



## LEEVE CERTIFICATION SUBMITTALS

44 CFR 65.10 provides the minimum design, operation, and maintenance standards that levee systems must meet *and continue to meet* in order to be recognized as providing protection from the base (1% annual chance, or "100-year") flood on National Flood Insurance Program (NFIP) maps. FEMA does not certify levees, but rather relies on certifications provided by registered professional engineers, public agency officials responsible for operation and maintenance, and Federal agencies responsible for levee design in determining whether or not a given levee system meets the requirements of 44 CFR 65.10. FEMA review is solely for establishing flood risk zones and does not constitute a determination by FEMA as to how a levee system will perform in a flood event. If a levee is certified to meet 44 CFR 65.10, FEMA will reflect the levee as providing protection from the base flood on the NFIP maps (referred to as "accrediting" the levee).

Levee certification submittals should provide data and documentation in the following areas:

- Operation and Maintenance
- Engineering Design
- Interior Drainage Analysis (only required if levee system is determined to meet 44 CFR 65.10)

To facilitate FEMA review, MT-2 Form 3, "Riverine Structures Form" should be submitted for each riverine levee system to be certified, with supporting documentation and backup data attached. Similarly, MT-2 Form 5 "Coastal Structures Form" should be submitted for each coastal levee system to be certified. The components of a levee certification submittal are summarized in the following sections.

### Operation and Maintenance

Information on the operation, maintenance, and performance of the levee system to be certified should be provided by the responsible official from the public agency responsible for continued operation and maintenance of the levee system.

- Operation Plans and Criteria

A copy of the officially-adopted Operation Manual for operation of closure devices and internal drainage mechanical systems must be submitted

- Operations must be under jurisdiction of Federal or state agency, an agency created by Federal or state law, or NFIP participating community
- Must document flood warning system triggering emergency operation activities and demonstrate sufficient warning time for operation of system components
- Closures:
  - Formal plan of operation, including specific actions and assignment of responsibility by individual name or title
  - Periodic operation (no less than annually) for testing & training
- Interior drainage systems:
  - Include storage areas, gravity outlets, and/or pumping stations
  - Formal plan of operation, including specific actions and assignment of responsibility by individual name or title
  - Manual backup for activation of automatic systems
  - Periodic inspection and operation (no less than annually)

Additionally, documentation of any levee operation-related training conducted (e.g., agenda, attendee sign in sheets, etc) can also be submitted.

- Maintenance Plans and Criteria

Copy of the officially-adopted maintenance manual for the levee system must be submitted

- Maintenance must be under jurisdiction of Federal or state agency, an agency created by Federal or state law, or NFIP participating community
- Must ensure that stability, height, and integrity of levee and associated structures maintained
- Must specify maintenance activities to be performed, frequency of their performance, and responsible person by name or title

In addition to the maintenance manual or plan, copies of maintenance and inspection reports and verification that any deficiencies that were noted during maintenance inspections have been corrected should be submitted. Additionally, documentation of any levee maintenance-related training conducted (e.g., agenda, attendee sign in sheets, etc) can also be submitted.

- Performance Assessment

Written commentary on the performance of the levee system in any actual flood event(s) should be submitted by the agency official responsible for levee operation and maintenance. This assessment should include as much of the following information as is available:

- Date(s) and magnitude of flood event(s)

- Photographs of levee protected areas during historical flood events
- Whether or not the levee was overtopped, breached, or otherwise failed
- Whether or not interior drainage (e.g., pumping stations) and closure systems were activated and how they performed
- How gravity outlets performed
- Extent and depth of interior ponding behind the levee
- Extent and magnitude of any underseepage
- Extent and magnitude of erosion, sedimentation, or structural damage to the system
- Extent, if any, of damage to any buildings or infrastructure due to flooding behind the levee system
- Any other pertinent information relevant to the levee's performance

### Engineering Design

Data and documentation demonstrating that the following structural design criteria have been met certified by a registered Professional Engineer must be provided. The submitted documentation must include certified "as built" plans. Recent photographs of the levee system, including embankments and levee closures while not required, will be helpful to FEMA in performing the review.

- Freeboard
  - Riverine levee systems
    - 3 foot minimum above the base flood profile
    - Additional 1 foot within 100 feet of either side of structures (e.g., bridges, culverts) riverward of levee or where flow is constricted
    - Additional one-half foot of freeboard on upstream end of levee system
  - Coastal levee systems
    - 1 foot above the height of the 1% annual chance wave or maximum wave runup (whichever is greater) associated with the 100-year stillwater elevation at the site.
- Closures
  - Openings must have closure devices
  - Closures must be structural parts of the levee during operation and designed according to sound engineering practice. This precludes the use of sandbag closures.
- Embankment Protection

- Requires engineering analyses demonstrating that no appreciable erosion of levee embankment during base flood and that anticipated erosion will not result in levee embankment/foundation failure through reduction of seepage path and subsequent instability
- Engineering analyses should address:
  - Expected flow velocities
  - Expected wind and wave action
  - Ice loading
  - Debris impact
  - Slope protection techniques
  - Flooding duration and velocities
  - Embankment and foundation materials
  - Levee alignment, bend, and transitions
  - Levee side slopes
- Embankment and Foundation Stability
  - Requires engineering analyses evaluating expected seepage during base flood loading conditions. Analyses must demonstrate seepage into/through levee foundation and embankment will not jeopardize stability. Alternatively, analysis demonstrating that the levee is designed and constructed for stability against Case IV loading conditions defined in USACE manual EM 1110-2-1913 *Design and Construction of Levees* may be used. Factors to be addressed in the engineering analyses include:
    - Flooding depth
    - Flooding duration
    - Embankment geometry and seepage path length
    - Embankment and foundation materials
    - Embankment compaction
    - Penetrations
    - Other factors affecting seepage and stability
- Settlement
  - Engineering analysis assessing potential freeboard loss due to settlement showing that minimum freeboard will be maintained. The analysis must address:
    - Embankment loads
    - Embankment soil compressibility
    - Age of levee system
    - Construction compaction methods

- Detailed settlement analysis must be submitted
- Procedures from USACE manual 1110-1-1904 *Soil Mechanics Design-Settlement Analysis* can be used (note that 44 CFR 65.10 references EM 1100-2-1904, an earlier version of this USACE document)

In lieu of the above structural requirements, a Federal agency with responsibility for levee design may certify that the levee has been adequately designed and constructed to provide protection against the base flood. Therefore, if the levee system was designed and constructed by a Federal agency, such as the U.S. Army Corps of Engineers or Bureau of Reclamation, levee owners should contact that agency for assistance in evaluating the levee's current condition against the 44 CFR 65.10 criteria and, if appropriate, providing a written certification of the levee system.

It is important to note that, for existing levees, certifications made by registered Professional Engineers should be based on current field conditions rather than relying solely on "as built" documents and design reports. The U.S. Army Corps of Engineers *Levee Owner's Manual for Non-Federal Flood Control Works* provides guidance on inspecting and maintaining levees in good condition.

A site visit by the certifying engineer or agency is recommended. Factors to be evaluated include (but are not necessarily limited to):

- Evidence of settlement of the levee such that freeboard has been lost
- Erosion, such as from rainfall runoff, embankment overtopping, or embankment caving
- Unacceptable encroachments such as excavation, tilling, piping for irrigation, placement of utility poles, etc.
- Slope stability problems, such as degradation of embankment protection materials, slope failure, tree growth, etc.
- Evidence of inadequate or poor maintenance
- Evidence of breaches, cracking, ruts, or depressions
- Evidence of seepage or sandboils behind the levee
- Closure structures or internal drainage structures (e.g., flap gates, pipes, pumping stations) in bad repair or blocked
- Accumulation of debris in the channel that may deflect floodwaters toward the channel bank
- Presence of burrowing animals

In addition to assessing the current condition of the levee based on visual inspection, detailed geotechnical investigations and tests of the levee materials may be warranted to determine the stability and settlement of the levee, particularly for levees older than 10 years. Whether or not geotechnical explorations are required is left to the judgment of the professional engineer or Federal agency performing the certification. However, if the certifying Professional Engineer or Federal Agency determines that such geotechnical

explorations are not warranted, written justification for that judgment should be provided.

Special consideration should be given to the potential for underseepage. U.S. Army Corps of Engineers Technical Letter 1110-2-569 *Design Guidance for Levee Underseepage* (dated May 1, 2005) provides guidance for design of levees to minimize the adverse effects of levee underseepage. For existing levees constructed prior to this underseepage guidance, emphasis should be placed on gathering data from levee performance during previous floods. This performance data should be used as part of the engineering judgment in the final determination of potential for underseepage and adequacy of existing seepage control measures, or if additional measures are needed.

#### Interior Drainage Analysis

If a levee system is determined to meet the criteria of 44 CFR 65.10, an interior drainage analysis identifying source(s) and magnitude of interior flooding must be performed by a registered Professional Engineer. This interior drainage analysis must be based on joint probability of interior and exterior flooding and must consider capacity of drainage lines and pumps to evacuate interior floodwaters. The U.S. Army Corps of Engineers EM 1110-2-1413 *Engineering and Design- Hydrologic Analysis of Interior Drainage Areas* provides guidance and criteria for performing an interior drainage analysis for a levee system.

The following page provides the web URLs for the documents and engineering manuals referenced in this document.

### Web Links to Important Documents

Document	Brief Summary	Web URL
44 Code of Federal Regulations 65.10, <i>Mapping of Areas Protected by Levee Systems</i>	FEMA's regulatory criteria for accreditation of levee systems on NFIP maps	<a href="http://www.fema.gov/pdf/plan/prevent/fhm/lv_s6510.pdf">http://www.fema.gov/pdf/plan/prevent/fhm/lv_s6510.pdf</a>
MT-2 <i>Revisions to National Flood Insurance Program Maps</i>	Form 3 (Riverine Structures) or Form 5 (Coastal Structures) of these application/certification forms should be completed and submitted for each levee to be certified.	<a href="http://www.fema.gov/pdf/fhm/mt-2.pdf">http://www.fema.gov/pdf/fhm/mt-2.pdf</a>
USACE manual EM 1100-2-1904 <i>Soil Mechanics Design-Settlement Analysis</i>	Basic principles in design and construction of earthen levees. Includes guidance on field investigations and laboratory testing that can be used to assess the current geotechnical condition of an existing levee.	<a href="http://www.usace.army.mil/publications/eng-manuals/em1110-2-1913/toc.htm">http://www.usace.army.mil/publications/eng-manuals/em1110-2-1913/toc.htm</a>
USACE manual EM 1110-1-1904 <i>Soil Mechanics Design-Settlement Analysis</i>	Guidelines for calculations of vertical displacements and settlement of soil under shallow foundations supporting various types of structures.	<a href="http://www.usace.army.mil/publications/eng-manuals/em1110-1-1904/toc.htm">http://www.usace.army.mil/publications/eng-manuals/em1110-1-1904/toc.htm</a>
USACE <i>Levee Owner's Manual for Non-Federal Flood Control Works</i>	Guidance on the operation and maintenance of levees, floodwalls, and other flood control structures, including inspections and flood preparedness.	<a href="http://www.usace.army.mil/cw/cecwhs/em/fcw/lom/lom.html">http://www.usace.army.mil/cw/cecwhs/em/fcw/lom/lom.html</a>
USACE Technical Letter 1110-2-569 <i>Design Guidance for Levee Underseepage</i>	Guidance for design of levees to minimize the adverse effects of levee underseepage	<a href="http://www.usace.army.mil/publications/eng-tech-ltrs/etl1110-2-569/toc.html">http://www.usace.army.mil/publications/eng-tech-ltrs/etl1110-2-569/toc.html</a>
EM 1110-2-1413 <i>Engineering and Design- Hydrologic Analysis of Interior Drainage Areas</i>	Guidance and criteria for performing an interior drainage analysis for a levee system	<a href="http://www.usace.army.mil/publications/eng-manuals/em1110-2-1413/toc.htm">http://www.usace.army.mil/publications/eng-manuals/em1110-2-1413/toc.htm</a>