



**Informational Circular No. 1: Summary of the
California Levee Vegetation Research Program (CLVRP)**
January 18, 2010

The agencies of the California Levees Roundtable are conducting research that will determine the extent to which woody vegetation, such as trees, may affect the safety of levees in California's Central Valley. These studies include a national research program implemented by the US Army Corps of Engineers (Corps) as well as a parallel and complementary effort initiated in California referred to as the California Levee Vegetation Research Program (CLVRP).

The goal of the CLVRP is to collaboratively pursue objective research, utilizing the scientific method, to create new knowledge or correct and integrate previous knowledge regarding levee vegetation. Research results will contribute to the scientific foundation for future policy about the management of vegetation on levees in California. The research is also intended to inform the FloodSAFE Levee Evaluations Program, which is evaluating and prioritizing all geotechnical factors that impact the safety and performance of Central Valley levees.

The Roundtable agencies sponsoring the CLVRP include NOAA Fisheries, US Fish and Wildlife Service, California Department of Water Resources (DWR), California Department of Fish and Game, Central Valley Flood Protection Board, Sacramento Area Flood Control Agency (SAFCA), and Central Valley Reclamation Districts. Funding and project management for the CLVRP are primarily provided by DWR and SAFCA.

The Corps' Engineer Research and Development Center (ERDC) has been charged with implementing the national levee vegetation research sponsored by the Corps. ERDC and the CLVRP have been collaboratively coordinating their research efforts. This process of peer review and support includes mutual review and comment at key intervals throughout the research process, conducting joint fieldwork in California, and mutual input on data analysis and reporting of results.

CLVRP researchers include scientists from the Davis and Berkeley campuses of the University of California and from the University of Georgia, as well as team of expert consultants in the fields of engineering and plant sciences.

The CLVRP studies address:

- **Tree root architecture** – This study will evaluate major tree root (over 1 inch in diameter) growth into levees. Research will assess how tree location, species, and soil characteristics affect root growth patterns. This information will subsequently inform seepage and stability studies described below.

- **Susceptibility of trees on or near levees to windthrow** – The critical forces necessary for windthrow of trees on California levees will be studied by experimentally pulling trees. Measurements of tree characteristics, deflection under load, soil characteristics, and soil plate characteristics for pulled trees will be used for regression of the likelihood of tree failure under wind load. Trees will be pulled from the riverside and landside levee slopes and from levee toes. Field results will be compared to windthrow data from the January 2008 California wind storm. Information from this effort will also inform seepage and stability studies described below.
- **Tree roots and the potential for water piping and seepage through levees** – Tree roots in levee structures are suspected of creating preferential pathways that may enable water to flow through levees and foundations, leading to internal erosion (or “piping”) that can cause structural failure. Full-scale tests will be conducted on living trees, single dead trees surrounding by live trees, areas with groups of dead trees or stumps. Results for each type of root system will be compared to similar trials on slopes with only turf. In addition, researchers will investigate whether internal levee structures such as seepage cutoff walls (slurry walls) can be penetrated or damaged by root growth. This research will consist primarily of forensic trenching at locations where roots and slurry walls coincide.
- **Slope stability** – Data collected in the tree root architecture, windthrow, and piping & seepage studies will be used to determine if analytical models of slope stability can predict the effects, positive and/or negative, of various vegetation scenarios on levee stability. The CLVRP data will also be used in modeling conducted by ERDC.
- **Habitat use by burrowing mammals on levees** – Researchers will quantify the habitat associations used by burrowing mammals on Central Valley levees and assess the effects of habitat change on the distribution and abundance of the mammals. The scientists will also assess the effectiveness of grouting as a means of filling burrows created by California ground squirrels.
- **Forensics of past levee failures in California** – Researchers will correlate historic levee performance with historic levee vegetation using interviews in conjunction with historic documents and photographs. Interviews will be conducted with levee maintaining agencies throughout the state and will be coordinated with DWR’s Non-Urban Levee Evaluation (NULE) program.

Preliminary studies and findings

Preliminary CLVRP studies began in the Sacramento Pocket Area on the Sacramento River east levee in Fall 2009. These involved investigating whether tree roots can penetrate or damage a slurry wall, and where tree roots grow in relation to the levee. Methods used to date include excavations, ground-based LiDAR, and data collection for later modeling.

These studies will be used to refine methods for the more comprehensive research effort beginning in Winter 2010 (described above). That effort will take place at levees and floodplains on the Sacramento River, San Joaquin River, Yuba River, Bear River, Feather River, and Sutter Bypass. Preliminary results and data obtained from this effort will be provided in a subsequent CLVRP informational circular.

Background – Why are these levee – vegetation studies needed?

The research effort follows the 2007 announcement that the US Army Corps of Engineers would begin strictly enforcing a policy that would require removal and prohibit future establishment of woody vegetation on levees - within a 15-foot buffer zone on either side – due to its potential risk to levee reliability, inspectability, and flood fighting. Failure to comply with the policy could result in decertification of levees and removal of eligibility for federal rehabilitation assistance in the event of flood damage.

However, local and state agencies with responsibility for levee maintenance in areas with extensive existing woody vegetation on levees wish to avoid removing existing vegetation that may be benign or beneficial to levee safety, and which provides significant environmental benefits. These agencies would prefer a policy or variance process that identifies dangerous vegetation for removal but also allows any benign or beneficial vegetation to remain if it is managed to allow inspections and flood fighting.

There is existing slope stability research and anecdotal evidence that supports the hypothesis that woody vegetation may aid in levee stability and prevent erosion failures under some conditions; however, the body of research that specifically examines the effects of woody vegetation on levee stability is small. Conversely some researchers hypothesize that trees may have played a role in some levee failures, though this is difficult to prove since a levee failure can erase the evidence of its cause.

Because there remain many unanswered questions, the partners of the CA Levees Roundtable, including the US Army Corps of Engineers, agreed to conduct additional research on the effects of vegetation on levee stability.

The CLVRP has developed in consultations through the California Levees Roundtable. This multi-agency partnership prepared the California's Central Valley Flood System Improvement Framework (2009) (*Framework*). The *Framework* document provides general guidelines for helping the State, in coordination with federal and local entities, to focus on flood system improvements and public safety in the near term, while a more comprehensive, long-term flood system plan is developed. Section 12 – of the Framework describes the goals of a program that could be implemented to contribute peer reviewed scientific research to support a vegetation management policy in support of the California FloodSAFE initiative. More information on the California Levees Roundtable and the *Framework* document can be found at http://recbd.ca.gov/docs/031209flood_improvement.pdf

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