KEEPING CRYSTALLINE

Biotechnical erosion control treatment protects Lake Tahoe

By Jaime Ziegler, P.E. & Julie Etra, MS, CPESC

Mitigating historic watershed impacts at Kings Beach involved propagated wetland mats for channel stabilization.

Lake Tahoe affords world-renowned water quality and clarity and has a hydraulic residence time of approximately 700 years. Unmitigated storm water pollution generated in the watershed may have detrimental effects for generations.

Since the early 1970s, with the designation of the lake and surrounding watershed as an "Outstanding National Resource Water" and 303(d) Water Body, efforts have been underway to restore historic ecosystem and watershed damage, and to mitigate the impacts of existing and new land-use activities and their effects on storm water quality.

Approximately $1 billion of public money has been invested in watershed preservation, restoration and mitigation with oversight and guidance by the federally mandated bi-state Tahoe Regional Planning Agency (TRPA). Storm water- and ecosystem-based regulations are scientifically based and are applied equitably to all resource management, dispersed recreation and development within the basin, without regard to the time they were constructed.

Riprap Alternative

Due to the intensive efforts in ecosystem-based storm water management in the Lake Tahoe Basin over nearly 40 years, many innovative storm water management techniques have been developed. In 1997, Western Botanical Services Inc. (WBS) developed an alternative for riprap culvert outfalls on several projects for the California State Parks, the city of South Lake Tahoe and the California Tahoe Conservancy. This biotechnical erosion control treatment consisted of the offsite propagation of a wetland mat using a biodegradable erosion control blanket as the substrate, seeded with locally collected site-adapted native seed.

After final project grading and culvert placement was complete, the blankets were installed to prevent channel erosion and mimic the local natural stream and meadow. The success of these relatively small pilot projects, subject to concentrated hydraulic forces, proved bioengineering solutions to be feasible.

In the summer of 2000, the Snow Creek Restoration Project in Placer County, Calif., was constructed based on design specifications prepared by a multi-disciplined team that included WBS. Twenty thousand square feet of wetland mats were propagated off site by the Nevada Div. of Forestry one year prior to project construction for stabilization of the project stream channel.

In many projects today, as with this landmark project, large onsite quantities of transplantable native vegetation that meets species composition requirements and has the strength to withstand the system hydraulic forces do not exist. Because the watershed is dominated with cold fall temperatures and a deep snowpack in the winter and spring, growth of vegetation within the base flow channel of developed and wild land systems can be difficult.

Use of pre-propagated and

biodegradable wetland blankets provides an ecologically sound, aesthetically pleasing structural alternative to hard-armoring technologies traditionally used for channel stabilization. The Snow Creek project successfully proved that a large-scale alternative to riprap-based channel restoration and stabilization can be implemented in the most sensitive watersheds.

Fit for Kings Beach

In 2009, the American Recovery and Reinvestment Act provided a funding source for design and construction of the Fox Street Clean Water Pipe Project, a TRPA Lake Tahoe environmental improvement project required to mitigate historic watershed impacts contributing to increased sediment and nutrient loading to Lake Tahoe. Propagated wetland mats again were chosen for channel stabilization in one reach of the watershed restoration. The restored stream reach is located on a popular sandy beach of Lake Tahoe's north shore called Kings Beach.

As with most public works projects within the Lake Tahoe Basin, watershed and infrastructure improvements were owned and maintained by multiple public agencies. This project included ownership interests by Placer County, the California Department of Transportation, The U.S. Forest Service, The California Tahoe Conservancy and the California State Lands/Parks. Project review and permitting was required by the TRPA, the California Water Quality Control Board – Lahontan Region and the U.S. Army Corps of Engineers. WBS and project engineer CardnoEntrix, with approval from all project stakeholders, developed the fast-track bioengineering design of the channel during the spring and summer of 2009.

Using 3-ft-by-15-ft Rolanka BioD blankets and 12-in.-by-10-ft coir logs as the substrate for the plants, a project specification consisting of native seed and transplanted native plugs was incorporated into the project design. With experience gained from a bioengineering propagation project in the summer and fall of 2009, Al Pombo Inc., a general engineering contractor, in association with Ziegler Civil Eng. (ZCE) provided a competitive bid to supply the propagated wetland mats. WBS provided peer review and guidance on all phases of the testing and propagation process used to ensure success of the final product.

Based on the requested seed mix consisting of graminoids and forbs, a pilot study and testing was initiated by ZCE soon after bid award to determine seeding rates, soil substrate rates and composition and watering requirements. Because Lake Tahoe is a nutrient-limited lake, no fertilizers were used in the propagation of the wetland mats. Two thousand square feet of wetland blankets, weighing approximately 400 lb per individual mat, were grown from May to

September 2010 during seasonally low temperatures. The wetland mats were installed on Sept. 30, 2010, during seasonally high temperatures.

The broad vs. ditch design channel geometry was based on a 100-cu-ft-per-second design flow, with a channel slope of 4% to 6%. Channel side slopes ranged from 4:1 to 8:1. Propagated coir logs (green logs) were used as checks in the channel bottom. Within several days of mat placement, the plants began rooting into the native beach sands. Additionally, blowing sand from the beach deposited onto the mats and created a seamless transition from the native beach to the newly restored channel.

Immediately after the mats were installed, several severe fall storms resulted in damage to the anchorage of the mats, requiring some repair. Rainfall totals for the month of October measured more than 11 in., with two storms totaling 3 in. and 6 in., respectively. Severe rainfall and seasonal cold temperatures put the wetland mats to the immediate test as the plants entered dormancy while being subjected to scouring.

Based on previous experience, the plants rooted into the wetland mats are expected to grow vigorously in the spring when the snow melts and the growing season begins.

Learning More

It is essential for designers and the contractors providing the materials to have a thorough knowledge of site soils, vegetation and hydrology, as well as product limitations. Particularly in areas with short growing seasons, allow enough lead time for adequate plant establishment. Small demonstration projects can provide valuable data and educational opportunities for stakeholders to apply the technology to larger sites or in varied applications.

A research and development program is currently underway in order to refine and improve all aspects of the propagated mats for the challenging site-specific conditions found in the Lake Tahoe Basin.

Application of this methodology in other regions of the country likely will not follow the exact protocol due to variations in growing season, native vegetation, soils, ecology, aesthetics, climate, hydraulics and regulations. However, designs can be modified based on local conditions and consultants are encouraged to avoid the use of boilerplate solutions. Implementing bioengineering technologies may take extra effort, but the end results are worthwhile. SWS

Jaime Ziegler, P.E., is president of Ziegler Civil Eng. Ziegler can be reached at jazce@sierra.net or 530.581.1760. Julie Etra, MS, CPESC, is president of Western Botanical Services Inc. Etra can be reached at etra.julie@gmail.com or 775.849.3223.

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