SCHULTE RESTORATION PROJECT

The area near Schulte Bridge on the Carmel River at River Mile 6.7 (measured from the ocean) is mentioned in John Steinbeck's novel Cannery Row as the place where Doc Ricketts would send his boys out to get frogs, which were probably California red-legged frogs. This area was stable until floodplain development began to accelerate in the 1950's in response to an influx of population. The Volkswagon shown was carried away as the river sought to reoccupy high flow channels that had been turned into orchards, roads, and houses. The 1960's ushered in a period of increased groundwater extraction that continues today to put pressure on this limited water resource.

A serious condition of instability developed in this area in the late 1970's as water extraction and the drought of 1976-77 devastated much of the streamside vegetation holding together the loosely consolidated sands and gravels that formed the streambanks. A wet period between 1978 and 1983 caused the river to migrate up to 600 feet from its pre-1978 location, wiped out nearly all riparian vegetation in the vicinity of Schulte Bridge and washed an estimated 500,000 tons of sand and gravel downstream. The steelhead fishery declined precipitously, which prompted local fisherman to demand action. MPWMD began restoration efforts in 1986 and continues restoration and monitoring programs in this area.

The Steinbeck Pool

At the right hand side of these photos, a large granite outcrop (obscured by vegetation) causes a deep pool to form and abruptly turns the river toward Schulte Bridge. It is thought that the pool and outcrop was a favorite supper spot for John Steinbeck, thus the name for the pool.

Above – this photo, taken in 1958 by Charles R. Walker in slide form, is simply labeled “Carmel River.” It was probably shot on April 2, the day a major flood event occurred. Note the abundance of streamside vegetation.

Left – this view is ca. 1971, during a short, but severe drought. It was probably taken in late fall or early winter, before trees began leafing out. But streamside vegetation appears to be fairly dense.

Drought of '76

In November 1976, when this photo was taken, Carmel Valley was in the grip of an intense drought. Pumping dropped groundwater levels to as much as 55 feet below the riverbed, which caused a massive die-off of streamside vegetation.

Look closely in the foreground and you can see bulldozer tracks. Streambanks were mechanically cleared of dead vegetation during the summer and fall months. This activity probably took away the last vestige of protection along the loosely consolidated streambanks and contributed to the episode of erosion that followed the drought.

Above - a view to the granite outcrop (at left of photo) that dominates this reach of the river.

Emergency Work

Rains and swift flows returned in 1978 and continued through 1983. Property owners, desperate to halt bank erosion, dumped many types of materials over the streambank during high flows. Left - concrete rubble dumped in 1982 on the streambank washed out in 1983 and was replaced by tires banded together (above), which also failed. Schulte Bridge can be seen in the background.

Biotechnical River Restoration

In 1911, 1914, and 1918 major floods in the Carmel Valley formed much of the modern floodplain. In the ensuing decades, a lack of large magnitude floods allowed property owners to develop land prone to flooding for residential, commercial, agricultural, and recreational uses. Another significant factor in the evolution of the floodplain was the construction of two main stem dams on the upper Carmel River in 1921 and 1948. The dams cut off bedload sediment from the upper watershed that would otherwise inhibit the capability of the river to erode riverbanks. In response to these conditions, the river channel narrowed and deepened and by the 1940's a dense vegetative cover protected the streambanks; however, the potential for severe localized erosion due to swift flows increased dramatically.

The protective vegetation system developed by the river makes the difference between banks remaining stable at high flow and blowing apart in fierce winter storms. In geomorphology terms, the river is in a transition zone between being braided, which is a highly unstable channel form, and being a single thread channel, which is usually more stable. Streamside vegetation went into decline when extensive ground water pumping began in the late 1950's. An especially severe drought during 1976-77 prompted the local water purveyor, the California-American Water Company, and others to pump extensively from the aquifer to satisfy community demand for water. Ground water levels declined to unprecedented lows and riparian vegetation suffered as well.

Wet winters between 1978 and 1983 caused the river to flow at moderately high levels against banks devoid of healthy vegetation. In what has been described as a "positive feedback loop", an episode of erosion carved unprotected riverbanks and deposited the material within the riverbed in large gravel bars. The deposits caused further bank erosion by deflecting flows into downstream riverbanks. This effect continued into the mid-1990's, when extensive bank erosion occurred in the lower five miles of the river – a reach that had remained relatively stable for more than 60 years.

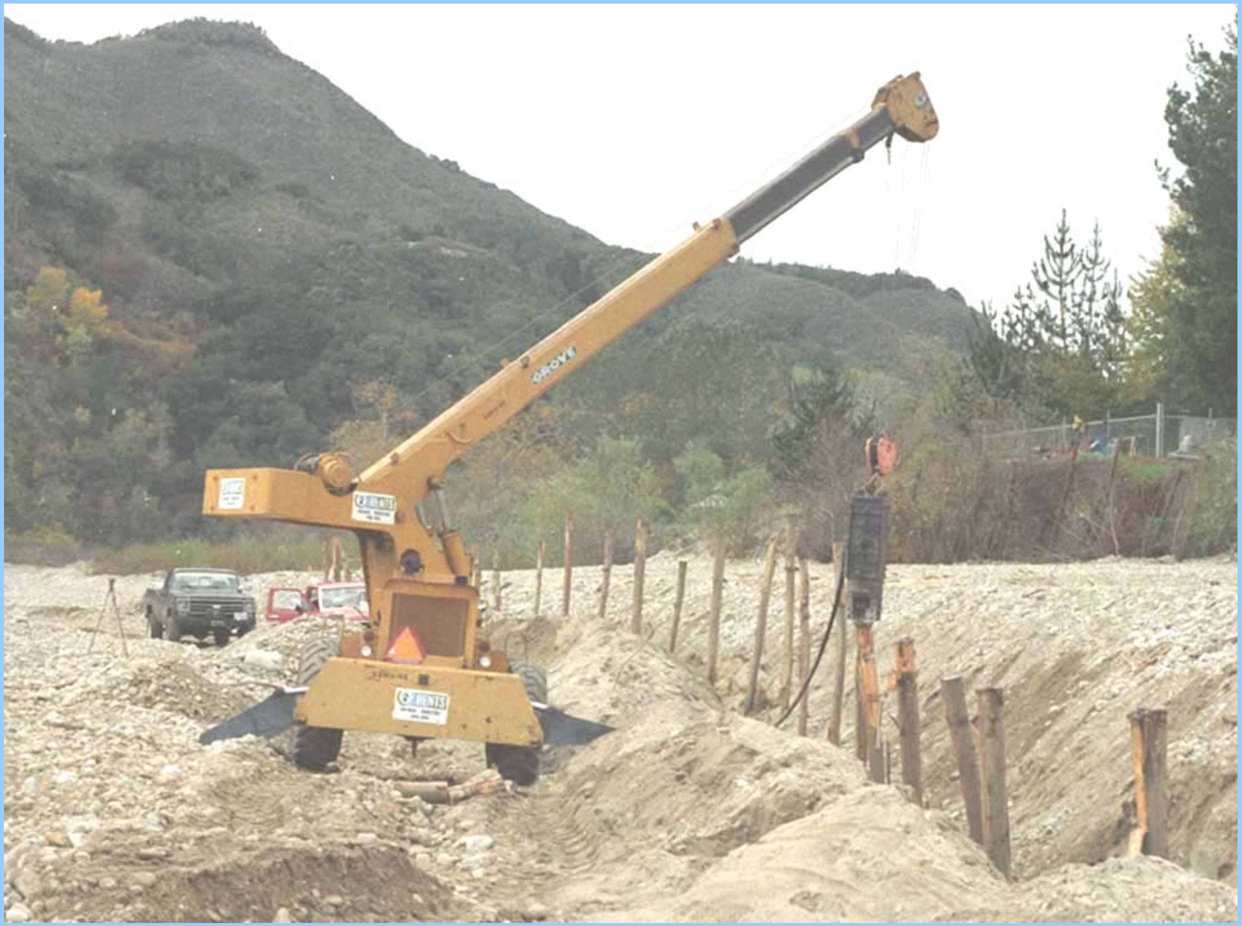
CONTINUED NEXT SLIDE

Biotechnical River Restoration (continued)

By using historical aerial photographs and measurements in the field, MPWMD researchers and staff were able to show that the river should be stable if restored as nearly as possible to the form it was in the mid-1960's. The Carmel River Management Plan (Plan) adopted by MPWMD in 1983 recommended biotechnical restoration methods, rather than traditional hardscape alternatives such as lining the banks with concrete or rip-rap. The Plan called for restoring the stream by using native vegetation with various types of stabilizing components such as rock rip-rap, boulders, gabions, wire mesh, logs, fiber rolls and other materials. Primary goals included stabilization of streambanks, restoration of riparian vegetation, and enhancment of the fishery habitat.

Initially, District plans to form a benefit assessment zone to fund a two-mile long project near Carmel Valley village were rejected by voters. But in 1986, MPWMD funded a pilot restoration project near the Schulte Road bridge. In 1988, MPWMD completed initial work at the 25-acre Schulte Restoration Project, which included 40,000 cubic yards of grading to reform the channel and adjacent floodplains, excavation of nine fish ponds in the channel bottom, and installation of thousands of willow and cottonwood cuttings in the streambanks and adjacent floodplains. A drip irrigation system was installed to keep the new plants alive during the dry season. Because the community withdraws a significant volume of groundwater from this area, MPWMD continues to irrigate and maintain this project area. Recent work includes planting a variety of riparian trees and shrubs, removing invasive plant species, monitoring avian populations, and conducting topographic surveys.

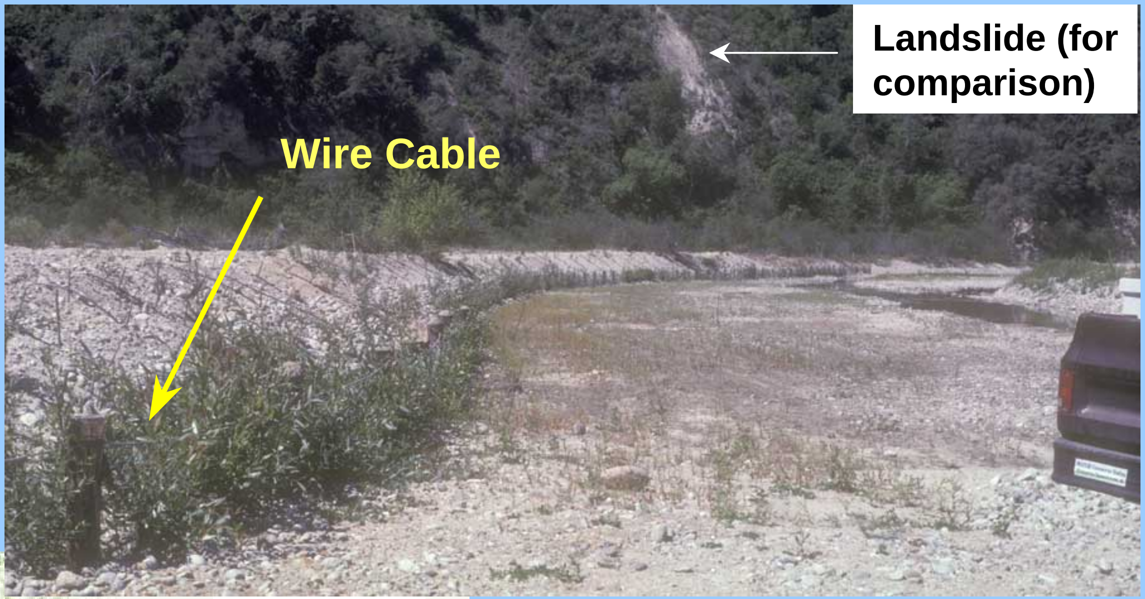
Streambank Protection

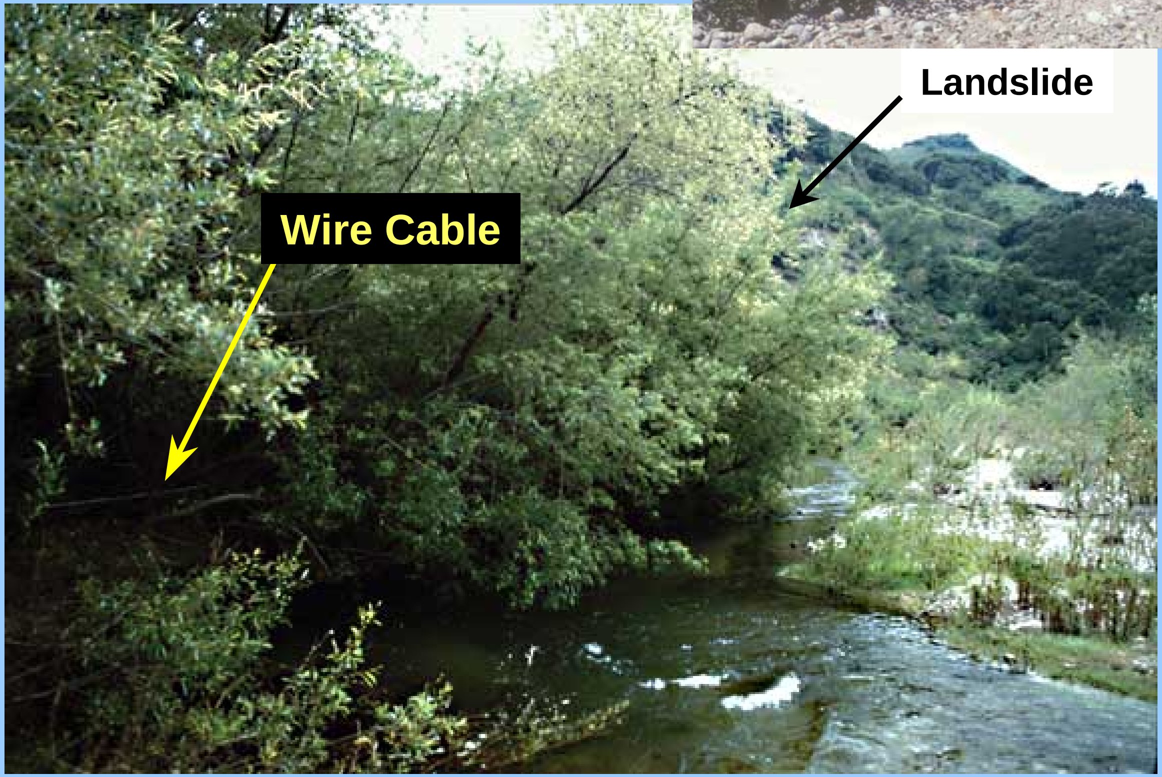


Above - 12-foot long eucalyptus posts were sunk at 10-foot centers at the toe of the streambank along the outside of bends. This provided the framework to place six-foot wire mesh that resembled chain link fence. About three feet of the mesh was buried below the streambed to resist toe scour.
This method worked fairly well at the Schulte Project, as a drought between 1987 and 1991 allowed vegetation to become established enough to resist high flows.

Post and Wire Comparison

Right – view downstream in May 1988, shortly after construction.
Below – same view in May 2002.





As streamside plants mature, the post and wire is incorporated into the trees and can provide significant protection; however, after several years, the posts rot at the toe of the slope. This reduces the effectiveness against erosion and can be a liability if the wire mesh and posts move downstream and clog the channel. In addition, fisheries biologists object to wire mesh placed near the path of migrating adult steelhead.

Repairs at Schulte Bridge - 1986

Restoration work was carried out in three phases, with work at the bridge scheduled first. Here, concrete rubble is placed on a streambank rebuilt with native river material. The shiny black cloth under the rubble is used to stop fine strambank material from washing out during high flows.

Right – a close up near the loader bucket, showing what appears to be green sticks amongst the rubble. Willow cuttings were integrated into the slope protection from the beginning.

Floodplain Rebuilding

Above - finished bank in 1986.

Right – same view 16 years later in May 2002. There are few visible signs of the concrete rubble and filter cloth installed during construction, but the erosion protection placed to protect the bridge withstood two of the highest flows on record in 1995 and 1998. MPWMD continues to irrigate and maintain this area.

No Problem Lasts Forever

Left - degradation of the riparian corridor culminated in an episode of erosion that scoured the channel and streambanks between 1978 and 1983 and transformed the reach into a braided, meandering channel with virtually no streamside cover. After many years of effort, a dense riparian corridor is now forming in this area as shown in the above photo.

These views were taken upstream of Schulte Bridge from the rock outcrop above the "Steinbeck" pool.

Return of the Carmel River

Right – willow cuttings installed in 1988 benefited from very low winter flows initially, which allowed these to mature. Today, these willows are more than 30 feet tall and have resisted extreme flow events with relatively small losses.

Left – nearly perennial flow between 1995 and 2002 encouraged more wetland species, such as the cattails just left of center. In late summer 2002, this reach dried up, which resulted in the loss of several streamside alders and cattails. Irrigation continues in the floodplain. Increased avian diversity and a strong increase in the number of spawning steelhead indicate good improvement of habitat. But intensive management is likely to continue in the foreseeable future.