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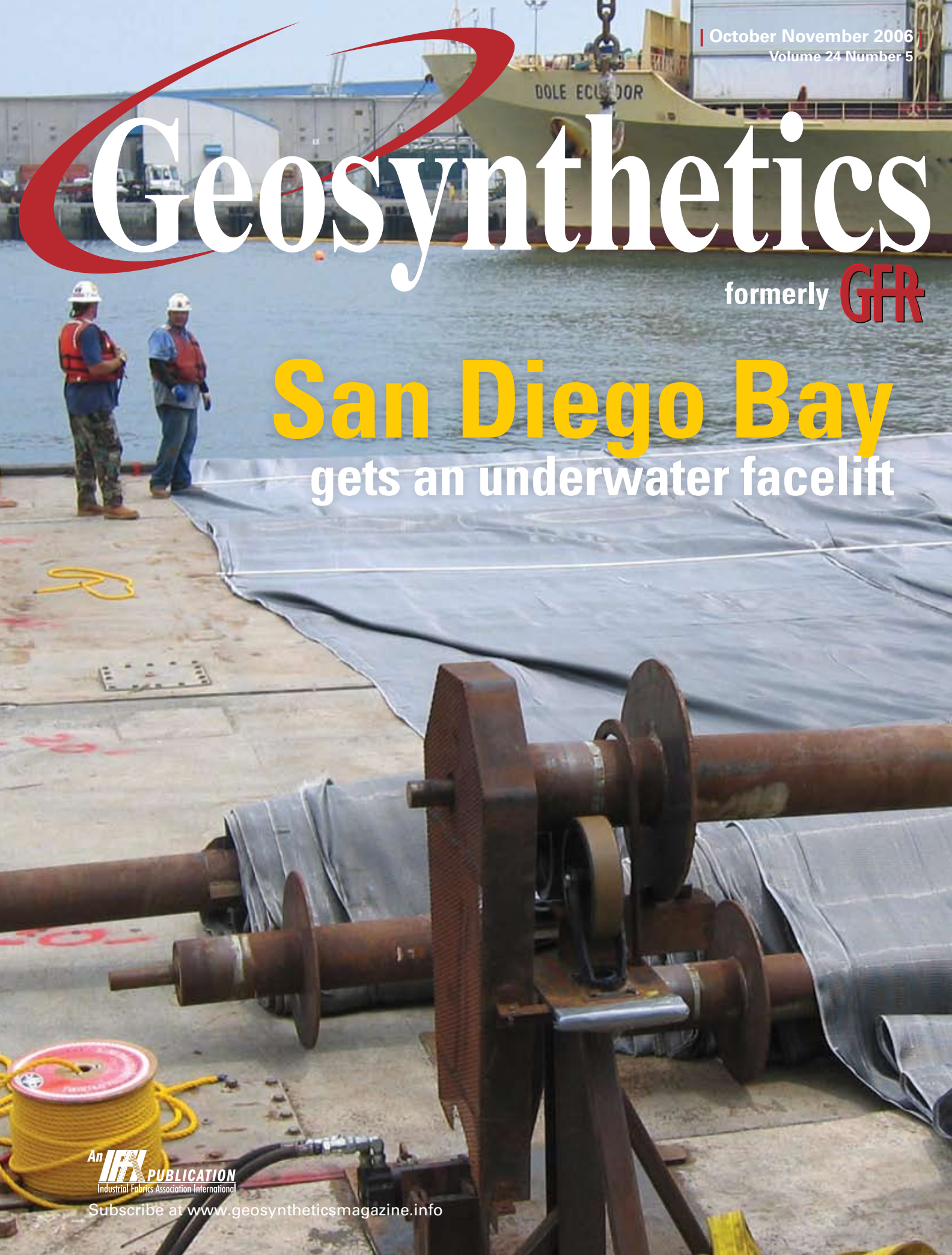

San Diego Bay
gets an underwater facelift

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Geotextile cap is a key to this novel seafloor remediation project

Overview

This project included aquatic remediation of a former shipyard area consisting of approximately 3,500 tons of underwater demolition, 35,000 yds.^{3} of dredging of contaminated material with upland disposal, and placement of a new structural cap consisting of layers of geotextiles, sand, gravel, and armor rock to contain the remaining contaminated sediments.

The specified work also included debris removal, demolition of shipways, repair and reconstruction of a 1,200-ft.-long seawall, repair and retrofitting of a 180-ft.-long mole pier, construction of rock revetment, wave berm, maintenance dredging of approximately 41,000 yds.^{3} of material with offshore disposal, and other related items of work as specified.

Environmental remediation

Beginning in the 1880s, the Campbell Shipyard site—adjacent to the under-construction Hilton San Diego Convention Center Hotel in downtown San Diego—was used for industrial activities including shipbuilding, the manufacturing of bulk petroleum, and gas waste disposal. Consequently, extensive environmental remediation has been required to clean up the site for development.

In the first phase of remediation, the Port treated or removed more than 80,000 yds.^{3} of contaminated soil from the upland portion of the project site. During the current and final phase of remediation, 9.2 acres of waterside sediment was capped with 5 feet of geotextiles, sand, gravel, and rock. Included in the capping phase are 1.6 acres of mitigation area to replace eelgrass habitat lost by the project.

Campbell Shipyard site

The Campbell Shipyard operated actively near the corner of 8th and Harbor Drive in San Diego from 1910 until 1999. Also located in this area were a manufactured gas plant waste facility and a bulk petroleum distribution facility.

In the late 1990s the shipyard's lease expired and was not renewed. In 2003, the port completed an extensive cleanup of the land, including the removal of thousands of cubic yards of contaminated soil.

All photos courtesy of Triumph Geo-Synthetics

Prep and staging | Prep and staging using an I-beam: To establish the start of a fabric run on the seafloor, the geotextile was attached to an I-beam. The positioning of the fabric was established with a global positioning system, monitored by the field superintendent and the crane operator.

| Sarah O'Connor, Sr. Civil/Environmental Engineer with Triumph Geo-Synthetics; Michael Whelan, P.E. with Anchor Environmental; and Ron Bygness, editor of *Geosynthetics*, contributed to this article.

Rebar and prep/staging | The rebar was encased in PVC pipe capped at both ends. It was then attached approximately every 10 yards along the length of the fabric to help in deploying fabric into the water and to aid in positioning the fabric on the seafloor.

However, waterside cleanup proved more difficult.

When the basin was tested, it was determined that interminable dredging and properly disposing of all of the hazardous material would cost too much. Instead, a cap was designed and placed over the sediment to separate the contaminated material from the marine environment: a 5-ft.-thick cap—2 ft. of sand, 1 ft. of gravel, and 2 ft. of armored rock.

The Port is now completing remediation and capping at this site. This remedial activity is being performed in accordance with a 1995 Cleanup and Abatement Order issued by the Regional Water Quality Control Board (RWQCB) and an agreement with the RWQCB under the Polanco site redevelopment statute. This remedial activity included:

• On-site chemical stabilization of 30,000 yds.^{3} of petroleum-contaminated soil (completed December 2001).

• Excavation and off-site disposal of 30,000 yds.^{3} of benzene-contaminated soil associated with a manufactured gas waste impoundment (completed July 2003).

Rebar process | Workers attached rebar across the full width of the 45-ft.-wide, 900-ft.-long roll of geotextile fabric.

Rebar process | The rebar was attached onto the fabric using zipties approximately every 10 yards along the width of the entire length of the 900-ft.-long geotextile roll.

Site preparation, geotextile installation

Prior to installation of the geotextile layer on the seafloor, the contractor removed material, including debris, rocks, and remnants of other piles exposed at subgrade that could damage the geotextile during placement or while applying the armor-rock cap, revetment cap, or habitat cap that would follow on top of the geotextile layer.

Dredging of specific areas of the site's impaired sediment was completed in the summer of 2006 in preparation for the capping procedures. The project was a subaqueous geotextile, sand, gravel, and rock cap over a 9.2-acre area. This cap included a 1.6-acre habitat area. The cap will isolate the site's impaired sediment from environmental receptors and allow for the site's continued use for navigation.

The geotextile layer was applied following completed dredging operations. Following consulting assistance with the contractor and port engineer, the selection of a suitable geotextile as well as help with the installation of the geotextile for this project was undertaken.

HP770 PET geotextile was used for this portion of the layered capping. This geotextile is a polyester/polypropylene fabric with a specific gravity of 1.07. It is woven from high-tenacity, long-chain polymers composed of at least 95% by weight polyesters that form a stable network such that the filaments retain their dimensional stability relative to each other including selvages. It does sink, albeit slowly.

To aid in the deployment and accurate placement of the fabric on the seafloor, the contractor attached #4 rebar encased in PVC pipe with capped ends. The rebar was attached perpendicular to the fabric about every 10 yards prior to being rolled off a floating sectional barge into the water.

Deployment | The rolls of fabric were unfurled and floated into the bay from the deck of an 80-ft. x 60-ft. sectional barge.

Cap installation

The installation of the geotextile layer occurred in a submerged marine environment. This work involved the use of derrick/sectional barges and divers.

Placement constraints included:

1. The geotextile placement involved working from a floating, sectional, deployment barge.
2. The contractor could not anchor the barge with spuds within the capping areas.
3. Penetration of the subgrade during placement of the geotextile cap within the armored cap, revetment cap, and habitat cap areas was not allowed.

Engineered cap

The largest portion of the capped area is an engineered cap designed for permanent isolation of remaining environmental pollutants in bay sediments.

The engineered cap is composed of a geotextile overlaid by 2 ft. of sand

| The geotextile fabric floats into the water.

Closeup of the textile | This is the seam of the fabric—3 15-ft.-wide fabric panels were sewn together to get the desired width of 45 ft. It was then folded and rolled prior to shipping to California from Georgia. The fabric rolls had to be unrolled and unfolded, then attached to the 50-ft.-long spool on the floating deployment platform.

Crane with ball/anchor | When the derrick barge is moved, these 15-ft.-high anchors also have to be repositioned.

for isolation of pollutants in existing sediments; a 1-ft. layer of well-graded, gravelly aggregate material to act as a filter layer between the overlying armor stone and the underlying sand, while also protecting against bioturbation; and then a final layer of 2 ft. of armoring stone to protect against erosive forces that may be imposed on the capping system.

Additional foundation support, in selected areas overlaying unconsolidated bay sediments at the edge of the cap, was strengthened by placement of a layer of "dumped rock foundation."

Habitat cap

The habitat cap is a 1.6-acre eelgrass environment. The design of the habitat cap includes a base layer of sand overlaid by a geotextile layer and topped by a final layer of 2 ft. of sediments with grain sizes ranging from medium to coarse sand to provide a suitable substrate to support the overlying eelgrass habitat.

The function of the geotextile is as a separation layer to help isolate any underlying residual environmental pollutants and to protect against bioturbation into the underlying sediment.

Another structural element is a rock containment berm to protect and enhance the stability of the entire cap system.

Costs

Implementation of these cleanup and abatement actions, including installation of an appropriate capping system to isolate sediments containing residual shipyard waste, has cost approximately $16 million.

To date, a total of more than $72 million has been spent on the entire project area, including: demolition, dredging, and disposal; all land and bay environmental cleanup, disposal, and capping; site preparation, and construction of a 2,000-vehicle parking facility to accommodate further development.

Project Highlights

Project title: Sediment remediation and aquatic enhancement at the former Campbell Shipyard site
Location: San Diego Bay; San Diego, Calif.
Start date: September 2005
Completion date: 1st quarter, 2007
Owner: San Diego Unified Port District
Project Manager: Mahmoud Akhavain
Contractor: Traylor Pacific
Project Manager: Calvin Casey
Project Engineer: Mohamad Ramlawi
Marine Superintendent: Ed Adair
Designer: Anchor Environmental LLC
Geosynthetics: Mirafi HP770 PET fabric, installed to help create a cap over the bay floor of the former Campbell Shipyard site on San Diego Bay, installed from a derrick barge and floating deployment platform
Suppliers/consultants: Blaylock Engineering Group, Everest International Consultants, Merkel & Associates, Ninyo & Moore, Terracosta Consulting Group, and Triumph Geo-Synthetics Inc.