2006
PROJECT OF
THE YEAR
AMERICAN
PUBLIC
WORKS
ASSOCIATION
SACRAMENTO CHAPTER
APWA

Mountain House Creek Restoration

TRACY, CALIFORNIA

PACE
PACIFIC ADVANCED
CIVIL ENGINEERING, INC.

Project
Mountain House residential and commercial development in Northern California

Civil Engineer/Planners
Carlson Barbee & Gibson, San Ramon, Calif.
Pacific Advanced Civil Engineering, Inc., Fountain Valley, Calif.
SWA Group, Sausalito, Calif.

Product application
Restoration of a creek corridor running through a large development, including use of precast concrete bridges, provided environmental and recreation benefits and decreased stormwater infrastructure costs.

Creek restoration supports land development

Designers blend environment and recreation in a new California city.

BY DEREK H. KARIMOTO, P.E.; RONALD J. ROVANSEK, PH.D., P.E.; AND KAREN DOLL, P.E.

Answering to Northern California's ever-growing housing demands, the first new California city in the 21st Century rose up from the agricultural fields of the San Joaquin Valley just outside the San Francisco Bay Area. Mountain House, a $1.5 billion residential and commercial development by master developer Trimark Communities, LLC, a subsidiary of Sunchase Holdings of Arizona, covers 4,784 acres and is expected eventually to house 44,000 residents.

Faced with high infrastructure costs, strict stormwater management regulations, and a desire to enhance and protect the natural environment, Mountain House applied an innovative approach to flood control and stormwater management that focused on restoring Mountain House Creek, which runs through the center of the development. Trimark turned to Pacific Advanced Civil Engineering, Inc., (PACE) for alternatives to the initial stormwater management plans, which called for costly mechanical pumping equipment, numerous large buried storm drain pipes, and several dry, extended detention basins covering more than 20 acres.

SWA Group, the project master planner and landscape architect, incorporated a concept into the project's master plan to trans-form Mountain House Creek from an agricultural ditch into a multi-use focal point for the community that incorporated stormwater conveyance, environmental habitat, and passive recreation functions. PACE added to this model by using the creek as the project's primary means of water quality treatment, as well as for stormwater conveyance.

The Mountain House Creek is approximately 15,700 feet long, and has long been used as an irrigation channel, livestock water source, and drainage ditch. Over the years, grading operations intended to maximize the agricultural efficiency of the land reduced the natural channel and riparian corridor of Mountain House Creek to a narrow, straightened, man-made ditch. It carried small, intermittent flows released by upstream agricultural operations and supported little riparian vegetation or wildlife habitat. Minimum widths of the restored creek were set forth in the master plan by Carlson Barbee & Gibson (CBG), the civil engineering firm that designed the neighborhoods surrounding

the creek. PACE set the creek corridor boundary, which averages approximately 300 feet wide and was excavated to a depth of 10 to 15 feet. This wide corridor contains a naturalized, meandering creek aver-aging about 20 feet wide, as well as water quality best management practices (BMPs) to treat runoff from the project prior to combining with creek flows. The entire corridor is planted with native riparian vegetation and provides a swath of green space, native wildlife habitat, and recreational facilities through the heart of the new city.

The proposed Mountain House Creek restoration project posed several technical challenges. First, the U.S. Army Corps of Engineers (Corps) holds jurisdiction over a substantial area of the Mountain House development, so all improvements had to meet the Corps requirements. Trimark built the road infrastructure in phases within the Corps permit-jurisdictional limits on a strict timeframe. Any subsequent phases to the first phase of construction had to take place outside of Corps jurisdictional limits. These constraints required the creek to be constructed and revegetated prior to the construction of the transportation infrastructure. That infrastructure called for several bridge crossings in post-phase one construction, which therefore had to be placed outside of the creek limits. Second, more than 25 water quality BMPs had to be designed in detail to accept runoff from the surrounding development. Third, the creek had to provide simultaneously wetland irri gation, flood conveyance, stormwater treatment, and public access within a finite area of land.

Bridge solution

Engineers had to accommodate Corps restrictions and tight construction schedules in the design of five vehicle bridges across Mountain House Creek. To choose a bridge structure that would meet the project's construction challenges, PACE analyzed several structure types, including the CON/SPAN Bridge System precast concrete arch structure. The CON/SPAN Bridge System was selected for all Mountain House Creek vehicle crossings based on several factors — speed of construction, ease of maintenance, lack of special backfill requirements, and lifespan.

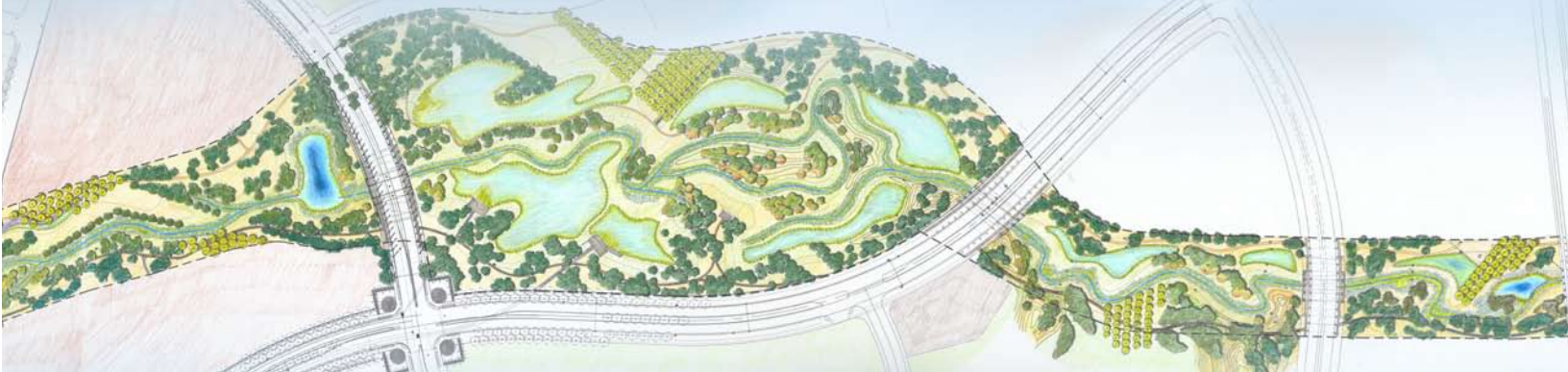
"There were really two key issues as to why we selected CON/SPAN," said Eric Teed-Bose, director of Community Development for Trimark. "One, we had a very limited construction window to complete the work, so we needed a product that could be prefabricated, dropped into place, and finished quickly because our [Corps] permit had a very short window. Secondly, we wanted a product that would also meet the local CSD (Community Services District) durability standards. The CSD was concerned about the

The Mountain House Creek Restoration project, comprising wet and dry BMP basins, is the centerpiece of the newly planned Mountain House Community in Northern California.

shelf life of the project, and we were concerned about the cost, and we also wanted something we could blend into our aesthetic needs."

The local team from CONTECH Bridge Solutions worked with Teichert Construction to install the five bridges during a six-month construction period in 2004. The construction procedures allowed placement of the arches on footings constructed outside of jurisdictional areas. The bridges were built by placing the precast concrete arches onto the footings using cranes located outside of the low-flow area of the creek. This construction technique allowed the project's later phases to avoid disturbance of the restored riparian zone and fulfill permit requirements while meeting construction schedules. Each of the five bridges was designed as a three-cell structure to convey typical flows through the natural-bottom center cell, and flood flows through all three cells. The center cell was constructed with a natural bottom, as requested by the Corps, to provide conditions that encourage the passage of fish and wildlife. The outer cells are built with a floating concrete slab invert to allow the structure to pass storm flows as great as the 100-year flood event. Scour concerns mandated the use of cut-off walls on the outer cells, in addition to the deep pedestal walls supporting the center cells. The five structures ranged in length from 80 feet to 232 feet, and, according to Teed-Bose, were completed within Trimark's budget.

The longest structure at Byron Road posed the most technical and construction challenges for the design team. First, the bridge had to be designed for 100 feet of Cooper E80 loading for the rail-road right-of-way and 132 feet of typical traffic loading within the roadway right-of-way. Second, the rail line could not be



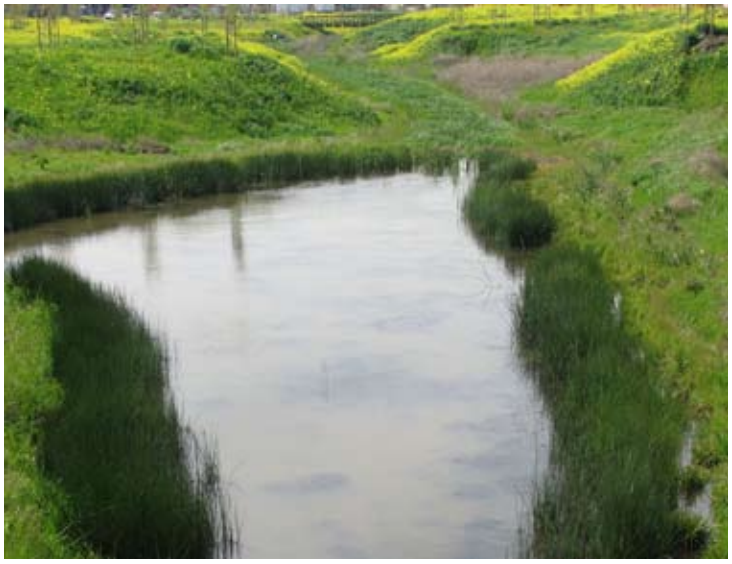
closed for any period of time — phased construction was used to meet the tight construction schedule. Third, utility crossings had to be averted, including an existing, high-pressure gas line and overhead power lines that limited the reach of the crane.

Water quality

Most stormwater management for the project site takes place within the creek corridor in approximately 25 stormwater wetlands and dry and wet pond BMPs. All runoff from the surrounding development is conveyed via 25, small buried storm drain pipes and is routed directly to the creek corridor. Within the creek corridor, the water quality BMPs capture, detain, and treat stormwater runoff and release it to supplement creek flows.

Each BMP was sized based on the drainage area and land use proposed within its watershed; the inlet pipe size and flow rate expected during storms; and guidelines for detention time, depth, and other factors related to water quality improvement. Design of water quality BMPs required constant communication between PACE, which designed the BMPs, and CBG. Coordinating the design of the creek corridor BMPs and the storm drainage system for the neighborhoods proved to be a significant challenge since the design needed to satisfy a wide variety of project needs.

The innovative use of a creek corridor for stormwater treatment and conveyance provided significant savings of land and expense compared with the traditional stormwater collection and treatment system that was included in early versions of the Mountain House Master Plan. Storm flows and treated stormwater are carried by the creek rather than in underground storm drain pipes. This not only has created a healthy and flowing creek that supports wildlife and provides recreation and aesthetic benefits, it also eliminated most of the large-diameter storm drain pipes from the original plan. In fact, eight, 84-inch-diameter storm drain pipes originally were proposed to cross under Byron Road in the center of the project, but the creek system eliminated the need for five of these pipes.



The Mountain House Creek Restoration project, comprising wet and dry BMP basins, is the centerpiece of the newly planned Mountain House Community in Northern California.

In addition to conveying runoff generated within the project site, Mountain House Creek also conveys offsite flows from several large watersheds. An area of approximately 31 square miles drains through Mountain House Creek to Old River, part of the San Joaquin River Delta. The widened, restored creek corridor provides conveyance for offsite flows while slowing floodwater, providing temporary storage of flows, and allowing sediments to settle out of suspension.

Recreation and habitat

PACE also worked with SWA Group to redefine the stream limits and find a successful balance to provide recreational corridors in a protected natural environment. From the initial planning stages, the stream corridor was conceived as a multi-use corridor, according to SWA Group Principal Joe Runco. As the project progressed, the strategy shifted to incorporate the wildlife passage-ways into the new stream layout, reinforcing the value of the corridor yet again.

"Our plan has always been to work within the competing needs of the area, such as recreation, stormwater management, water quality, and now habitat," said Runco. "Particularly, the hardest to address were habitat and recreation, because they're seen as being the least compatible. The recreation element — which included linear trails, picnicking areas, and limited viewpoints — was designed to control where people accessed the creek. Those areas tend to be at wider places along the creek, near the edges."

A combination of vehicular and pedestrian bridges were care-fully planned to facilitate safe pedestrian access to and from schools and among the neighborhoods. Early plans for these crossings included full-span bridge designs. Later, multiple arch structures were chosen to span the jurisdictional areas and pass flow, while creating the appearance of bridges. Each structure was faced with a combination of field-placed stone, stucco, dated keystone blocks, decorative railings, and decorative precast caps in a successful effort to blend with the neighborhoods' various architectural styles. The structures were tied into the Italianade architectural design, making bridges an integral part of the community's aesthetic design while creating convenient access to the creek area.

Finishing touches on the recreation element are still being added to the community. These include educational signposts that share the history of the creek corridor, information about the area's native fauna, and important water quality functions of the creek. Signage, planned vegetation, and low-key fencing protect the stream from vehicular intrusion while encouraging pedestrian access along planned trails in the community.

According to Teed-Bose, three critical functions of the stream drove the developer's goals for its renovation. "It needed to handle all of the upstream flow coming to Mountain House and convey it safely," he said. "In addition, we had our own on-site hydraulic issues, such as figuring how to manage urban and non-urban flows. The second goal was to turn that hydraulic facility into a community amenity, not just as a destination for

people to come to, experience, and enjoy, but also as a corridor that connects other destinations, like the future regional park with the town center."

Trimark's plan was to create a multi-mode, pedestrian and cycling corridor. The third purpose of the stream was to blend all hydraulic and environmental areas into a wildlife movement corridor, connecting the undeveloped areas of Alameda County and the Altamont Hills with the downstream riverine habitat areas along the Old River in San Joaquin County.

"With all of these competing dynamic interests among wildlife and wetland preservation, recreation, and design," Teed-Bose said, "the river corridor provided a way to successfully meet all of those individual needs."

Stormwater management has become one of the biggest challenges facing land developers, and large, ambitious projects such as Mountain House require innovative, multi-purpose stormwater solutions. The conversion of Mountain House Creek from an agricultural ditch into a naturalized creek flowing within a biotic, multi-purpose corridor through the center of the new city meets a variety of project goals while reducing infrastructure costs. The creek corridor provides the majority of project stormwater treatment requirements, conveys flood flows, provides wetland mitigation, and supports passive recreation on walking trails and overlooks. The creek also eliminated numerous large storm drain pipes, several large, dry extended detention-basin BMPs, and greatly reduced the cost of stormwater infrastructure for the project without compromising safety and treatment. Mountain House Creek demonstrates that function and beauty can both be created when engineering and project design are in partnership with nature.

Derek H. Karimoto, P.E., is vice president of the Stormwater Management group for PACE, a water resource engineering firm specializing in stormwater management, recreational water features, and environmental water. He can be contacted at dkarimoto@p-a-c-e.com. **Ronald J. Rovansek, Ph.D., P.E.**, a senior project engineer for PACE, can be contacted at rrovansek@p-a-c-e.com. **Karen Doll, P.E.**, is a project engineer for CONTECH Bridge Solutions. She can be contacted at kdoll@con-span.com.