



# ATTACHMENT 4 Initial Research into the Effects of Woody Vegetation on Levees

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U.S. ARMY CORPS OF ENGINEERS

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**Background:** The U.S. Army Corps of Engineers' (USACE) Engineer Research and Development Center (ERDC) has conducted advanced, quantitative research on the impacts of trees on levees focused on specific aspects of this complex issue. The "Initial Research into the Effects of Woody Vegetation on Levees" research report provides a better understanding of the impacts of trees on levee performance. The report is available at <http://wri.usace.army.mil>. With life safety as a top priority for infrastructure projects, USACE will use this new information to inform its decision making for trees on levees in the USACE levee safety program.



**Research Effort:** There are many concerns about the impact of trees on levee integrity and performance. This two-year, \$1.34 million research effort is the initial effort to better understand some of these complex issues. The research included a global literature review, site characterizations and assessments, field data collection (root mapping, root strength and soil properties) and numerical model development. Specifically, the research team modified a root pull-out apparatus to measure root strength and applied non-intrusive methods to map tree roots. The team also modified or developed two-dimensional and three-dimensional computer models to help quantitatively define tree root impacts on levee slope stability and seepage.

### Results:

- Initial research has advanced our knowledge and understanding of some aspects of this complex issue.
- The presence of trees on a levee increases the uncertainty associated with levee integrity and performance.
- ERDC researchers considered the effects of trees at various locations on levees and found that a tree may either increase or decrease the factor of safety; at some locations where a tree was found to increase the factor of safety under one set of conditions, that same tree was found to decrease the factor of safety when other likely conditions were considered.
- ERDC researchers have determined that because of the many variables, including climate, moisture, soil types, tree species and levee designs, the full impacts of trees on levees may never be fully quantifiable.

**Future:** ERDC does, however, recommend continued research into the impact of trees on levees as USACE seeks to improve its levee safety policies and procedures. Furthermore, the addition of quantitative and qualitative research will help levee sponsors make better informed decisions about safety and set priorities for operation and maintenance among limited resources.

Though this initial research on impacts of vegetation on levees resulted in additional valuable information, the total impact of vegetation, such as large trees, on levees continues to be extremely complex, highly variable, and unquantifiable. USACE remains confident that a well-constructed levee with well-maintained grass cover represents the optimal goal for reducing the uncertainty of the performance of levee systems. This better ensures long-term reliability throughout the project life. Although the results of this initial research do not warrant a change to the USACE national vegetation management standard, USACE will use the results to inform its decision making for trees on levees in the USACE levee safety program, such as with prioritizing deficiencies.

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