

Design and Construction of a Seawall for Dredged Mud Reclamation and Port Development - Port of Brisbane

Griffith University - 2 October 2008
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Summary of Presentation

- Introduction
- Geotechnical Investigations and Site Conditions
- Constraints and Risks
- Construction Trials
- Design and Construction
- Rock, Sand and Geotextiles – Delivery and Placement

The Alliance Team



Constructor



PORT OF BRISBANE
CORPORATION

Owner/Client



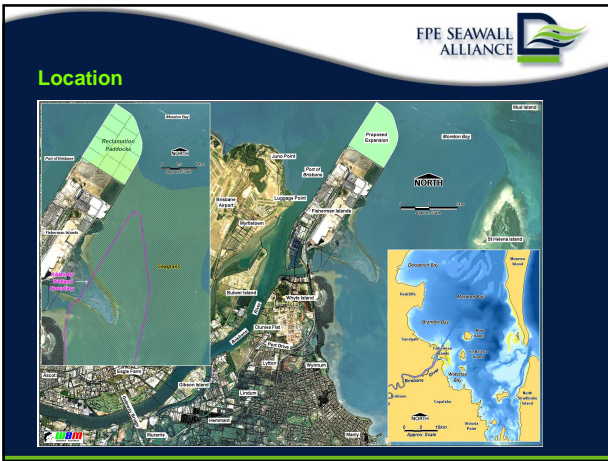
Geotechnical



Coastal / Ecological



Environmental / Civil



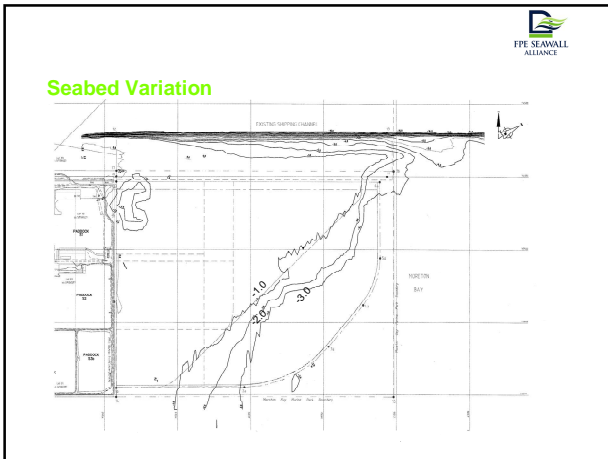
Scope

Purpose of reclamation area

- To enable future Port development
- To enable disposal of Maintenance Dredging Spoil (storage capacity of approx 25Mcm over next 20 – 25 years)

- Extension of Fisherman Islands by 1.8 km to the NE with provision for future berth development
- 4.6 km wall to enclose 230ha footprint which will enable progressive development of the site
- Final wall level in Stage 1 RL + 4 m (6 metres wide)
- Second stage – reclaiming the land will take around 15-20 years





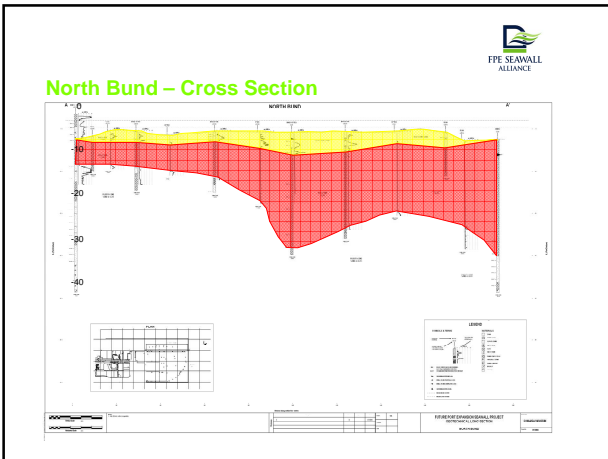
Geotechnical Investigations

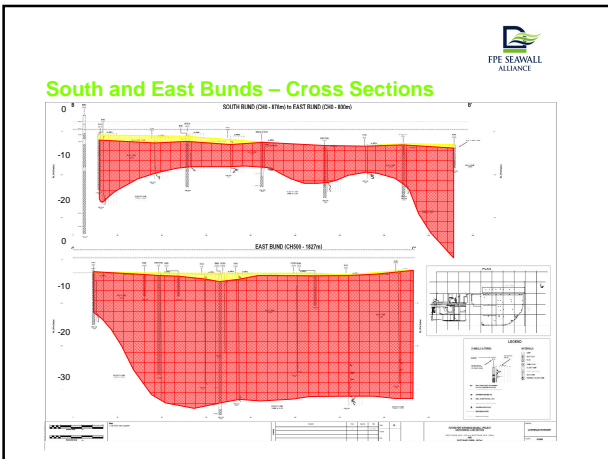
- Boreholes and Piezocones
- Limited vane shear testing in boreholes
- limited number of dissipation tests
- Laboratory tests


Geotechnical Conditions

Geology – Quaternary marine deposits

- Holocene deposits overlying Pleistocene deposits overlying Petrie Formation (basalt rock)
- Holocene alluvial deposit has 2 sub layers
 - upper layer : mainly sand with interlayered soft clays & silts (0-4m)
 - Lower layer : highly compressible, soft to firm clay (sand layers relatively few or absent) (8 to about 30m)
- Pleistocene deposit
 - Older alluvial deposit
 - Mainly very stiff to hard clays and medium dense to dense sands
 - Compressibility relatively low

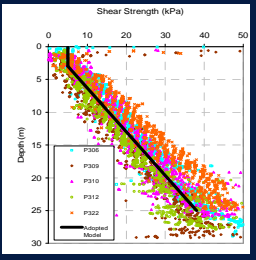






Geotechnical Models

- Several geotechnical models adopted along the alignment based on strength variation and the soil profile
- Use corrected vane shear test results and piezocone test results to obtain the strength models
- For settlement analyses, lower and upper bound values selected based on laboratory and field data



The Challenge / Risks

- Up to 30 metres depth of compressible clay
- Marine environment with adjacent marine park
- Very shallow water (1m at Low tide) for 50% length, and deep water on the east bund (more than 6m at High tide)
- Site in sensitive location at mouth of Brisbane River
 - Strict turbidity controls, Sensitive sea grass
 - Sensitive shore / wader bird roost
- Limited thickness of sand at seabed level on the east bund
- Very soft clay at seabed on east bund
- Settlement of 1m to 2m during construction alone

Construction Trials

Trial Bunds –Why?

- Construction techniques & productivity rates
- Penetration into seabed
- Toe heaving/mud waving
- Suitability of construction materials
- Turbidity
- Laying of geotextile
- Potential damage to geotextile
- Geotechnical stability parameters
- Suitability of geotechnical instrumentation
- Environmental impacts and monitoring procedures

Proposed Trials

- Inshore Trial – land based, trial on southern bund
- Offshore Trial – marine based, on the eastern wall
- Geotextile Damage Trials

Geotextile Design and Trials



- Both HS and filtration geotextiles subjected to a series of damage trials as no data available for placement and trafficking of rock on geotextiles.
- Critically assessed results and created damage factors which essential meant higher grades or mass of geotextile required
- UV degradation & Seam testing conducted
- DAMAGE TRIALS & SEAM TESTING



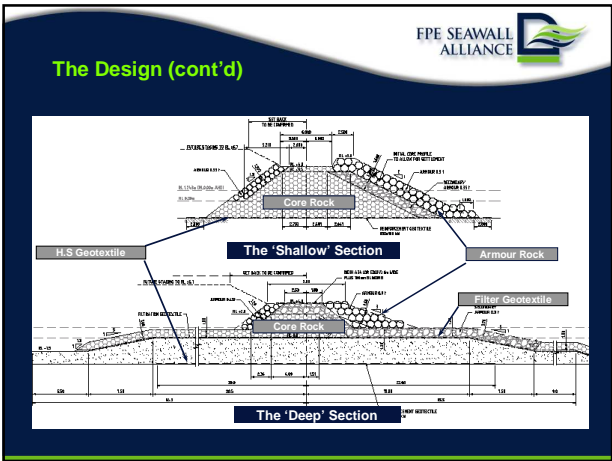
Placement Trials



The Design



- Shallow Section - Rock Bund overlying high strength geotextile
- Deep Section – A sand blanket is placed on a high strength geotextile prior to placement of a filtration geotextile and rock overlay
- Armour Rock protection to outer face to protect against weather
- Final Level to RL+4
- Overall Length 4.6 km with turning bays every 200m



EPE SEAWALL ALLIANCE

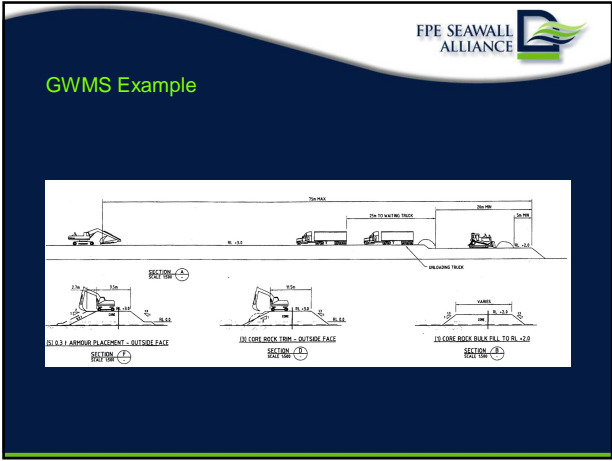
Design and Construction Process

Interactive design and construction process controlled by:

- Geotechnical Work Method Statement (GWMS)

Describes the procedure for construction to minimise risk of slip failures e.g.

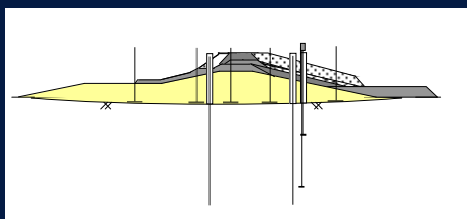
 - Machinery type, no, location
 - Maximum bund levels
 - No. of loads and locations for dumping
- Instrumentation and Monitoring



Primary Settlement Stations



Typical Cross Section



Analysis

- Stability analysis
 - SlopeW software
 - Transverse and longitudinal stability
- Settlement Prediction
 - CAOS (allows for fill submergence) by Prof Poulos
 - Upper and lower bounds
 - Geometry modified to allow for settlements

Materials Used

- Total sand volume – 400,000 m3
- Total high strength geotextile – 200,000 m2
- Total filter geotextile – 155,000 m2
- Total rock volume – 690,000 m3

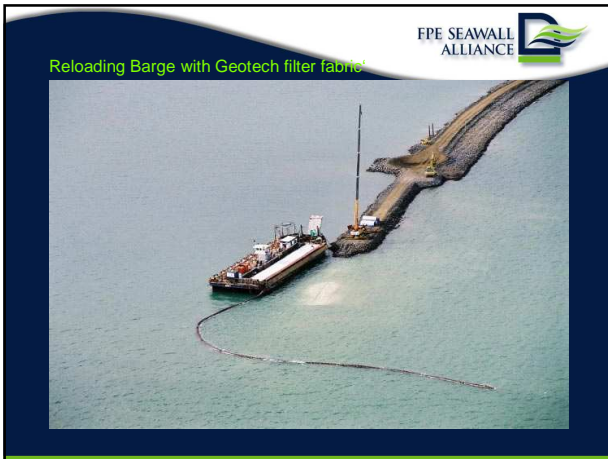
Rock Delivery and Placement

- Rock delivered by rail @ 3,200 tpd from Beaudesert
- Modified tipping 'Skel' trailer to work face
- Rock placed by end tipping / dozing and trimming
- Total 1.2 million tonnes



Placement of sand

- Hydraulic placement - avoid slips
- Hydrographic surveys
- Re-assessment of design
- Alteration of rock profiles based on results


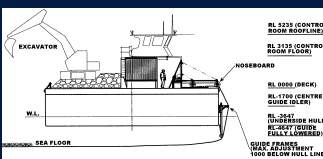


Geotextiles

- Use of high strength geotextile (400-850kN/m) – minimal penetration of rock into seabed and avoid turbidity due to seabed disturbance
- Use of robust filtration geotextiles to reduce damage from rock
- Geotextile stitching – trial stitches and testing
- Geotextile damage due to rock and trafficking – Land trials
- Geotextile placement – Occurrence of folds, alignment
- Checking by divers

Geotextile Placement

- Original known system was to stitch together & roll up large panels up to 25m on mandrel and use multiple barges
- New innovate system developed using geotextile panels upto 40m by 100m folded then rolled. No mandrel required, only 1 barge required
- Prototype of laying barge

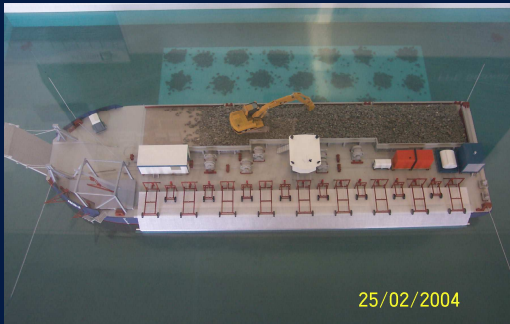
Geotextiles

The Geotextile

- H.S. Geotextile stitched in Toowoomba (200,000m²)
- Filter Geotextile stitched in Southport (155,000m²)
- Stitched geotextile placed by purpose built barge



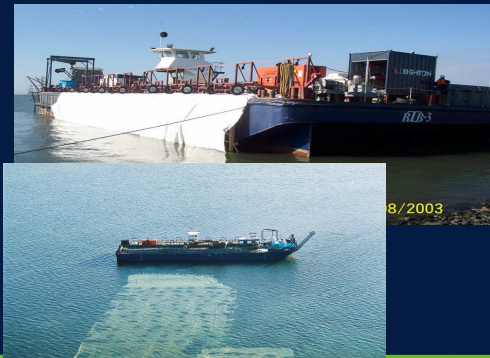
Geotextile Deployment System



Geotextile Deployment System



BARGE IN ACTION



MULTI PURPOSE BARGE



After laying high strength geotextile, placed sand & filter fabric, then covered by rock



PROJECT REALITY



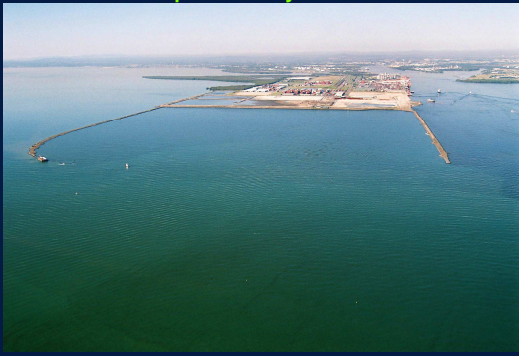
East Bund under construction



Aerial from South p/e February 04



Aerial from North p/e February 04



2008





Thank you
