



San Pablo Bay

Suisun Bay

San Francisco Bay

The Flood Crisis in California's Central Valley

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In the event of a large earthquake near the Delta, levee failure and island flooding could draw salt water (blue) from San Francisco Bay well into the Delta waterways (orange).

California flood officials watched with dismay the destruction and despair created by Hurricane Katrina, knowing that a myriad of such tragedies could easily come to California. While California does not generally suffer hurricanes, it receives significant precipitation and runoff from warm winter storms. In fact, the odds of a catastrophic flood were higher in California because the levels of protection provided by most of its levees are much lower than those associated with the levees that protected New Orleans.

Last year, California's Department of Water Resources (CDWR) released "Flood Warnings: Responding to the Flood Crisis in California." This white paper was mandated by the California Legislature to document challenges associated with a deteriorating levee system in the state's Central Valley and outline possible solutions. Among the findings was that California's Central Valley flood control system is not only deteriorating, but in many places is literally washing away. At the same time, California's growing population is

pushing new housing developments and job centers into the floodplains of the Central Valley. Flood control funding cuts at many levels of government combined with increasing liabilities have created a ticking time bomb for flood management in California.

The Early Days

Rimmed on the east by the Sierra Nevada and on the west by the Coast Range, California's Central Valley is basically a large bowl collecting most of the state's rainfall. Prior to the development of the West, the valley periodically would become a huge inland sea when valley flood waters overflowed their banks and spread across the floodplains. As farmers began moving into the Central Valley floodplains in the early to mid-1800s, they constructed small dikes or levees to provide some protection against flooding and reclaim the land for agricultural development. Soon, communities such as Sacramento, Marysville, and Stockton sprang up along the rivers. Limited flood control efforts failed to provide much protection and many communities and surrounding lands were repeatedly flooded. Mining activity in the mountains worsened the situation by filling many river channels with so much silt and

sand that navigation and flood carrying capacity were severely impacted.

In the late 1800s a system of new levees, weirs, and bypass channels was proposed. The federal government agreed in the early 1900s to lead efforts to construct flood control projects in the Central Valley, and a California State Reclamation Board was formed as the local sponsor. The board provided land, easements, rights-of-way and, in some cases, a local cost share. It also agreed to accept ownership of the projects completed by the U.S. Army Corps of Engineers, maintain the system, and hold the federal government harmless. Much of the levee system was later turned over to local reclamation districts to maintain.

The Corps of Engineers constructed new levees and enlarged existing ones, with most work occurring from 1917 to 1960. The levees were designed without benefit of modern engineering; even the relatively newer ones were constructed using techniques considered unacceptable today. Levees constructed in the early 1900s were commonly built from muck dredged from the river and spread with little compaction.

Today's Deteriorating System

The Central Valley's state-federal flood control system currently includes approximately 1,600 miles of project levees that protect more than 500,000 people, two million acres of cultivated land, and approximately 200,000 structures with an estimated value of \$47 billion. Most levees are maintained by local reclamation districts. California directly maintains about 300 miles of levee system, and operates and maintains the channel and bypass system in the Sacramento

Valley. Funding for maintenance work carried out by local reclamation districts is generally provided by local assessment fees, while maintenance work performed by the state is principally funded by the state's general fund. The state also

operates ten maintenance areas where local reclamation districts have been dissolved, using funds collected from those protected by the levees.

While most of the levees are maintained reasonably well by local agencies and the state, those constructed almost a century ago have significantly deteriorated. Effects include internal and external erosion induced at high flows, degradation/removal of natural berms, animal burrowing, and settlement and cracking. The uncontrolled growth of vegetation and build-up of sediment has also significantly reduced the amount of water that can flow smoothly through the system.

Riverbank and levee erosion has been particularly devastating. Part of the levee system was designed so flood flows would scour out the mining sediments filling river channels. The success of that design now causes flows to erode the natural channels and flood protection levees.

The cost of considering environmental issues has also become a factor in trying to maintain the deteriorating system. Significant effort and resources are required to preserve habitat and

minimize or mitigate impacts to various endangered species. Many maintenance projects now cost double or triple the amount envisioned decades ago.

Many levees also have design deficiencies associated with underseepage and other foundation weaknesses that were never considered in the original design. Costs to reevaluate the structural integrity of most project levees are estimated at over \$60,000 per mile. For the 1,600 miles of levees in the Central Valley, this reevaluation alone would cost over \$100 million.

Flood Liability

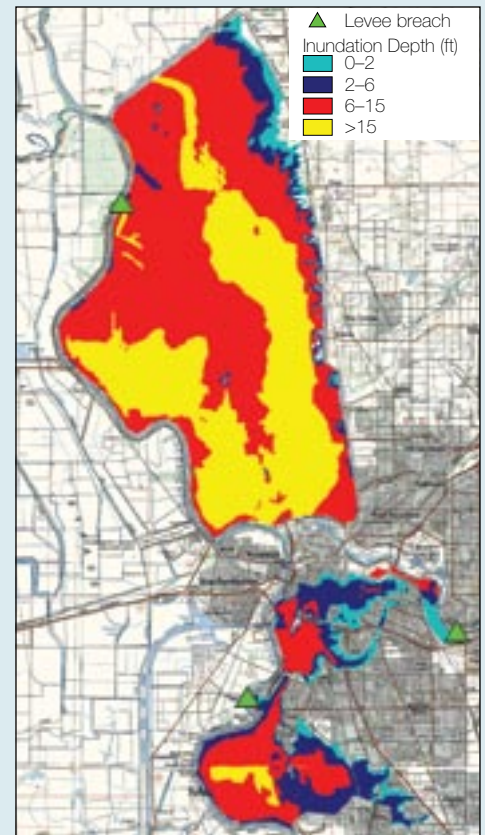
In recent years, California's courts have exposed public agencies and the state to enormous financial liabilities for flood damages. *Paterno vs. State of California* ruled in November 2003 that when a

public entity accepts and operates a flood control system built by another, it assumes liability as if it planned and built the system. The *Paterno* ruling held California responsible for defects in a Yuba County levee foundation and its failure in 1986, even though the levee was originally constructed by local agricultural interests in the 1930s and later incorporated into the state-federal flood control system. This particular judgment cost California about half a billion dollars and may make California ultimately responsible for the structural integrity of much of the Central Valley flood control system.

Sacramento's Flood Concerns

Sacramento was founded at the confluence of the American and Sacramento rivers and is protected from flooding by both upstream dams and state-federal project levees. The city has only about a 100-year level of flood protection (each year there is a one percent chance of a flood disaster), far lower than most major urban areas in the United States. River cities such as Tacoma, St. Louis, Dallas, and Kansas City have 500-year levels of protection. Even New Orleans was thought to have a 250-year level of protection.

The levees were designed without benefit of modern engineering; even the relatively newer ones were constructed using techniques considered unacceptable today.



Location and inundation depths of a 200-year flood in Sacramento.

Local, state, and federal agencies have been working together to improve Sacramento's flood protection; however, major improvements are still several years away. Meanwhile, these agencies have determined that a large flood would inundate significant areas of Sacramento to depths of 15 feet or more (see figure above), with resulting property and economic losses ranging into tens of billions of dollars.

The Vulnerable Delta

The Central Valley is drained by the Sacramento and San Joaquin rivers, which meet in the Sacramento-San Joaquin Delta. There, nearly 60 islands and tracts lie below sea level, kept dry by more than 1,115 miles of levees, many of which are founded on organic, peat soils. Over 700 miles of them are local, privately owned levees constructed and enlarged by farmers during the last 140 years. Most have problems associated with long-term settlement and island subsidence. More than 160 levee failures and island inundations occurred in the 1900s, mostly but not exclusively during

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flood events. In June 2004, a levee failed and flooded over 12,000 acres on Jones Tract for no known reason, resulting in an estimated \$100 million in damage and reconstruction costs, most of which will ultimately be paid for by taxpayers.

The delta provides important habitat and conveyance for various fisheries and wildlife; equally important, two-thirds of California's population obtains at least some of its drinking water from its exports. An earthquake near the delta could cause massive levee failure and island flooding which would draw salt water from San Francisco Bay into the delta waterways (see figure, page 20). The

increased salinity could reduce or even shut down water exports from the delta for months, if not years, with a potential economic impact of up to \$30 billion to \$40 billion in the first five years.

Initiatives and Solutions

CDWR's white paper recommended several strategies to reform the flood management system in the Central Valley, among them:

- maintain the existing infrastructure;
- address deferred maintenance and deficiencies to recover intended original design capacity;
- update floodplain maps to inform the general public and guide policies;

- upgrade urban areas to higher levels of protection;
- improve emergency response;
- complete a Delta Risk Management Strategy; and
- mandate flood insurance for those living behind a levee.

The Governor is supporting legislation to reform California's flood management programs and develop funding mechanisms to sustain them. The state is also working closely with local and federal partners to improve the system. Clearly, much needs to be done for California's Central Valley to avoid the fate that befell New Orleans.

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Levee Districts Struggle

Most of the responsibility for maintaining California's 300-mile network of levees falls to local districts. And as an investigation by the *Sacramento Bee* found, not only the levees need help. Nearly half of the 73 levee districts whose financial audits were reviewed by the *Bee* operated at a deficit during the last fiscal year. The average deficit was \$134,000 and the maximum was \$500,000. Only a third of the districts had enough cash reserves to cover one year's operating expenses.

According to the *Bee*, these results mean that levee districts are struggling to keep up with basic maintenance, upgrades are not likely, and financial reserves are draining away. Among the *Bee's* findings:

Eight key islands on the western edge of the Sacramento-San Joaquin Delta are essential for maintaining the fresh water supply in the delta.

If any of the islands flooded, salt water would contaminate the fresh water in the delta, which provides two-thirds of Californians with fresh water. Yet the *Bee* found an average annual operating deficit of about \$80,000 among the districts responsible for the island levees.

One levee district in the southern Central Valley decided to disband after its levees failed inspection for liability insurance coverage. The district had been operating off funds from a land sale, but that money ran out. Fearing personal liability if a levee failed, the board resigned, hoping Tulare County will take over maintenance responsibility. County officials told the *Bee* that they have not yet decided what to do, but that they were not taking over levee maintenance in the meantime.

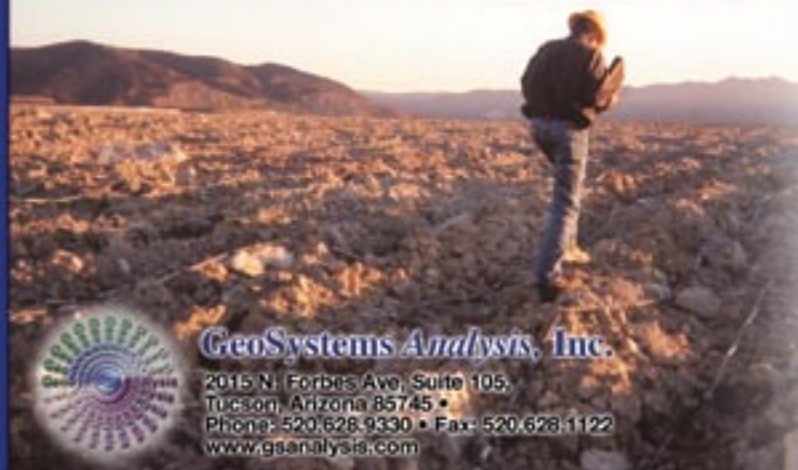
Levee districts are funded from property taxes, but not as a proportion of assessed value. Thus,

according to the newspaper, as farmland gives way to residential development, the districts receive no additional money, even though the potential liability increases significantly. Flood-control experts told the *Bee* that the districts are widely considered to be run frugally by people who know the land well and volunteer their labor and equipment to do repair work, often for free.

Certainly more people than just those adjacent to the levees benefit from them, including developers, homeowners, and water consumers to the south. Metropolitan Water District of Southern California Vice President Tim Quinn told the *Bee* that his agency recognizes a need to share in the costs of flood protection, but he fears the agency is an easy mark, with deep pockets, and any acceptable financing plan would need to have broad participation from all beneficiaries.

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