Boskalis
Dredging & Marine Experts

PROJECT SHEET

CHANNEL DEEPENING PROJECT, MELBOURNE, AUSTRALIA

INTRODUCTION

To maintain its position as number one container and general cargo port in Australia, the Port of Melbourne Corporation (PoMC) proposed a plan to make the port accessible to 14m draught vessels during all tidal phases. PoMC currently handles 37% of Australia's container trade worth A$90m per day in exports, comprising 3,500 commercial ship calls per year and 2 million containers annually. By 2035, PoMC aims to handle 7,000 TEU vessels and increase traffic to 8 million containers annually. Over time, the Channel Deepening Project is expected to deliver A$2 billion in economic benefits to the State of Victoria. From an economic standpoint alone it was clear the project would deliver benefits to the state of Victoria. From an environmental and social perspective, the design, execution and public relations challenges were numerous and complex.

PROJECT ELEMENTS

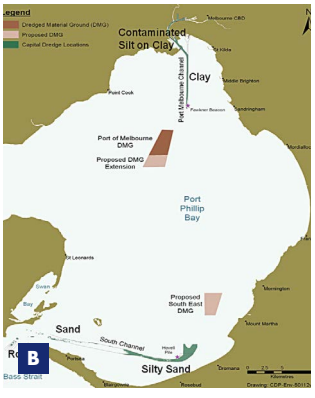
The Alliance contract was chosen by PoMC to cover the high technical and environmental risks during the execution phase of the project. The tender process began in August 2003, followed shortly thereafter by the development of a contractor shortlist and finally the selection of a preferred contractor by PoMC following an extensive interview and workshop process. The key selection elements adopted by PoMC for their choice of contractor were:

- Innovative techniques for dredging and marine engineering applications
- Environmental awareness and the ability to strictly comply with license conditions
- The ability to effectively operate under an alliance style contract
- The ability to communicate in a fair and open way in an alliance environment.

Following the selection in April 2004 an Alliance Agreement was developed between PoMC and Boskalis Australia Pty Ltd, i.e, a contract where risk sharing was the norm and Boskalis could provide advice during the project development phase using its 'in house' expertise and experience. Also during this time, Boskalis assisted with the development of the Environmental Effects Statement (EES) and eventually the Supplementary Environmental Effects Statement (SEES), with final approval taking place in December 2007. The project, valued at approximately Euro 300m, was jointly executed by the Boskalis-PoMC Alliance and covered the alliance fundamentals; i.e. actions and decisions are to be made with an open book policy, based on 'Best for Project' principles. Innovative dredging techniques were needed throughout the project: at the Entrance to Port Phillip Bay, rough seas, strong tidal currents and a limestone seafloor required the use of a large Trailing Suction Hopper Dredge (TSHD) and the development of a unique draghead along with offshore Oil & Gas industry developed technology to effectively dredge the sea bottom. The dredging of very fluid contaminated silt from the Yarra River required

FEATURES

Client	Port of Melbourne Corporation
Location	Melbourne and Port Phillip Bay, Victoria, Australia
Period	**Preparation:** including the tender, EES and SEES: August 2003 – January 2008 **Execution:** February 2008 – November 2009
Contractor	Boskalis Australia Pty Ltd



A Location map
B Project outline
C TSHD Queen of the Netherlands in Port Phillip Bay with Melbourne's skyline in the background.

controlled disposal at an under-water containment site. Therefore stiff clays, which were dredged from within the channels, were used to create an underwater bund to surround the dredged material relocation site for the placement of the dredged contaminated silt. To achieve full containment, these contaminants were later capped with 0.5 m sand using a specially developed spreader device attached to the dragarm of a trailer suction hopper dredger.

Service protection works*) were required to protect the sewer and oil & gas pipelines crossing the Yarra River. These services would have their existing level of protection reduced as a result of the channel deepening works. To withstand the impact by the drop and drag of anchors on these services, Boskalis developed a plan for the construction of a rock protection, rather than moving the existing pipelines to a deeper level. The Boskalis solution was determined to be a more economical alternative but required highly precise stone-laying accuracy .

Regarding environment*), high priority was placed on the following:

- The threat of rocks falling on the sponge gardens and corals in the canyon at the entrance to Port Phillip Bay
- The migration of the contaminated silt by dredging in the Yarra River
- An increase in turbidity as a result of dredging which could cause damage to the unique fauna and flora of Port Phillip Bay.

Finally, proper communication was key to establishing confidence with media and stakeholders. Through the concerted efforts of PoMC and Boskalis, progress, performance and incident reports were made publicly available through PoMC's website and weekly press conferences were held by PoMC. This transparency ultimately led to the project's acceptance by the wider community.

EARLY CONTRACTOR INVOLVEMENT

Starting with the signing of the Alliance Agreement in May 2004, Boskalis Australia actively participated in the planning and preparation for the project. This led to the following actions.

1: DREDGING THE ENTRANCE

A crucial first step was the dredging of the Entrance, which is located near the Port Phillip Heads Marine National Park, a highly prized reef and natural habitat. Explosives were last used to widen the Entrance in 1986 but were considered such an environmentally hazardous activity that they were not to be used again. Dredging was therefore considered the only viable option for the deepening of the Entrance. Dredging in the Entrance, however, was a difficult proposition as the Entrance is known for its rocky seafloor and turbulent seas, where waves of 3m and currents of up to 8 knots are regularly experienced. Techniques and equipment traditionally used for dredging hard seabead materials were therefore likely to encounter difficulties whilst undertaking dredging activities in the Entrance.

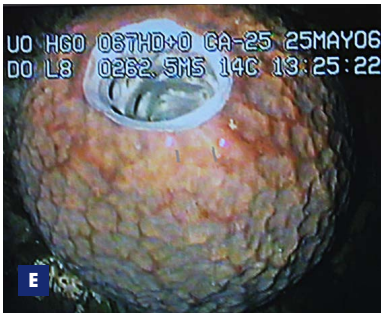
Boskalis concluded that dredging works in the Entrance would be best suited to a large and powerful TSHD since this type of dredging plant is highly manoeuvrable and better suited to working in severe weather conditions. However, the dredging of rock with a TSHD presented further challenges. Early involvement of the Boskalis R&D Department, Central Technical Department (CTD) and Dredging Department resulted in the development of a new type of draghead, known as the ripper draghead, that could be mounted on a large TSHD.
Full-scale tests were conducted in a quarry to obtain more insight into the ripper draghead's design prototype cutting characteristics. Laboratory model suction tests were conducted and also finite element calculations supported the design process. The TSHD's crew also received training on a ship simulator to prepare them for operations in the Entrance. The final test of the ripper draghead was then undertaken when it was installed on the TSHD Queen of the Netherlands and adredging trial in the Entrance was carried out for a period of two weeks.

2: SERVICE PROTECTION WORKS

Early contractor involvement also allowed Hydronamic, the engineering research arm of Boskalis together with the Central Technical Department to be involved with the "service protection works*)" including: > Placement engineering of 10 cm steel plates covered with 25 cm shock absorbing concrete above the 2.5 m diameter sewer > The design of grouted rock layers above the gas and oil pipelines including the design and construction of the grouting equipment.


D

D Ripper Draghead
E Sponges of approximately 60cm at 65m water depth
F Sponges of approximately 53m water depth



E

F

3: REMOVAL OF CONTAMINATED SILT IN THE YARRA RIVER

Boskalis and Hydronamic also helped prepare work methods for the removal of the contaminated silt in the Yarra River, for the placement of the contaminated material in a bunded disposal site and for placement of the sand cap. The Boskalis patented diffuser was modified for the placement of contaminated silt and a 12-m wide spreader for the TSHD was developed to cap the contaminated silt with sand.

4: ASSISTING WITH THE SUPPLEMENTARY ENVIRONMENTAL EFFECTS STATEMENT (SEES)

Furthermore, Boskalis assisted PoMC with the Supplementary Environmental Effects Statement, clarifying and justifying equipment selection, participating in the rock fall assessment, fauna mapping in the Entrance and sampling of contaminated soil. Boskalis also cooperated with PoMC in developing the Environmental Management Plan. Overall, Boskalis's participation in the SEES was vital to optimize work methods to meet strict environmental controls and intense government scrutiny.

THE WORKS

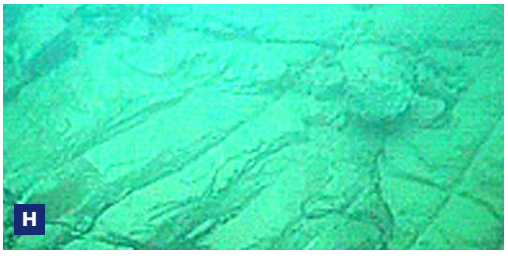
Dredging works commenced in early February 2008 and were completed in November 2009. At the Entrance, the TSHD Queen of the Netherlands installed with the specially designed ripper draghead was deployed to dredge the limestone seafloor. The work method applied was aimed at efficiently removing the hard seabed materials while minimizing the likelihood that any residual rock would be relocated into the 100-m deep canyon and damage the precious sessile fauna like sponges and soft cor-als. Part of the work method for the dredging of the Entrance involved

G The operation in full swing: three Boskalis TSHD's working together
H Dredged bottom after cleaning up
I Dredged bottom with regrowth in the entrance
J Spreader for the capping of the contaminated silt

cleaning the seafloor of loose rubble for 18 hours after every 24,000 m^3 of dredging. The clean up procedure was effective as verified by video surveys after completion of the Entrance. Later surveys have shown regrowth of the original kelp vegetation.

At the Yarra River and Williamstown Channel, toxicity tests conducted as part of the SEES determined that all silt in these areas were contaminated. Therefore, an underwater disposal facility in the Port of Melbourne Dredge Material Ground (DMG) was created for the safe disposal of 1.4 Mm^3 of contaminated silt in approximately 20m deep water. A 5-m high clay bund with 40 m crest width to enclose the 2000 x 600 m area was built by the TSHD Queen of the Netherlands with clay dredged from the northern channels. The contaminated silt was then dredged by the TSHD Cornelis Zanen and discharged through a Boskalis-patented diffuser into the disposal area to avoid mixing of contaminated material with ambient water during placement. Thorough position control and recording of the dredger ensured the complete removal of all contaminated material.

After a break of 140 days, as stipulated by the SEES, the TSHD Queen of The Netherlands began capping operations. This vessels large hopper capacity was favourable for the long sailing distance between the sand source in South



Channel West and the PoMC-DMG. The newly developed 12-m wide spreader ensured an even outflow over the full width of the spreader. The innovative configuration of jets and hopper sections on the Queen of The Netherlands resulted in a constant discharge capacity with a constant mixture concentration. Hydrographic surveys guided the capping process and the 0.5-m cap was placed within 6 weeks.

Also during the SEES, a turbidity model was calibrated based on measurements during the dredging trial. The modelling results provided realistic environmental turbidity limits. For management purposes two response levels were defined to enable early and consistent response if the measured turbidity levels were increasing. During the dredging works Boskalis managed a system of 20 buoys, which were used to check compliance as well as to support further reporting purposes such as background values. Based on these measured turbidity results, the work method of the TSHDs could be adjusted where necessary.

Daily or twice daily hydrographic surveys of the bathymetry were essential to maintain the accuracy of the dredging and rock placement works. Special processing of the multibeam data ensured the accuracy of the surveys and wireless transfer of data over the local 3G network ensured a quick transfer of the updated drawings to the remotely operating dredging vessels.

SUCCESSFUL ENVIRONMENTAL COMPLIANCE

With support from Boskalis, PoMC developed an Environmental Management Plan (EMP), the governance document of the Channel Deepening Project, which applied to all capital works and environmental monitoring programmes. Both the Victorian and Australian government ministers of environment approved the EMP which detailed the environmental requirements, in particular: equipment standards, monitoring programmes, regulatory control and reporting requirements and communication measures. Environmental limits were set for turbidity and noise and work method related controls were established to manage all dredging operations. Strict requirements demanded the immediate reporting of exceedances (e.g. turbidity), non-compliances and other incidents and hazards. In addition, PoMC, assisted by Boskalis, conducted a Baywide monitoring plan focused on key species, habitats and ecological processes. The Baywide programmes were reviewed quarterly and the results of the reviews could be used to adjust the environmental limits. During the course of the works none of the limits required adjustment.

HSE PERFORMANCE

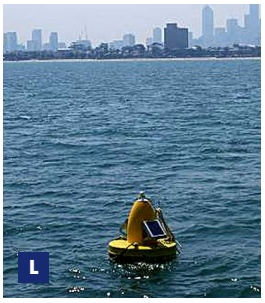
The Alliance adopted a risk management approach to manage Health, Safety and Environment within its ope-rations. These included but were not limited to

- Hazard Identification (HAZID) workshops
- Risk Assessments
- Job Hazard Analysis
- Step Back 5
- Hazard and Incident communication platforms

PoMC required full adherence to federal and state legislative HSE requirements and standards. The Channel Deepening Project team conducted frequent audits to ensure compliance, all to full satisfaction.

SUCCESSFUL COMPLETION

In total 22 Mm^3 of material were dredged during the project. For the service protection works, 61,000 tonnes of rock were placed with high precision. Both PoMC and stakeholders were fully satisfied with the high environmental performance achieved while the project was completed well within budget and time. The overall success of the project was recognised by the industry through the award of '2010 Project of the Year' by Infrastructure Partnerships Australia.



K Boskalis' largest TSHD, 'Queen of the Netherlands' in Melbourne.
L Monitoring buoy in Port Phillip Bay
M With a capacity of 35,500 m^3, the 'Queen of the Netherlands' is one of the largest Trailer Suction Hopper Dredgers in the world

Royal Boskalis Westminster N.V.
PO Box 43
3350 AA Papendrecht
The Netherlands

T +31 78 69 69 000
F +31 78 69 69 555

royal@boskalis.com
www.boskalis.com