IMPROVING OUR NATION'S LEVEES

How Sacramento is protecting its urban areas from the threat of future flooding

BY PAUL ENNEKING

Unfortunately, we have all witnessed what happens when levees are unable to provide their intended level of protection.

In Spring 2011, intense storms and tornadoes caused the Mississippi River to inundate the southern United States with historic flooding. While some was due to purposeful breaching of the levees to release water, much of it was the result of failing or overtopped levees. In North Dakota, the Souris River flooded more than 4,000 homes and hundreds of businesses, and Hurricane Irene hit communitites along the Eastern Seaboard. And none of us will ever forget the storm surges of 2005 produced by Hurricane Katrina, which breached the levees protecting New Orleans and flooded more than 70 percent of the metropolitan area.

There's just no debating the crucial role that levees play in protecting our urban areas from flooding.

TAKING ACTION

In Sacramento, California, the threat of levee failure is well known to those who live in and around the city boundaries. The vulnerability of Sacramento-area levees was exposed during a record flood in 1986, when the Folsom Dam exceeded its capacity and several levees nearly collapsed under the strain of a vicious storm. Downtown Sacramento came within hours of being inundated. As a result,

Levee improvements are well underway on the I Street South Levee in the city of West Sacramento.

the city undertook a long-term levee improvement program to help protect residences, business and farmland from this very real threat.

Serious floods are typically categorized as being a 100-year or 200-year events, depending on the magnitude. When the city began its comprehensive re-evaluation of Sacramento's area's levee system, it revealed that many of these levees were more than a century old and well below 100-year flood protection.

In 1989, the Sacramento Area Flood Control Agency (SAFCA) was formed to increase the level of flood protection by improving the levees. For the last 18 years, Psomas, an engineering firm, has been part of a team whose goal is to improve the soil conditions and increase the height of the levees that protect the Natomas Basin, an area where the American and Sacramento Rivers meet. The Natomas Basin, which encompasses roughly 53,000 acres, includes portions of the city of Sacramento, Sacramento County and Sutter County. SAFCA is improving flood protection in its watershed in two phases. The first phase, which is nearing completion, will protect against a 100-year storm event. Phase two is designed to achieve the agency's ultimate goal, which is protection from a 200-year storm.

LAND ISSUES

Adequate levee height is a critical factor in flood protection, as it directly corresponds to the magnitude of the flood event that a particular levee can control. There is a direct relationship between the height of a levee and the width of its base, as a levee typically cannot be raised without expanding its horizontal footprint. This means that, in most cases, additional land must be acquired to raise the height of a levee.

It is through sophisticated modeling techniques that hydrology and hydraulics engineers determine what levee height will provide the necessary protection for a given storm event. The modeling takes into account watersheds and their tributaries, the existing flood protection system and the storm history for the watershed. Today, we also have the benefit of a network of GPS satellites which ensure a highly accurate reference to facilitate measuring exact elevations around the world. Historically, coastal tide gauges were used to determine the mean sea level, and as the sea level is not consistent on both coasts of the United States, elevations were adjusted slightly along a network of benchmarks across the country. It is vital that the most accurate elevations are consistently used, as inconsistent use in levee design, construction, maintenance and evaluation can contribute to catastrophic levee failures, like what occurred in New Orleans during Hurricane Katrina.

Once the necessary height of the levee is determined, the project team will know whether or not additional land will be needed to accommodate raising the existing levee height. As with any right of way project, there are a number of issues and challenges associated with the land acquisition. Since levees are often miles long, a substantial amount of additional land could be required. Whether the land is rural/ranch, agricultural, residential, retail or industrial, each type can present a different challenge.

In the Sacramento region, most levee-adjacent land is private and consists of farmland and commercial and residential property, including many high-priced waterfront homes. Landowners are not typically supportive of giving up their land for levee improvements, even though this is being done for their own protection, as well as for the benefit of the community at large. As with other projects requiring land acquisition, property owners with the financial means have organized and hired attorneys to

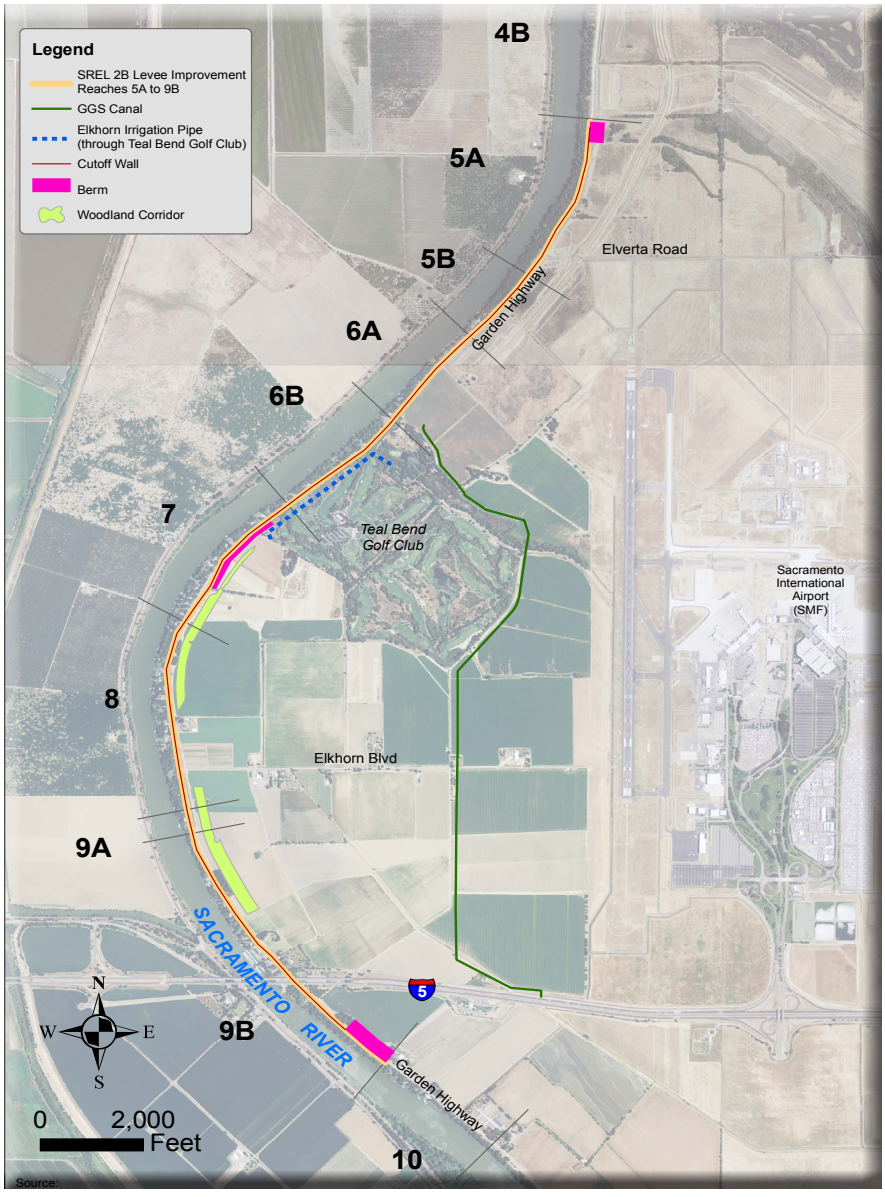
fight the flood control agency trying to acquire the land. A great deal of communication and diplomacy is needed to work through these issues. In some cases, a project may require niche property specialists. One example of this involved a strip of land along the edge of a golf course that was needed for levee improvements. This required that several of the golf holes be reconfigured. In order to make this work, experts were called in, including a golf course designer and an appraiser who specialized in golf courses. The process of determining just compensation required many factors be considered, including the loss of business while the construction and reconfiguration was underway.

Avoiding critical habitat and the associated environmental constraints can also affect the location and amount of land to be acquired. In Sacramento, the Swainson's Hawk, the Giant Garter Snake and the Valley Elderberry Longhorn Beetle (and its critical habitat, the Elderberry Tree) are all threatened or endangered species. In addition, there are often Native American cultural sites in the vicinity of levees that must be taken into account.

FULL OR PARTIAL ACQUISITION

In this era of reduced revenues and budget shortages, acquiring right of way can be costly and therefore a challenging process. Right of way acquisition, including the cost of the land and the acquisition process, often makes up 15 to 20 percent of the total cost of designing and constructing a levee improvement project.

The amount of new right of way needed varies widely depending on how the levee is to be improved. At one extreme, the design solution may entail building an entirely new levee, called a setback levee, adjacent to the existing levee. Obviously this method requires a great deal of new land. At the other extreme, the best solution may be to construct a deep slurry wall down the middle of the existing levee in order to stop seepage. In this case, no new right of way is required. I have also worked on projects that fall somewhere in the middle of these two extremes. In one case, the design solution called for raising the levee two to three feet for a 1000-foot stretch, including a levee patrol road and utility and canal relocations. This required the acquisition of roughly 10 acres of additional right of way. If a significant portion of a property needs to be acquired, a comprehensive analysis can identify the options and determine whether acquiring the entire property is the better option. If acquiring a portion



The Natomas Levee Improvement Program, which encompasses roughly 53,000 acres, is estimated to cost around $650 million.

Adjacent to the Sacramento River, the Teal Bend Golf Course was impacted by the levee under construction.

of the property could potentially compromise the owner's use and/or leave a remnant that has little or no practical and economic value, then purchasing the entire property may be the best option.

In one instance, a farmer owned 120 acres of farmland comprised of several parcels. There were roughly 100 acres that were suitable for farming and a 20-acre parcel where the farming operations and two residential houses were located. Eight acres were needed for the levee project, and these eight acres were in the section where the houses and farm buildings were located. The farmer felt the 12-acre remainder parcel would be unsuitable for its existing purpose, so the resulting settlement involved the agency purchasing the entire 20-acre parcel. The farmer continued to farm the remaining 100 acres, but did so from another nearby base of operations.

If a full acquisition is called for, relocation costs, lost customers, decreased revenues and potential loss of goodwill must be included in the appraisal in order to negotiate a fair compensation. Since the Uniform Relocation Act is the primary governing law for relocations, these projects will benefit from appraisers and right of way agents that specialize in the complexities of right of way acquisition involving landowner and business relocation. Most right of way acquisitions are negotiated and settled without going to court. Condemnation is avoided and only used as the last possible option.

In terms of funding, the Sacramento levee and flood control improvements are allocated from local, state and federal sources. Some of the key areas in Sacramento have voter-approved assessment districts to fund a portion of the improvements. In one such area, the Natomas Basin, levee improvements are expected to cost in the neighborhood of $650 million.

LONG-TERM PROTECTION

Over the last 20 years, the levee improvements in the Sacramento region have increased the flood protection back to 100-year storm levels in most areas, although the Federal Emergency Management Agency still requires flood insurance for about 6,000 residents.

The ultimate goal is to provide 200-year flood protection for the entire Sacramento area within a decade. This will be achieved by improvements to the Folsom Dam, as well as additional levee improvements along the Sacramento and American Rivers.

Construction is underway on several more phases of the improvement program, and plans call for the final phase to be completed by 2016. The ambitious, long-term levee improvement program now underway in Sacramento will protect residences, business and farmland from the very real threat of urban flooding.

Paul Enneking, PLS

Paul Enneking is Vice President, Director of Surveying and Mapping at Psomas, an engineering firm with offices in California, Arizona and Utah. He also serves as Project Director for Surveying and Right of Way Services for the Sacramento Area Flood Control Agency. Paul is a member of IRWA's Sacramento Chapter 27 and serves as the Survey Committee Chair.