

From Mean To Clean



A complex sequence of demolition, debris removal, dredging and installation of a multi-component sediment cap – that was the task facing the PORT OF SAN DIEGO at the old Campbell Shipyard site, write **TOM WANG (L) AND MIKE WHELAN**



Debris removal, one of the first jobs



William F at work



Initial capping by the mole pier



Dredged material's offloaded at the dewatering area



Rebuilding the mole pier...



...was a priority

On San Diego Bay and owned by the port, the site will be the frontispiece of the under-construction Hilton Convention Centre Hotel – but was contaminated by metals, hydrocarbons, PAHs, PCBs and TBT.

Hardly surprising then that the California State Regional Water Quality Control Board (RWQCB) issued a *Cleanup and Abatement Order* (CAO) requiring cleanup of sediments over about 3.7ha (9.2 acres) offshore. No easy job, because the site's in an active port area with regular vessel movements.

After much study, in-place capping of impacted sediments with targeted dredging was selected as the preferred remedy, due to its environmental protectiveness, constructability, cost-effectiveness and consistency with current and planned site uses. The project, however, also needed to both address the concerns of multiple stakeholders and cope with a number of key technical challenges:

- ◆ Design a clean sediment cap to isolate underlying chemicals from the environment and the water column
- ◆ Protect the cap against potential erosion from vessel-generated propeller wash, ship-generated waves, tidal currents and wind-driven waves
- ◆ Provide sufficient water depths for ongoing ship operations at the adjacent *Tenth Avenue Marine Terminal* (TAMT)
- ◆ Ensure that the project could be successfully constructed without impeding (or being impacted by) traffic to and from TAMT
- ◆ Provide mitigation for loss of existing eelgrass beds and create a stable, protected area at shallow, subtidal depths for this purpose
- ◆ Retrofit an existing seawall, mole pier and other structural features at the site to meet seismic standards.

But first, a little...

BACKGROUND

Beginning in the 1880s, the Campbell Shipyard site was used for bulk petroleum distribution and gas waste disposal. Campbell Shipyard itself began operations in 1926, focussing initially on building commercial fishing vessels and later (in the 1980s) on naval ship repair. The business ceased in the 1990s and most of the shipyard was demolished in 2000, except for a set of abandoned shipway ramps and a marine railway.

On the land side, the port had already treated or removed about 80,000m³ of contaminated soil. For the offshore remediation, various options that met CAO conditions were evaluated, including:

- A). Dredging all contaminated sediment and disposing of it at an upland facility
- B). Isolating the sediment by capping.

Change Of Use!

The HILTON CONVENTION CENTRE HOTEL will be built on the Campbell Shipyard site

The ground-breaking ceremony was held last January, foundation construction got underway in March and the project will transform the old shipyard.

Planned as a downtown landmark, the hotel will feature a 32-storey, 385ft tower with 1,200 private rooms, a 4.3-acre public park and a water taxi dock. It will cost over \$335M – and Hilton expect it to open in summer 2008.

More info at www.portofsandiego.org/projects/hiltonhotel

How the Hilton will look



Various combinations of the two came under discussion, each needing to incorporate some form of on-site mitigation for habitat losses – it was agreed that the abandoned shipways were ideal for creation of a new, raised eelgrass habitat.

But why not simply dredge it all?

Not feasible – as well as cost-prohibitive – due to the significant and highly variable vertical and horizontal extents of the contaminants, the likelihood of impacts to existing structures (sea wall and mole pier) and the need for habitat mitigation. Hence the capping / targeted dredging option outlined above because it had the following advantages:

- ◆ It met RWQCB CAO cleanup requirements by providing a clean substrate over contaminated sediments and meeting required surface sediment concentrations
- ◆ It incorporated a 1.6-acre eelgrass habitat, meeting mitigation goals – and did so by taking advantage of existing site topography
- ◆ It provided sufficient water depths to accommodate traffic to and from TAMT as well as for current and projected recreational and commercial boating activities
- ◆ Material for the sand cap would be excavated from nearby Grand Caribe Island, where the port plans to create an intertidal marshland, thus incorporating beneficial reuse into the project
- ◆ It was the most cost-effective solution that met cleanup requirements and stakeholder needs.

DESIGN TEAM

Six consultant firms, each contributing a key area of technical expertise, were asked to design the project:

- 1). **Anchor Environmental** – project management and remedial design
- 2). **Everest International Consultants** – coastal engineering
- 3). **Merkel and Associates** – habitat design and mitigation
- 4). **Blaylock Engineering Group** – structural engineering

- 5). **TerraCosta Consulting Group** – geotechnical engineering
- 6). **Ninyo & Moore** – waste characterization and disposal.

The overall design philosophy was to use method-based (prescriptive) specifications only where necessary and to instead use performance-based specifications to allow the contractor flexibility to use his own special knowledge and equipment – and develop suitable, cost-effective construction methods wherever possible.

Of course, there had to be prescriptive specifications for critical items to avoid potential uncertainties or complications.

The port put the project out to bid in April 2005, packaging the Campbell Shipyard work with two other port-designed projects: maintenance dredging at the *National City Marine Terminal* and berth deepening at TAMT (see panel). Two bids were received and **Traylor Pacific**, part of the **Traylor Brothers** group, won the contract.

BATTLE ORDERS

As per the design philosophy, Traylor Pacific was given responsibility to develop a construction sequence for less critical action items, but for some project elements sequencing was of great importance and precisely specified – as follows:

- ◆ An existing, dilapidated mole pier needed to be repaired and retrofit before dredging, which could possibly destabilize the structure
- ◆ Side-scan sonar and diver surveys had found timber piles, concrete and metal debris, rocks and other items in many site areas – all demolition and debris removal needed to be completed before dredging. The specifications also required removal of debris that protruded significantly above the mudline and could thus interfere with the capping process or with the cap's performance.
- ◆ All dredging needed to be completed and approved before

Right Place, Right Time

Pinpoint accuracy was vital to the dredging and capping works at San Diego's Campbell Shipyard Remediation Project and main contractor Traylor Pacific hired Seattle-based specialists eTRAC ENGINEERING to configure and implement positioning equipment and software

"We picked Hypack's *Dredgepack* software for positioning of Traylor's *William F* and *DB5* dredgers, as well as for a land-based Manitowoc 888 crane," eTrac engineer Nic Martin told DPC. "And with the use of Hypack's *Hypack Max* software on the Traylor survey vessel, the incorporation and customization of *Dredgepack* was integral in creating a seamless platform for the transfer of survey data, background files and daily information between vessels – without fear of software incompatibility."

eTrac installed boom-tip DGPS antennas on gimbals on the dredgers' cranes, giving Traylor sub-metre accuracy for dredging, capping and debris-pulling operations.

"Both the *William F* and *DB5* used crane-cab computer stations with external monitors for clear operator viewing," said Nic. "The barge position and heading was sent by wireless to the crane cab from the barge deck for further positioning detail and a secure wireless network was set up on both vessels for remote winch house computer stations.

"This allowed both crane and winch operators to view their position in real-time," he continued, "for quick and efficient movement of the barge during dredging and capping."

Dredgepack's *Bucket Print* feature also allows a dredgemaster to use an on-screen digital print showing the dredged or capped material location.

"The digital 'bucket size' can be adjusted in *Dredgepack* to match the size of the actual bucket being used," said Nic, "or the estimated footprint of material being

placed in capping operations."

He faced more of a challenge with the Manitowoc 888's relatively small crane cab, however.

"Space limitations led us to use a miniature, shock-mounted, marine computer with a 12.1-inch, high-intensity screen – vital for optimal daylight viewing – and a wireless radio mouse," he continued. "The 888's boom-tip positioning mimicked the *DB5* and *William F*, while position and heading sensors were mounted on the rear of the crane."

All three installations included wireless cellular capabilities for remote monitoring and configuring of the *Dredgepack* system via the Internet, allowing both Traylor engineers and eTrac technicians to update bathymetric data and background files instantaneously – as well as providing 24-hour troubleshooting capabilities.

eTrac also designs and builds the *TideTrac* tide gauges used on the project, Traylor using a *TideTrac* base station to send tide data to remote receivers on their survey vessel and dredgers, inputting data directly into Hypack.

"Both our *TideTrac* receiver and Hypack's *TideTrac* tide driver let contractors adjust their 'strike' to the correct dredging depth," said Nic. "The receiver and driver automatically display the corrected digging depth and the remote receivers also update the user on battery voltage, time since last update and station ID – in case multiple base stations are in the area. Data's also stored on a removable memory module that can be downloaded into any computer.

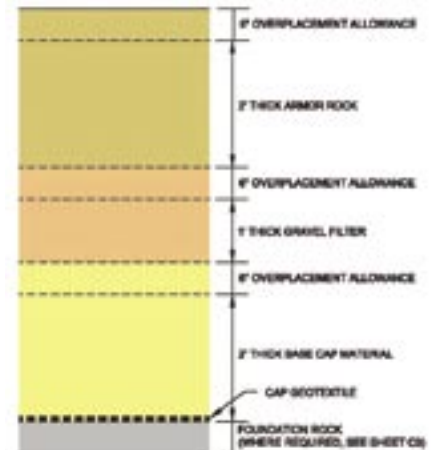
"The system's quickly installed and calibrates in seconds. We typically ship them with an optional solar panel, which Traylor chose to use," Nic added. "It's ideal for remote installs where battery swapping is challenging. And given San Diego's sunshine, the gauge can run virtually indefinitely!"

More info at www.etracweb.com

capping could start in order to avoid possible recontamination of the cap by resuspended dredged sediments. Similarly, all placement of foundation rock into the soft subgrade needed to be done before placement of any cap materials

◆ A pilot cap section needed to be completed and fully approved (layer-by-layer) to demonstrate that the contractor's techniques were successful

◆ Cap placement sequence was strictly defined – foundation rock, cap geotextile, sand base cap, gravel filter layer and armour rock – with



each layer approved before the next layer could be placed.

After placing sand cap material, the contractor was cautioned to install the overlying filter gravel and armour rock as soon as possible to minimize the time that the sand would be exposed and susceptible to erosion by prop wash or other forces.

INTO ACTION

As work began in autumn last year, the old shipway ramps – where the eelgrass habitat would be created – were demolished and the concrete, steel rails and other miscellaneous debris removed.

The extent of contaminated soil removal, however, necessitated a modification to the project design: part of the mole pier had to be demolished. A key project element was to stabilize the pier structure and retain its pre-existing geometry, a goal that remained. And the pier now has new sheet piling around all three sides.

Studies had also indicated that the 1920s-built concrete and timber seawall was seismically unstable and would likely fail under a design-level earthquake. Since this would damage portions of the sediment cap near the wall's base, it meant removing 1,759m³ of debris, stabilization and repair.

A revetment – a sloping mass of quarter-ton rocks – was also placed along its exposed front to provide lateral stability in the event of an earthquake.



Tide gauge in place



In-cabin displays

DREDGE PLAN

Mechanical rather than hydraulic dredging was required because of the lack of upland space for either active or passive dewatering of hydraulic slurry – Traylor Pacific used a toothed clamshell bucket and loaded directly onto flat-deck barges, surrounding the site with a double silt curtain to contain turbidity.

Daily dredging rates were typically 153m³ to 229m³, though production increased to as much as 765m³ while dredging an area close to TAMT – the cut thickness was greatest, over 3.3m. A 0.3m overdredge allowance was specified to account for equipment tolerances and the following locations were dredged:

- ◆ Open water areas adjacent to TAMT needed to maintain navigational depths of 6.1m to 7.9m MLWS to accommodate both boxships and fruit vessels. That meant dredging 9,175m³ of material to give the area 7.6m to 9.5m MLWS prior to capping to allow sufficient clearance once the 1.5m cap was in place.
- ◆ At the shipway ramps site, 12,234m³ of underlying sediment was dredged to achieve depths ranging from 2.1m to 2.7m. That will enable the post-cap surface to

be at the shallow elevations (1.2m to 1.8m) that eelgrass needs for successful development

- ◆ Isolated areas of raised seabed were dredged to both create a more consistent, level site bathymetry and to eliminate large-scale features that could interfere with the capping process

Dredging was also needed along the seawall to allow for placement of the rock revetment.

OTAY AND SYCAMORE

Though all the dredged material exceeded CAO cleanup criteria, it was not characterized as ‘hazardous waste’. Testing for bulk chemistry and leachability indicated that the sediment would be acceptable for placement at local landfills, including the Otay and Sycamore sites.

But it did mean the sediment would have to arrive with a low water content.

Initial dewatering was via the contractor’s barges that were equipped with enclosures built with K-rail barriers: sediment was permitted to drain from barges directly into the Bay through filter fabric-lined gaps under the rails – provided that water quality criteria were met at all times.

To complete the process, the

firm established a 0.6ha sediment stockpiling and dewatering area on an adjacent site that was lined and surrounded on three sides by K-rail barriers. Barges moored alongside this area and were offloaded by a land-based crane – a spill apron was also constructed to protect Bay waters.

And by June this year, dredging was complete.

CAP DESIGN

...was consistent with current regulatory guidance for sediment capping:

- ◆ The US Environmental Protection Agency’s 1998 Guidance for *In-Situ Capping of Contaminated Sediments*, and
- ◆ The US Army Corps of Engineers’ Waterways Experiment Station’s 1998 technical report DOER-1, entitled *Guidance for Subaqueous Dredged Material Capping*.

The water quality criteria selected were the *California Ocean Plan’s* six-month averages for metals, along with ecological screening values from the Department of Energy (1999) for organic compounds.

The performance endpoint for contaminant isolation selected for this project was a comparison of predicted porewater concentrations to applicable surface water quality criteria in the cap’s top 1cm (the

In Addition...

With Traylor Pacific deploying two dredgers and other specialised equipment for the Campbell Shipyard remediation, the PORT OF SAN DIEGO packaged other projects...

- ◆ Maintenance dredging at the *National City Marine Terminal’s* berths, plus
- ◆ Deepening at *Tenth Avenue Marine Terminal* (TAMT).

“Traylor used a clamshell for both projects,” senior engineer and project planning & estimating group leader Steve Austin told DPC.

“We don’t get that much silting, so berth maintenance dredging’s needed on average every ten years. Our navigation and turning basin dredging, plus the main channel, is carried out by the US Army Corps of Engineers (USACE),” he said.

Driver behind the TAMT deepening project was straightforward: “Ships are simply getting bigger,” Steve continued, “we just needed to take full advantage of the available depth and dredged to 42ft.”

That did mean strengthening the quay

wall – and in the process removing 20m³ of old debris.

As this is written, a concrete ‘mattress’ is being placed – with positional accuracy checked by a diving team – to ensure a level seabed alongside the quay.

“USACE acted as our ‘clearing house’ for the project,” Steve continued. “And I’m glad to say there weren’t any real environmental impacts.”

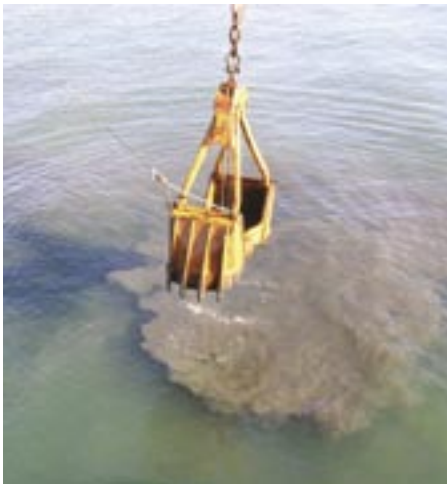
More info at www.portofsandiego.org



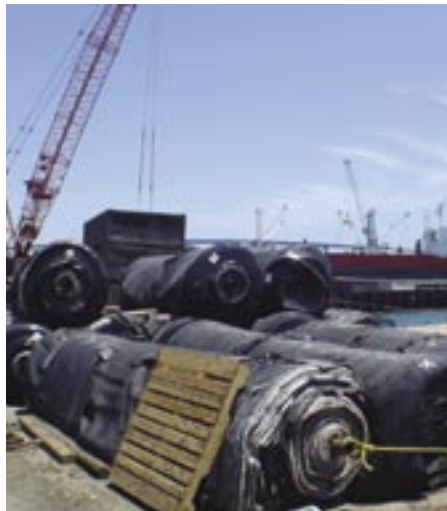
Port construction inspector Sherman Cotham (l) and Steve Austin at TAMT



Steve Austin and some of the debris removed at TAMT



The toothed clamshell bucket created relatively little turbidity



Geotextile ready for placement



Capping moves offshore

biologically active zone) at 100 years after construction. This performance endpoint was significantly conservative because it didn't account for the rapid dilution of porewater that occurs as it enters surface waters (where surface water criteria normally apply).

FINALLY...

As this is written, the project is ongoing, but due for completion in the next few months. And to ensure the cap's continuing performance, a long-term plan's been developed that includes:

- ◆ Monitoring the cap's physical condition to discern whether any degradation and/or erosion occurs
- ◆ Porewater monitoring at the top layer to see if site contaminants are being successfully contained
- ◆ Checking eelgrass recolonization at the new habitat, and
- ◆ Event-related monitoring as needed to address significant, one-time occurrences.

The latter covers such events as large earthquakes – we all hope it does not include what in California we call *The Big One*...

About The Author

This article is based on presentations given by Anchor Environmental engineers Tom Wang, PE, and Mike Whelan, PE, at June's WEDA XXVI and Texas A&M's 38th Annual Congress, held in San Diego. If you'd like more information, the full text is available through WEDA – www.westernredging.org – or you can reach the authors via email: twang@anchorenu.com and mwhelan@anchorenu.com

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