Boskalis
Dredging & Marine Experts

PROJECT SHEET

CHANNEL DEEPENING PROJECT, MELBOURNE, AUSTRALIA
SERVICES PIPELINE PROTECTION WORKS

INTRODUCTION

Part of the Port of Melbourne Channel DeepeningProject was to dredge the Yarra River, the last section of the Channel before arriving at Swanson Dock where the container terminals are located.

The Yarra River is crossed by steel service pipelines for gas (30" / 0.75 m) and oil (24"/ 0.60 m) and a concrete sewage tunnel of 3-m diameter. These services pipelines are essential to the city of Melbourne and had to remain 'live', i.e. operational during the deepening works. By deepening the river, however, the existing cover on these services pipelines would no longer adequately protect against possible anchor drop and drag and scour of the riverbed caused by the return current and propeller wash of passing ships.

CHALLENGES

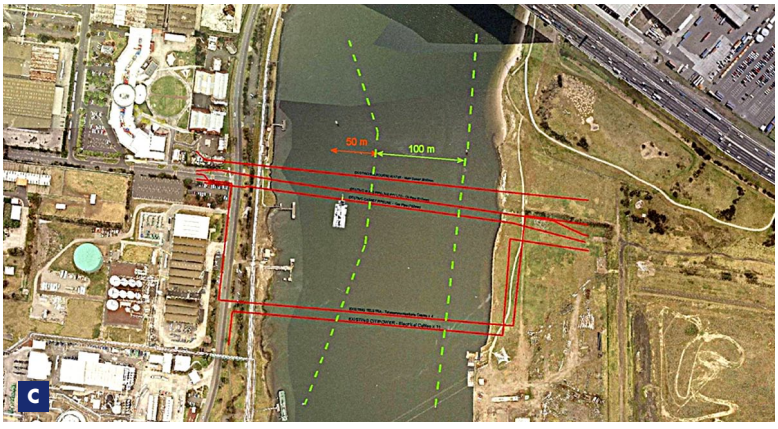
A new means of protection for the services pipelineswas necessary. The initial Port of Melbourne Corporation (PoMC) protection plan was to relocate the pipelines to a deeper level. Unfortunately, building a new concrete sewage tunnel and installing 2 pipelines in the river's complicated soil conditions would make the the construction of new crossings especially difficult and at inordinate expense.

As a Partner in the PoMC Alliance Team, Boskalis proposed a novel protection system using plate and rock placement that was far more attractive and financially viable. But this too presented challenges. Given that the allowable construction height(protection layer thickness) above the services pipelines was very limited, the usual practise of pipeline protection by depositing a layer of loose rock was not possible; a tailor-made design had to be created.

FEATURES

Client	Port of Melbourne Corporation
Location	Melbourne, 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 Steel plate to cover the sewer
C Aerial view of the Services crossing the Yarra River. The upper 3 had to be protected. The other 2 were demolished.



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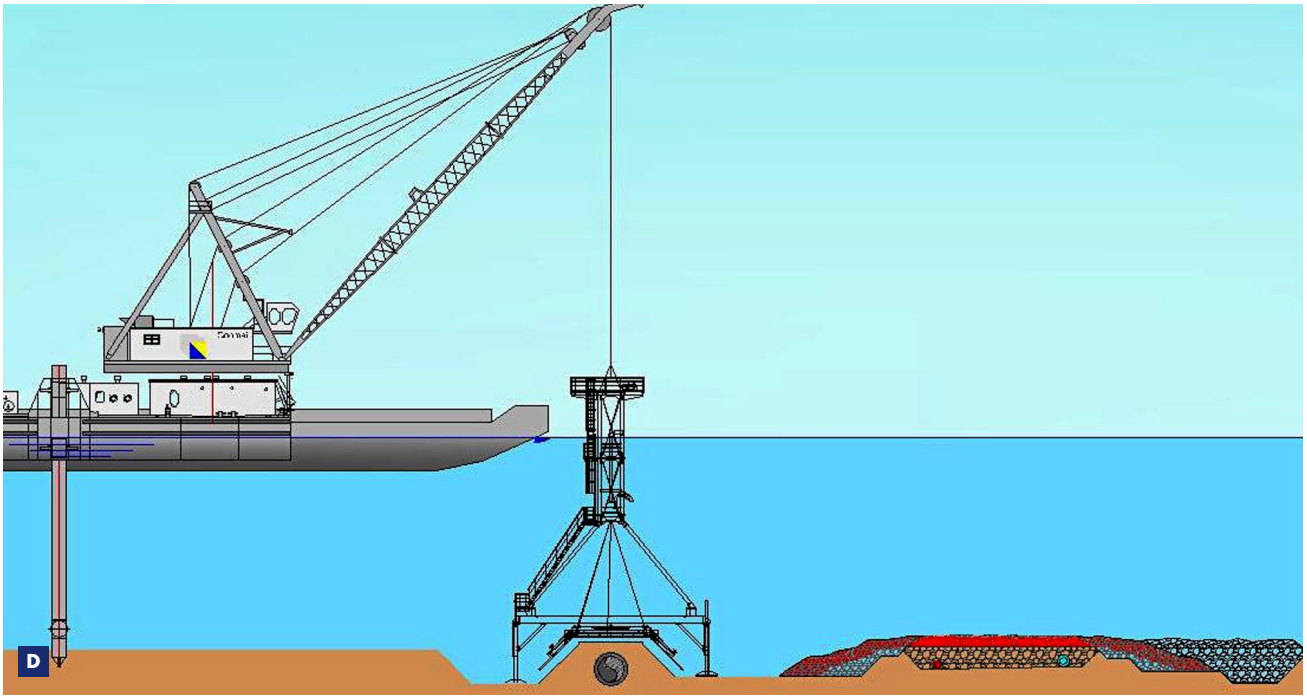


INNOVATIVE SOLUTIONS

A design team was formed by PoMC which included local consultants, a university and laboratories. Boskalis provided input on possible options and constructability.

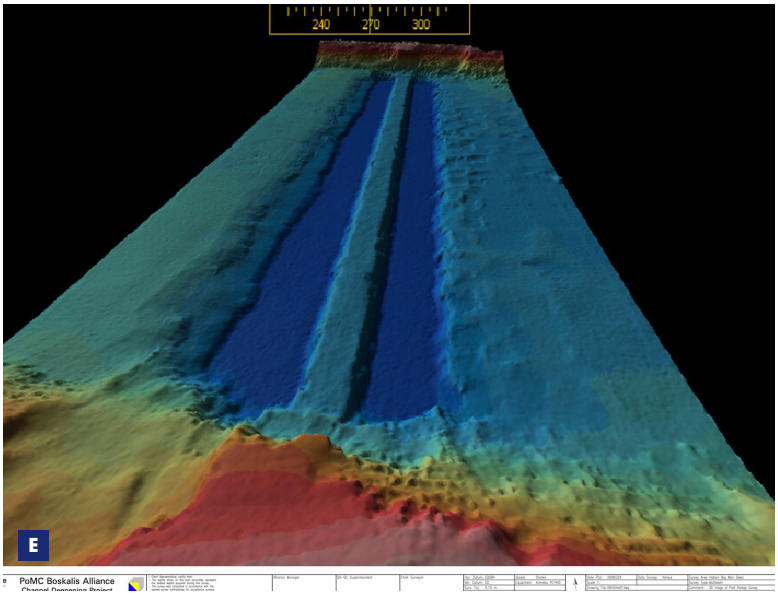
During the design process intensive consultations and risk assessments were held with services owners. To protect the sewer, Boskalis placed 80-mm steel plates with a cover layer of 150-mm styrocrete,encased in a steel box, in order to absorb the energy of a dropping anchor. In addition, steel wing plates placed at both sides of the 80-mm protective plates protected the sewer from dragging anchors. Placement of these protective plates required that a perfect bedding of the existing 0.5 m of natural clay be left in place on top of the sewer. To protect the gas and oil pipelines, Boskalis placed a cover of a 0.7-m-thick concrete penetrated rock layer of 150-mm diameter rock. Side slopes consisted of concrete penetrated rock slopes with a minimum thickness of 1.0 m of 300 mm rock.

To lift a dragging anchor to a level so that it could not grip under the constructions, anchor berms of 400-mmrock were made on the sides of all these protective constructions. Despite the very limited construction height above the services pipelines and water depths of 16 m and more, extreme precision was maintained during all construction stages for both the dredgingworks and the placement of the protective rock and steel plates.

D Cross section services protection. Steel plates are being placed
E Multibeam picture of the excavation with the HPG above and around the sewer

MODIFIED EQUIPMENT

Boskalis modified its main pieces of equipment, the backhoe dredger (BHD) Storken and the grab dredger Goomai, and developed special tools to achieve the required accuracy as well as to ensure a high level of safety.The BHD Storken was modified to be an electronically controlled operation with a special redundant version of the Boskalis Crane Monitoring System (CMS) equipped with multiple positioning and sensor systems. This system allowed the operator to see the grab and the services pipelines with their defined safety zone in real time. The Storken dredged with the Boskalis Horizontal



Profiling Grab (HPG)and the system gave audible alarms or could take over control when the grab came within the safety zones. She was also equipped with arobust set of additional controls to safeguard the integrity of the pipelines, such as remotely operated spud locking pins which ensured that the spuds could not drop without the deliberate action of the operator. The spuds were equipped with spud-cans (or' big feet') to reduce the depth that the spuds could penetrate into the riverbed. Furthermore, an automated concrete placement system was installed on the Storken for the application of a controlled volume of concrete per m^2 in order to construct the concrete penetrated protective rocklayers.

The grab dredger Goomai was modified to operate as a lifting crane for handling the support frame known as the Yarra Tree. The Yarra Tree was purpose-built to accurately place the protection plates over the sewer pipeline. The Yarra Tree is a stable, non-propelled structure, 23 metres in height that was securely installed in the riverbed during operations by the Goomai. It had a moveable system that allowed it to maneuver the protective plates onto the top of the sewer with accuracy to the centimeter. In addition, the Yarra Tree was equipped with a disk cutter device for centimeter-accuracy dredging as a backup system for the HPG.

TESTING

Considering that new techniques were to be applied and that the works were to be executed above live pipelines, extensive physical tests were

F Grab dredger Goomai lifting the Yarra Tree to place the steel plates above the sewer
G Disc cutter test
H Grouting beam attached to the BHD Storken

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executed to ensure the feasibility of the proposed systems:

- Physical scale tests (1:25) in which anchors were dragged on concrete penetrated rock protections above pipelines
- Full scale tests with concrete rock penetrated slopes
- Full scale tests with disk cutter in stiff clay
- Full scale tests of placement of protective plates.

SAFE AND PRECISE

The design and successful installation of this novel anchor protection system for pipelines and underwater constructions with minimal construction height was made possible through the cooperation between client, designer and contractor.
Boskalis modified and built equipment that was able to install the protection system safely and in compliance with challenging accuracy requirements. Ultimately this precision dredging ensured that the Port of Melbourne Channel deepening project was successfully completed with full protection of all services pipelines that exist underneath the Yarra River.


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I Position control of the Yarra Tree.
J Rock slope under construction for test.
K Rock slope prepared for concrete penetration test.
L Result of concrete penetration test

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