SOIL RETENTION
PRODUCTS INC.

ENVIROFLEX® Project Case Study
- Permeable and Plantable Scour Protection Product -

Project Location: Forester Creek Channel Improvement Project, City of Santee, California

Project Funding: City of Santee, San Diego Regional Water Quality Board and Caltrans

Background: The $36M Forester Creek Channel Improvement Project is the City of Santee's largest capital improvement project to date, which has received multiple awards for concept and design as a pinnacle for creek restoration to improve urban water quality. The project involved the widening and realignment of the creek in order to withstand a 100-year flood level while facilitating the restoration of riparian and wetlands habitat.

Forester Creek flows northwest from the City of El Cajon, through the City of Santee (skirting along the downtown area), where it outlets to the San Diego River and eventually drains to the coastal waters of Mission Bay, which adjoins with the Pacific Ocean. The Forster Creek is concrete lined through the City of El Cajon and was un-lined for a 1.2 mile segment within the southwestern portion of Santee prior to adjoining the San Diego River on the western side of the Mission Gorge Road bridge.

Prior to improvements, The Santee segment of the Forester Creek was under capacity for the 10-year storm event and threatened to overtop its banks during almost every significant storm. This condition threatened adjacent inhabited areas (evacuations were needed in 1995), created erosion conditions requiring continued maintenance, threatened bridge abutment and pier foundations, and also flooded the major thoroughfare, Mission Gorge Road, which is designated as a safety route out of the city in case of regional catastrophe.

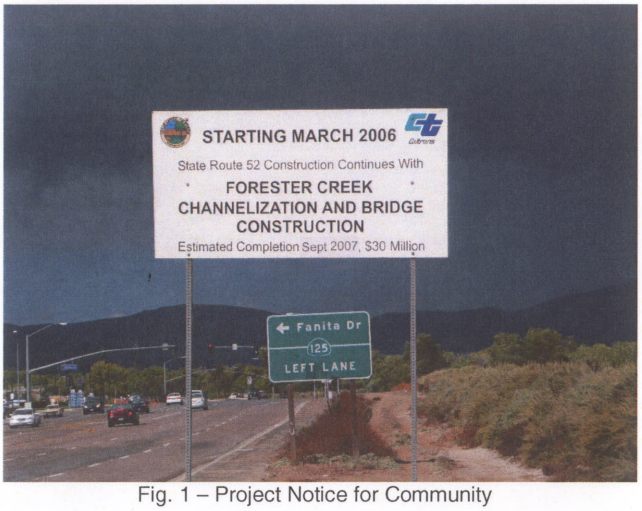


Fig. 1 – Project Notice for Community

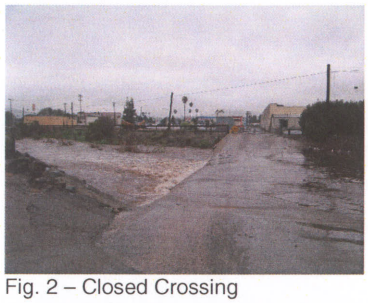


Fig. 2 – Closed Crossing


Fig. 3 – Mission Gorge Road Bridge


Fig. 4 – Near Overtopping of Banks

Design: Under review of the San Diego Regional Water Quality Board and the Federal highway Administration (FHWA), the entire 1.2-mile channel was elected to be widened (by up to three times - approximately 200 feet wide) in order to handle a peak capacity of 13,000 ft^3/sec at initial channel velocities of 20 ft/sec and re-vegetated to improve regional water quality. To accommodate this design, a large energy dissipater was necessary at the head of the earthen channel to reduce discharge velocities from the upstream concrete channel. In addition, new bridges for the widened earthen channel were needed. Hard armored surfaces were necessary for a maintenance access road through the energy dissipater and as scour protection for bridge pier areas and narrowed sections of the channel. The project engineer for the site was Earth Tech and construction management was performed by PBS&J.


Fig. 5 – Concrete/ Earthen Interface


Fig. 6 – New Olive Lane Bridge

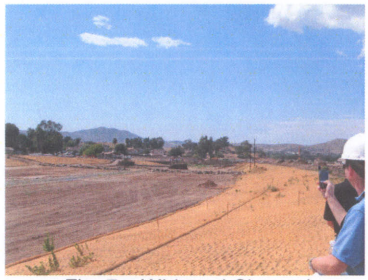


Fig. 7 – Widened Channel

2501 State Street • Carlsbad, CA 92008 • P: (760) 966-6090 • F: (760) 966-6099 • www.soilretention.com

Applications: The ***Enviroflex***® product was utilized in three areas along the channel alignment: 1) within the energy dissipater as an access road for rip-rap maintenance; 2) as scour protection for the 2:1 slopes and bridge pier foundations under the Olive Lane bridge; and, 3) again as scour protection, upstream and downstream, of the Mission Gorge Bridge.

Energy Dissipater: ***Enviroflex***® was used as a permeable, plantable, drive-able access road through a rip-rap energy dissipater at the earthen and concrete channel interface. ***Enviroflex***® was laid over an earthen berm to create an access road through the rip-rap dissipater area. 6"-thick ***Enviroflex***® mats were installed over 4" of 3/4" clean gravel over Mirafi Filter Weave 500 fabric over a compacted subgrade for a sturdy drive-able section. The angle points of the corners and turns of the berm were locked into place by a cable-tied concrete closure-pour. The ends of the access road were tied into the upstream concrete channel and downstream cut-off-wall with eyebolts and cables tied to blocks with a concrete closure-pour. Rip-rap was placed on either side of the trapezoidal access road to create the energy dissipater.


Fig. 8 – Concrete/ Earthen Interface

Fig. 9 – ***Enviroflex***® Access Road


Fig. 10 – Rip Rap Placement

Olive Lane Bridge: ***Enviroflex***® was also placed under the Olive Lane Bridge to protect the piers from scour and erosion. Adjacent 2:1 side slopes at abutment locations were also outfitted with ***Enviroflex***® scour protection blocks. The structural section consisted of 4" ***Enviroflex***® blocks placed over 4" of 3/4" clean gravel over Mirafi Filter Weave 500 fabric. ***Enviroflex***® was tied into bridge piers and abutments with dowels and a cable-tied concrete closure-pour. Scour protection on the slopes was achieved without anchoring of the face. ***Enviroflex***® solely relies upon the lateral confinement of the perimeter closure pour for the 16-foot high application.


Fig. 11 – Olive Lane Bridge


Fig. 12 – ***Enviroflex***® Installed under Olive Lane


Fig. 13 – 2:1 Slope at Olive Lane

Mission Gorge Road Bridge: ***Enviroflex***® was also utilized on the upstream and downstream sides of the Mission Gorge Road Bridge just before the outlet of the Forester Creek into the San Diego River. The structural section consisted of 4" ***Enviroflex***® blocks placed over 4" of 3/4" clean gravel over Mirafi Filter Weave 500 fabric. The perimeter conditions and a hinge point for a turn in the alignment were all enclosed within a cable-tied concrete closure-pour.


Fig. 14 – ***Enviroflex***® Installation


Fig. 15 – Upstream of Mission Gorge


Fig. 16 – Downstream of Mission Gorge

Construction: Archer Western was the general contractor for the project, while Soil Retention Systems, Inc. was the installer of the ***Enviroflex***® scour protection system. Approximately 75,000 square feet were installed within 25 days, which accelerated the construction schedule for Archer Western. Construction of the overall channel and associated improvements began in January 2006 and was completed by November 2007. The ***Enviroflex***® construction occurred in three phases during June, July and September of 2007.

The following construction details show the miscellaneous benefits of the ***Enviroflex***® scour protection system. The product is palletized and can be staked and stored close to the work area. The product can be transported and installed with light-weight equipment.

Fig. 17 – Product Delivered and Stored

Fig. 18 – Fabric and Gravel Placement

Fig. 19 - ***Enviroflex***® Installation

Fig. 20 - ***Enviroflex***® Installation

Fig. 21 - ***Enviroflex***® Installation

Fig. 22 – ***Enviroflex***® Easily Transported

Fig. 23 – Saw-Cut Corners and Joints

Fig. 24 - Eyebolt and Cable Tie-In

Fig. 25 - Concrete Closure Pour

Fig. 26 – Top of Slope Anchor

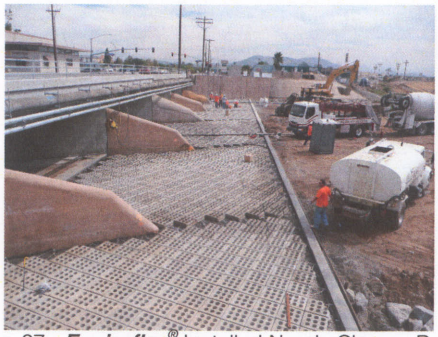


Fig. 27 - ***Enviroflex***® Installed Needs Closure Pour

Fig. 28 – Concrete Closure Pour

Performance: All project objectives were satisfied using the ***Enviroflex®*** scour protection system. Native vegetation has established within the ***Enviroflex®*** application areas. The access road is a stable driving surface in a continually saturated condition. The erosion protection at the base of critical structures has also been satisfied. The area experienced heavy rains and runoff quickly after construction and the Forester Creek design with ***Enviroflex®*** has performed as intended (see pictures of first event below). The channel design has been significantly tested during the 2007-2008 winter. The City of Santee now has an "asset for the community" not just a concrete channel, and was able to protect the critical areas with ***Enviroflex®***.

Fig. 29 – Engergy Dissipater during Storm Event

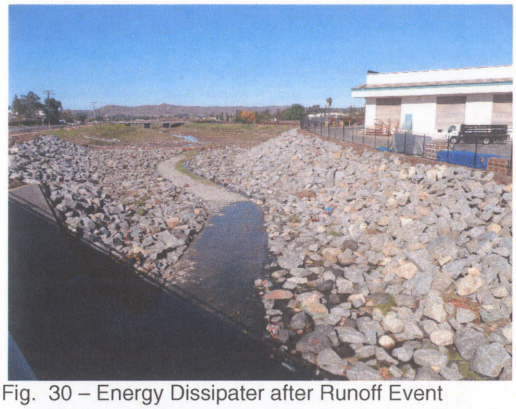
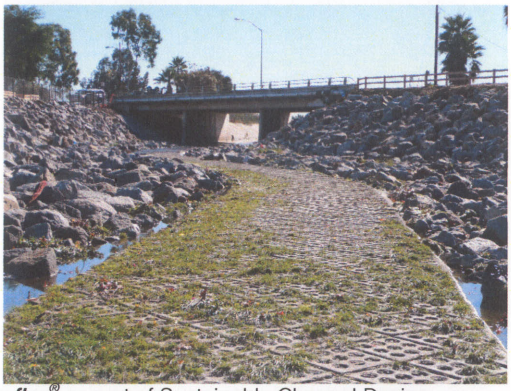
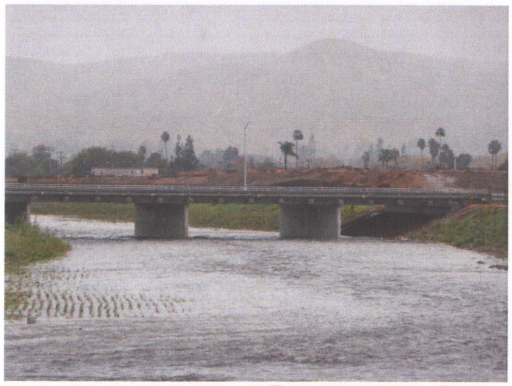


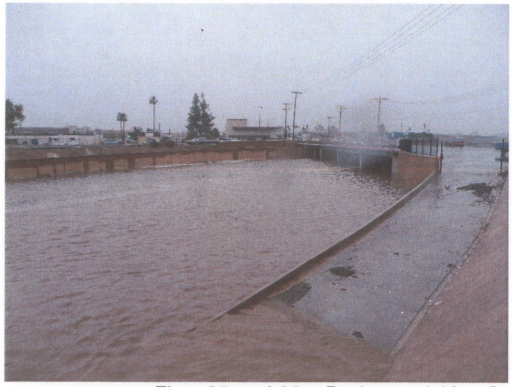
Fig. 30 – Energy Dissipater after Runoff Event



Figs. 31 and 32 – Energy Dissipater after Runoff Event - ***Enviroflex®*** as part of Sustainable Channel Design



Figs. 33 and 34 – During and After Storm Event at Olive Lane Bridge



Figs. 35 and 36 – During and After Storm Event on Downstream Side of Mission Gorge Bride