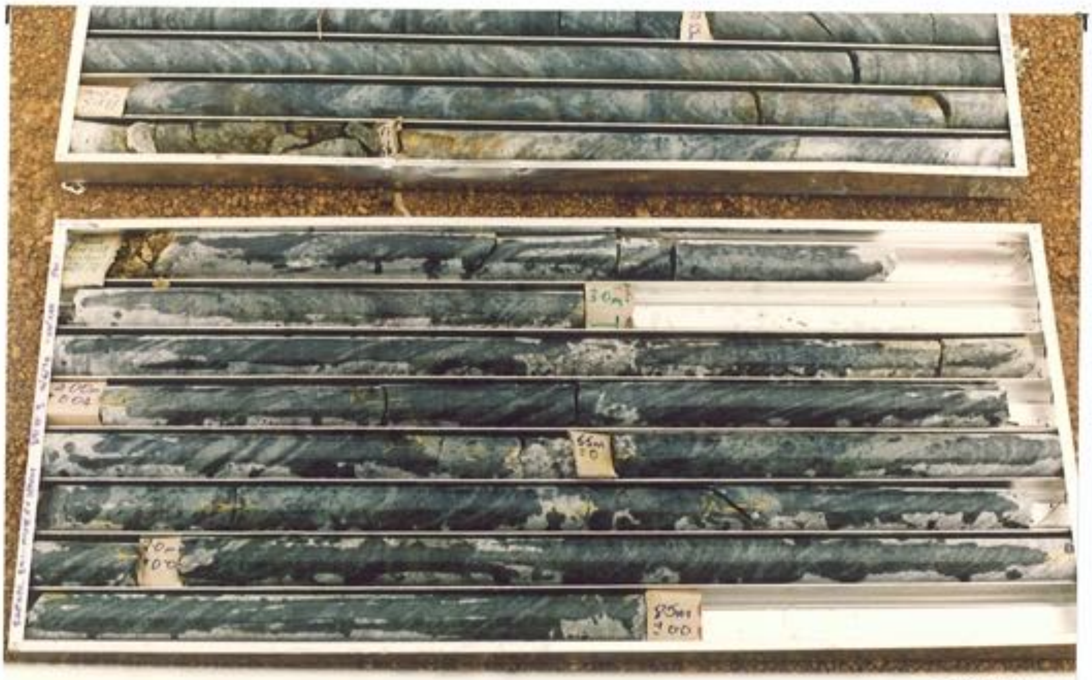
	INITIAL	DATE
COMP	PIM	8/94
DRAWN	—	—
CHKD	PIM	8/94
APVD		12/94

Core Photographs BB#2

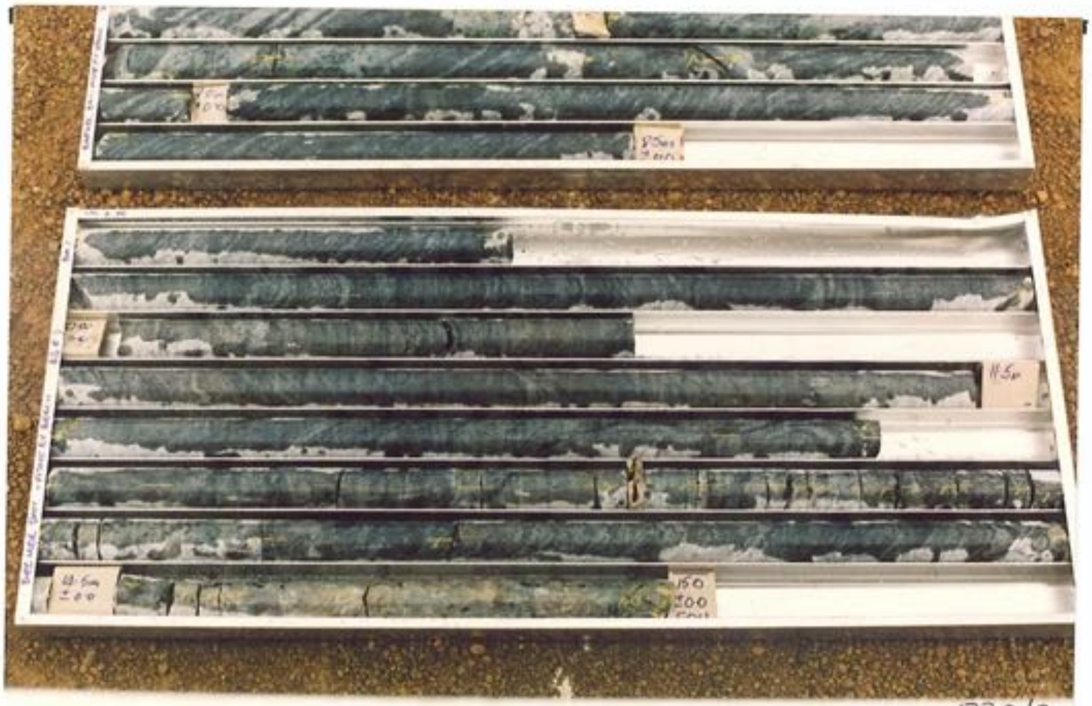
MAP INDEX

TO ACCOMPANY EG 424

24780/3/83—2500—H/1995



BB3/1



BB3/2

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

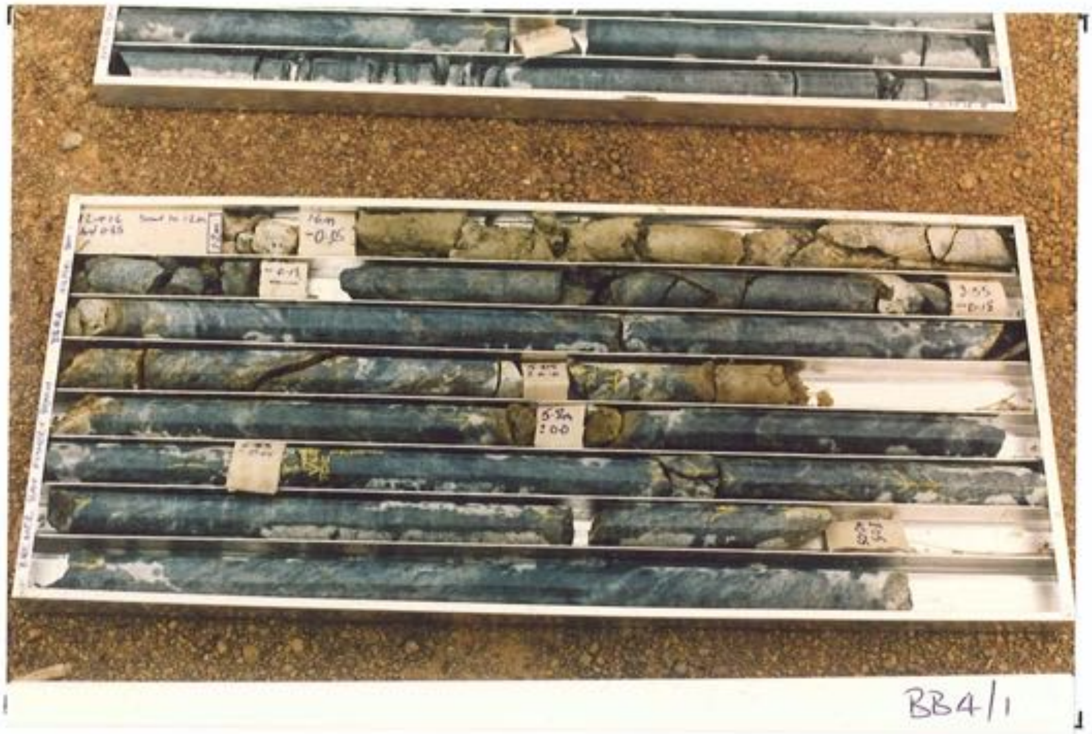
	INITIAL	DATE
COMP	Pum	8/94
DRAWN	—	—
CHKD	Pum	8/94
APVD	AE	12/94

Core Photographs BB#3

MAP INDEX

TO ACCOMPANY **EG 424**

24780/3/83—2500—H/1995


BB4/1

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

	INITIAL	DATE		
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DRAWN	—	—		
CHKD	IvM	8/94		
APVD	AF	12/94	TO ACCOMPANY EG 424	

24780/3/83—2500—H/1995

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:

massive	few joints or very wide spacing
blocky	approximately equidimensional
tabular	one dimension considerably smaller than the other two
columnar	one dimension considerably larger than the other two
irregular	wide variations of block size and shape
crushed	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:

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

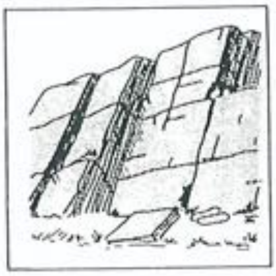
Quarrying

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

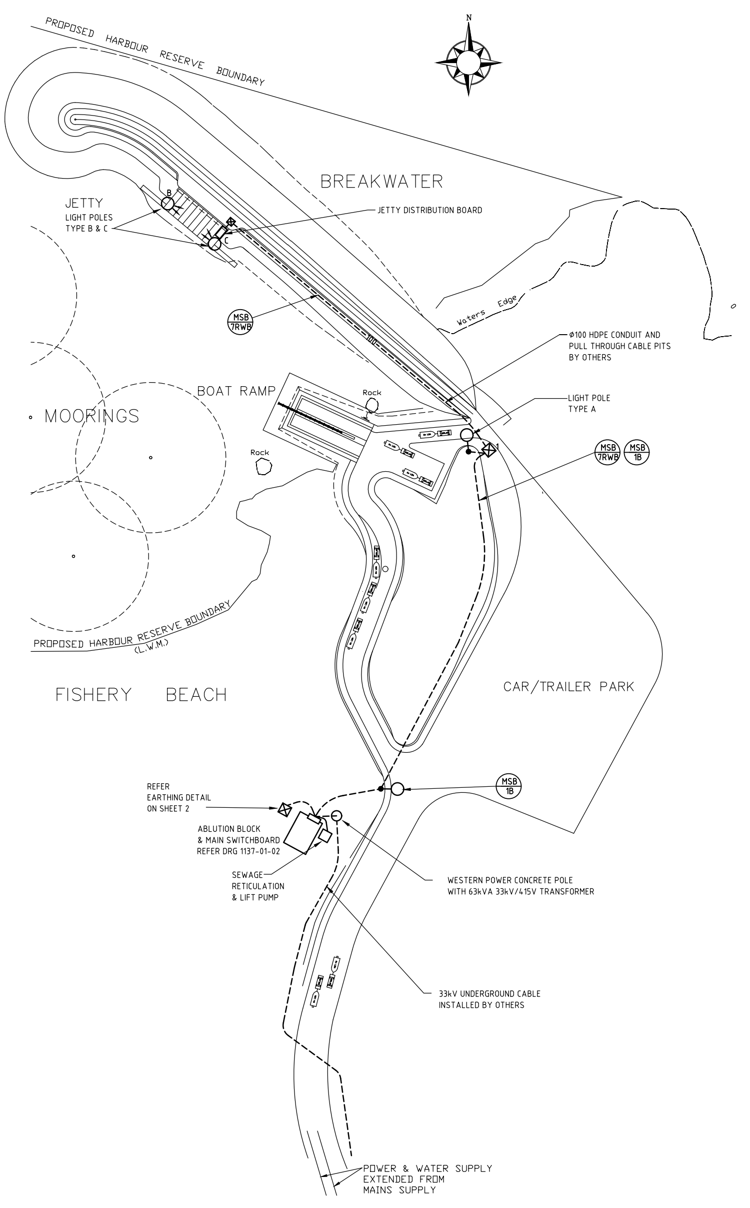
Irregular



Tabular

Columnar

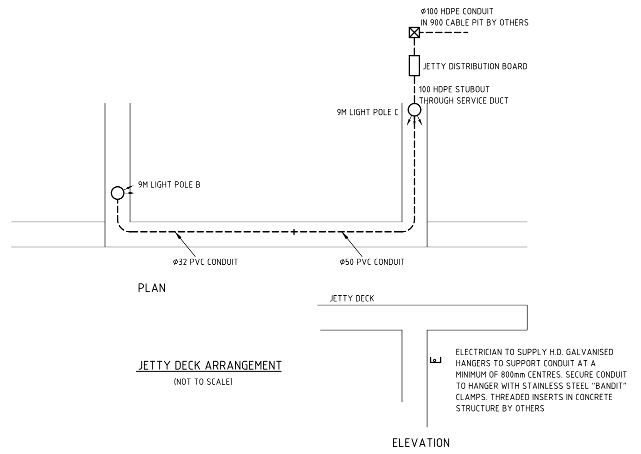
ATTACHMENT 6 SERVICES



LIGHTNG ARRANGEMENT

SCALE 1:1000

(FOR LOCATIONS OF ABLUTION BLOCK REFER TO ARCHITECTS DRAWINGS)
(FOR LOCATIONS OF TYPE A LIGHT POLES REFER TO SUPERINTENDANT)



JETTY DECK ARRANGEMENT

(NOT TO SCALE)

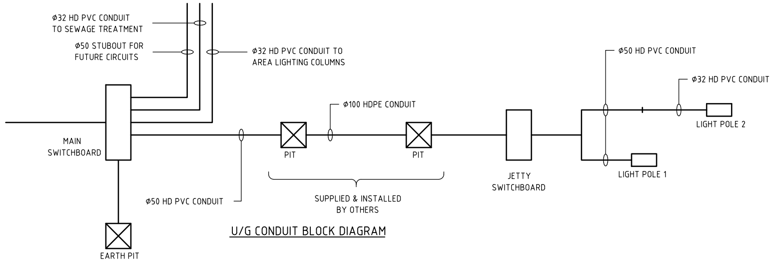
ELECTRICIAN TO SUPPLY H.D. GALVANISED HANGERS TO SUPPORT CONDUIT AT A MINIMUM OF 800mm CENTRES. SECURE CONDUIT TO HANGER WITH STAINLESS STEEL "BANDIT" CLAMPS. THREADED INSERTS IN CONCRETE STRUCTURE BY OTHERS

SYMBOL LEGEND

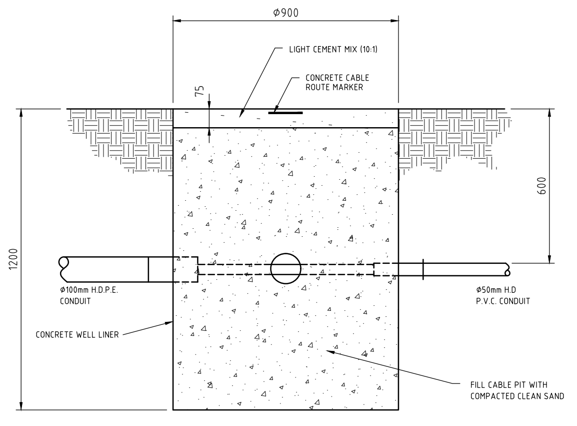
- ☒1 CABLE PULL THROUGH PIT, Ø900 WELL LINER
- ●—○ 9 METRE SEE-SAW POLE, TYPE A
- ○< 9 METRE SEE-SAW POLE, TYPE B & C
- — — 100 — — Ø100mm H.D. P.V.C. CONDUIT - MINIMUM COVER 600mm

CIRCUIT SYMBOL

- MSB/3R — SWITCHBOARD DESIGNATION
- — CIRCUIT NUMBER & PHASE



U/G CONDUIT BLOCK DIAGRAM



TYPICAL CABLE PULL
THROUGH PIT (TYPE 1)

(SCALE 1:10)

© NELSON MARDARDY
AND ASSOCIATES

CONSULTING ENGINEERS
1st FLOOR, PIEDMONT HOUSE
849 WELLINGTON STREET
WEST PERTH W.A. 6005

TEL: (09) 321 8177
FAX: (09) 321 9083

A.C.N. 008 894 817

DEPARTMENT OF TRANSPORT

Halpern Glick Maunsell
CONSULTING ENGINEERS
1 Ord Street, WEST PERTH W.A. 6005
Telephone: 321 4844 Fax: 324 1079

BREMER BAY
FISHERY BEACH BOAT HARBOUR

ELECTRICAL SERVICES
LIGHTING, UNDERGROUND CONDUITS AND
EQUIPMENT LOCATIONS

DESIGNED V.M.R.	DRAWN A.G.R.	CHECKED V.M.R.
DATE 25/10/95	SCALE 1:1000	

JOB No. 878
SHEET 1 OF 4
DRAWING No. E1A

REVN	ZONE	DATE	AMENDMENT	DRN	DESIGN APPROVAL
F		5/11/07	HOIST REMOVED - AS BUILT	CG	
E		23/10/06	REVISED - AS BUILT	CG	
D		12/7/04	AS BUILT	CG	PM
C		26/8/02	DRAWING No. WAS D.O.T 870-4-1 Rev B	CG	

ORIG SIZE	M/FILM	FILE No	SURVEY BOOKS
A1	MFILM	FILENO	SURVBOOKS

GENERAL NOTES

\ElecArchive\ELEC\Bremer Bay1137\1137-01-01.dwg

SCALE: AS SHOWN

UNLESS OTHERWISE STATED DIMENSIONS IN mm

DATUM:
HORIZ:
VERT:

0 10 20 30 40 50 100 150mm
BAR MEASURE INDICATES IF SCALES HAVE BEEN VARIED

DESIGNED
CHECKED
DRAWN
CHECKED
PROJECT MANAGER
PROJECT MANAGER DATE

APPROVED
APPROVED
APPROVED
AUTHORISED
DIRECTOR COASTAL & FACILITIES MANAGEMENT

Department for Planning and Infrastructure

Government of Western Australia

BREMER BAY - FISHERY BEACH BOAT HARBOUR
ELECTRICAL INFRASTRUCTURE
LIGHTING, UNDERGROUND CONDUITS AND EQUIPMENT
ARRANGEMENT AND DETAILS

DRAWING NUMBER 1137 - 01 - 01

REVN F

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ACN: 69 155 753 361