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	Engineering and Design CRITERIA FOR DESIGN AND CONSTRUCTION WITHIN THE LIMITS OF EXISTING FEDERAL PROJECTS	
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CRITERIA FOR DESIGN AND CONSTRUCTION WITHIN THE LIMITS OF EXISTING FEDERAL PROJECTS

1. Purpose. This pamphlet provides guidance to individuals, developers, engineering firms, non-Federal local project sponsors (hereinafter Sponsors), and local governmental agencies for the design and construction of activities related to the modification of Federal projects, such as Federal Flood Risk Management (FRM) projects (typically consisting of levees, channels, and flood walls), constructed by the U.S. Army Corps of Engineers - Fort Worth District (CESWF), and for which Sponsors have the responsibilities for operation and maintenance.

The guidance contained in this pamphlet applies to the activities per the date of publication. However, CESWF reserves the right to reconsider this guidance at any time due to unknown or unforeseen circumstances, technological advances, additional information, etc. In addition, Sponsors may choose to adopt more stringent criteria than those contained in this pamphlet.

2. Authority. The sole authority for U.S. Army Corps of Engineers (USACE) approval of modifications to Federal projects, operated and maintained by Sponsors, is Title 33 USC § 408, hereinafter Section 408. Section 408, authorized in the Rivers and Harbors Act of 1899 and amended in 1985 to include “public works”, allowed the Secretary of the Army to grant permission to modify public works so long as the modification did not impair the usefulness of the project and was not injurious to the public interest. The CESWF, in accordance with Title 33 USC § 408, retains the right of review and approval on all proposed modifications of Federal projects.

3. Applicability. This pamphlet applies to Federal projects, which includes Flood Risk Management projects constructed by CESWF and for which a Project Partnership Agreement or a letter of assurance agreeing to the operation and maintenance of the Federal project has been furnished to CESWF by the Sponsor. A Flood Risk Management project is designed to manage and reduce flood risk by safely conveying floodwater within the project and through a developed area. As such, any proposed modifications within the project must keep the safe passage of floodwater as the first priority. The role of the project Sponsor is maintenance of the integrity of the project while preventing negative impacts to the passage of the project design flood. The CESWF will not allow the safety of the project to be compromised or the required design carrying capacity of the project reduced.

Note that this pamphlet does not apply to CESWF dams, eco-system restoration projects, or navigation projects. Guidance for proposed modifications of these types of projects is provided in technical publications other than this pamphlet.

4. References. U.S. Army Corps of Engineers references pertaining to the design and construction of Federal projects are listed below. Modifications to a Federal project, including proposals for the

addition of vegetation, are controlled by requirements documented in these manuals, regulations, technical letters, and pamphlets. Sponsors may choose to adopt more stringent criteria than that contained in USACE design standards and guidelines.

- a. CPAR-GL-98-1. Installation of Pipelines Beneath Levees Using Horizontal Directional Drilling
- b. EM 1110-1-1804. Geotechnical Investigations
- c. EM 1110-1-1904. Settlement Analysis
- d. EM 1110-1-1906. Soil Sampling
- e. EM 1110-1-2908. Rock Foundations
- f. EM 1110-2-1901. Seepage Analysis and Control for Dams
- g. EM 1110-2-1902. Slope Stability
- h. EM 1110-2-1911. Construction Control for Earth and Rock-Fill Dams
- i. EM 1110-2-1913. Design and Construction of Levees
- j. EM 1110-2-2502. Retaining and Flood Walls
- k. EM 1110-2-2902. Conduits, Culverts, and Pipes
- l. ER 1110-1-261. Quality Assurance of Laboratory Testing Procedures
- m. ER 1110-1-1807. Procedures for Drilling in Earth Embankments
- n. ER 1110-1-8100. Laboratory Investigations and Testing
- o. ER 1110-2-8152. Temporary Cofferdams and Braced Excavations
- p. ETL 1110-2-555. Design Guidance on Levees
- q. ETL 1110-2-556. Risk Based Analysis, Geotechnical Engineering
- r. ETL 1110-2-561. Risk and Reliability, Seepage and Slope Stability
- s. ETL 1110-2-569. Design Guidance for Levee Underseepage
- t. ETL 1110-2-571. Guidelines for Landscape Planting and Vegetation Management
- u. Levee Owner's Manual. The Rehabilitation and Inspection Program (PL 84-99)
- v. 13500 SWD QMS, Approval of Modifications to Existing U.S. Army Corps of Engineers Public Works Projects

With the exception of Reference 4.u and Reference 4.v, these documents may be downloaded from the following website: <http://140.194.76.129/publications>. Reference 4.v is available on the CESWF website: <http://www.swf.usace.army.mil>.

5. General Criteria for Construction Within an Existing Federal Project.

a. Coordination with the Sponsor and the CESWF is recommended as early as possible during the proposed modification planning process to avoid major revisions or project delay. Concept proposals may be submitted for review. Submittals should include the proposed modification starting date and the project construction schedule, including sequence of construction. For existing Federal projects that include levees, the Sponsor shall initiate the review process for any proposed activities located within 150 feet of both the levee landside toe and levee riverside toe (see Figure 1).

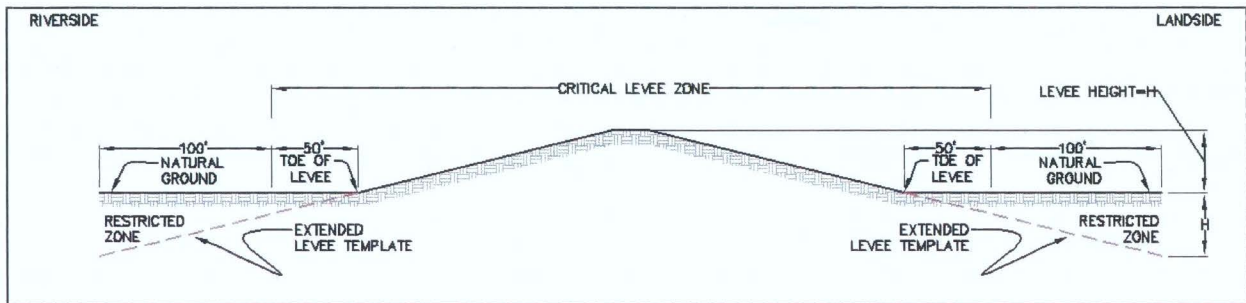


Figure 1. Critical Levee Zone and Restricted Zone

Note the designation of Critical Levee Zone and Restricted Zone in Figure 1. The Critical Levee Zone is the area of highest concern and subject to the more stringent requirements for justifying any proposed modifications. The Restricted Zone is defined as the outer boundary of the 150-foot area from each levee toe for which reviews are required. It is recognized that the Sponsor may not have real estate rights to the extent.

b. In accordance with “13500 SWD QMS Approval of Modifications to Existing U.S. Army Corps of Engineers Public Works Projects,” construction may not begin until final contract plans and specifications for the proposed features that impact the existing project have been reviewed and approved in writing by both the CESWF and the Sponsor. If the proposed project is a design-build project, the approval process will be discussed at the first coordination meeting.

c. Furnish five (5) sets of plans and specifications (hard copies as well as electronic copies) for the proposed work to the CESWF, Operations Division, Attention: CESWF-OD-TM, via the Sponsor, sufficiently in advance of the proposed construction to allow adequate time for review and approval. Include a vicinity map in the plans, as well as drawings that clearly depict the limits of existing features of the Federal project, including levees, and existing right-of-way or easement boundaries.

d. Detailed designs, calculations, and construction procedures must be provided for review if boring, jacking, or tunneling operations are planned. See subsequent paragraphs for additional details and required procedures. Also see Reference 4.i, EM 1110-2-1913.

e. Practice approved construction methods and best management practices to minimize erosion at the construction site. This includes making every effort to reduce the turbidity of the water at the site, such as by limiting the amount of time construction equipment is in the water. A Storm Water Pollution Prevention Plan (SWPPP) must be included in the final project submittal. The SWPPP shall meet the requirements of the Texas Commission on Environmental Quality (TCEQ), shall be approved by the Sponsor, and shall be implemented before commencement of construction or construction support activities. The SWPPP and a copy of the Notice of Intent (NOI) must be retained on-site during construction.

f. When construction work is in progress on a Federal project located downstream of a CESWF dam, a request from the contractor for changes in regulated releases will be considered only for urgent and compelling reasons. Normally, regulated releases from upstream lakes for evacuation of floodwater, water supply, recreation, or other purposes considered to be in the best interest of the public, will have first consideration.

g. Normally, construction equipment, spoil material, supplies, forms, buildings for inspectors, labs, or equipment and supply storage buildings, or any item that may be transported by flood flows, shall not be placed or stored within the limits of the existing Federal project during construction activities without prior approval of the CESWF and the Sponsor. Locations of construction trailers and stockpile areas shall be included on project plans and shall be approved by the CESWF and the Sponsor.

h. In addition to other requirements set forth in this pamphlet, it is responsibility of the project proponent or their representative to determine if permits for the desired work may be required under Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act. These permits require a minimum of 90 days to process. It is recommended that coordination with the CESWF Regulatory Branch be initiated in the early planning stages to prevent potential delays.

i. Levee maintenance and access roads that are damaged due to construction activities shall be replaced or restored to a condition equal to or better than pre-construction condition. Haul routes that cross a levee must be approved by the Sponsor and the CESWF. Levee protection methods, such as timber mats, may be required to protect the integrity of the levee during the construction process. All roads must be inspected and accepted by the Sponsor prior to completion of the project.

j. All fill and backfill shall be compacted in 6-inch lifts as specified in the contract specifications approved by the CESWF. Compaction shall be to at least 95 percent of modified density, as specified in ASTM D-1557, with moisture within the limits of 3 percentage points above optimum to 2 percentage points below optimum moisture content. All backfill shall consist of impervious materials. Vegetation shall be reestablished to its original condition or better. All excess material shall be removed from the limits of the existing Federal project.

k. Provide scour protection consisting of articulating concrete block revetment system protection capable of being re-vegetated at the outfall of stilling basins designed according to the issuing jet velocity. If approved by the Sponsor, stone riprap, gabions, or concrete paving may be substituted.

l. The crown or crest of the levee referred to in this pamphlet is the original (design) levee crest elevation. This may or may not be the same as the current levee crest elevation. All modifications shall be based on the higher of the two elevations.

m. The CESWF Water Resources Branch will provide applicable hydraulic models to be used for design upon request.

n. No permanent increase in the project design flood water surface profile will be allowed. The hydraulic impacts of temporary construction activities associated with a proposed modification shall be evaluated on a case-by-case basis.

o. The impacts to the existing Federal project valley storage shall be evaluated.

p. The proposed project may be subject to local and regional floodplain and regulatory requirements.

q. Any permanent disturbance of existing recreation facilities must be mitigated.

r. Interior drainage areas are an integral part of a Federal FRM levee project. Proposed modifications to interior drainage areas must be reviewed and approved in accordance with this pamphlet.

6. Crossing Over Existing Levees at Grade. Crossing over levees at grade is not a preferred method, but will be considered as an option if site conditions dictate this is the only cost effective alternative.

a. The Sponsors, at their discretion, may not allow any proposed crossings at grade over existing levees.

b. No excavation or notching will be performed into or on the levee, or within the levee template.

c. Topsoil shall be stripped from the levee and the utility line placed up and over the levee template slopes at grade. This will require rather abrupt line grade changes at the levee crest. The new line shall be covered by placing new fill uniformly on the slopes and the top of the levee and sloped away from the line and parallel to the longitudinal axis of the levee. Provide a minimum of 2 feet of cover over the new line. The slope of the fill covering the new line shall be 1 vertical on 20 horizontal, or flatter longitudinally along the levee crest and slopes. The topsoil shall then be replaced, all disturbed areas shall be seeded or sodded to establish turf, and any damage to levee access roads shall be repaired. During construction, the ability to flood fight within the impacted area shall not be impaired.

d. All valves located within 15 feet of either side of the toe of the levee shall be provided in a concrete box enclosure with a manhole type cover. Valve boxes located within the project shall be underground and flush with the surface. If the valve box is placed in the levee crest, the bottom of the excavation shall not be lower than 1 foot above the design water surface elevation. Fill shall be uniformly placed to slope away from the top of the valve box. If possible, all valves shall be placed on the landside of levees a minimum of 15 feet from the levee toe.

e. All manholes located within the Federal project and having rim elevations below the design water surface elevation shall have bolted, watertight covers in accordance with Title 30, Texas Administrative Code.

7. Pipe Crossing Under Levees with Open Excavation. This is the least preferred alternative because of the added risk during construction and will be evaluated accordingly if it is the selected alternative.

a. Provide a temporary ring levee (cofferdam) on the riverside of the existing levee at the location of the subject crossing at the same crest elevation as the existing levee. This ring levee shall have a minimum crest width of 10 feet and side slopes of 1 vertical on 3 horizontal or flatter. Construct the temporary cofferdam of impervious materials according to the provisions specified in Paragraph 5j.

b. When the temporary ring levee is complete, excavate through the main levee using 1 vertical on 3 horizontal cut slopes. The toe of the main levee and cofferdam or ring levee shall be a minimum of 20 feet (measured horizontally) from the top edge of the excavation.

c. Generally, sources for borrow materials shall not be located within the limits of the project right-of-way. In addition, depending on the type of soil, and whether or not pervious materials or unstable materials exist in the foundation of the existing levee, it may be desirable to limit the depth of

excavation or specify a minimum distance from the landside toe of the levee. All excavated slopes shall be properly designed and the drawings sealed by a registered professional engineer.

d. After the line has been placed, the open excavation shall be backfilled in accordance with Paragraph 5j. When backfill operations are completed, the entire foundation area to be occupied by the replaced levee fill shall be scarified, plowed, and/or harrowed to a depth of 6 inches, and then compacted by at least 16 complete passes of the tamping roller or to 95 percent modified density, whichever is more rigorous.

e. Accomplish levee replacement by placing fill in 6-inch lifts and compacting by not less than 8 complete passes of a tamping roller or at least 95 percent modified density. After compaction, the moisture content shall be within the limits of 3 percentage points above optimum to 2 percentage points below optimum moisture content.

f. Determine the in-place moisture content and density of the levee fill on a frequency of about one sample for each 500 cubic yards of backfill placed in the levee.

g. When the breached levee has been reconstructed to its original alignment and grade, the temporary ring levee shall be removed and all disturbed surfaces shall be finish-graded and turfed by seeding or solid sodding.

h. All manholes located within the Federal project having rim elevations below the design water surface elevation shall have bolted, watertight covers in accordance with Title 30, Texas Administrative Code.

i. For pipelines, install a control structure to prevent water from the levee riverside flowing through the pipeline to the levee landside. If the control structure is located on the riverside of a levee, it must be accessible during any flood stage of the river or stream and in all weather conditions. Controls may be automated, however, there must be manual override capability at all structures.

j. Gravity storm drains discharging into an existing Federal floodway or channel shall be provided with automatic flap gate(s) at the discharge end of the line and shall have energy dissipaters, as required. The Sponsor, as per written agreement, shall be responsible for inspection and maintenance of all drainage structures to ensure proper operation of the flap gates or other features.

k. Use monolithic conduits or conduits with watertight joints under the levee and levee template.

8. Pipe Crossing Under Levees with Boring or Jacking of Sleeves.

The sequence of work shall be as follows:

a. Excavate the boring and jacking pit (which must be on the landside outside the projected toe of the levee template slope).

b. Bore and jack the sleeve to a point beyond the projected riverside toe of the levee template slope.

- c. If the difference in the diameters of the bore and sleeve exceeds 3 inches, the annular space shall be pressure grouted with bentonite slurry.
- d. Place the product line in the sleeve.
- e. Pressure grout the product line in sleeve with bentonite slurry.
- f. Excavate the pit on the riverside and construct a manhole with gate valve placed on inside face of manhole away from channel. Tie the line from the sleeve under the levee and into the manhole with a gate valve.
- g. Tie the line from the sleeve under the levee and into a manhole on the landside.
- h. During work on items 8.a through 8.g, a plug will be required. The plug shall be placed and braced at the open end of the sleeve and pipe located in the jacking pit at the close of work each day. This plug must remain in place until the gate valve is installed and connections made to ensure protection from flooding from the river.

9. Pipe Crossing with Horizontal Directional Drilling Under Levees and Channels.

a. Detailed contractual drawings, plans, procedures, and engineering calculations shall be provided to CESWF for review (see Reference 4.a, CPAR-GL-98-1 for guidelines on directional drilling). These must include all the requirements of Paragraph 5 and the following additional items:

- (1) Inside diameter of the final bore hole and outside diameter of the product casing,
- (2) Detailed description of construction and horizontal boring methods to be utilized,
- (3) If the difference in the diameters of the final bore and product casing exceeds 3 inches, provide the method of pressure grouting the annular space between the outside of the product casing and the inside of the bore to prevent seepage under the levee template during maximum river stages,
- (4) A profile of the proposed line showing alignment (including location of the river and levees),
- (5) Location of entry and exit points, location, elevations and proposed clearances for all utility crossings and structures,
- (6) Right-of-way lines, property, and other utility right-of-way or easement lines,
- (7) Depth under the base of the levee, depth of the line under the river channel, and location of both ends of the string. If the proposed depth of the pipe string directly below the base of the levee is less than 30 feet, then detailed engineering calculations sealed by a registered professional engineer shall be provided for review. These calculations must show a minimum 1.5 factor of safety against hydro-fracturing to be acceptable.

b. Develop and provide a quality control plan for the project that includes the maximum allowable drilling pressure, gage calibration method, and specific responsibility for assuring that the pressure is not

exceeded. During the drilling process, the pressure in the borehole must be monitored to ensure that the operational drilling pressures remain within the safe limits to prevent soil fracturing. The name of the party responsible for monitoring the work must be specified.

c. The minimum clearance distance from the top of the proposed pipe encasement to the bottom of the existing Federal channel project or to the bottom of the existing streambed shall be 7 feet (whichever is lower). All crossings shall comply with the applicable requirements of Texas Administrative Code.

10. Buried Lines Parallel to Levees and Channels.

a. Buried lines parallel to a levee (on either the riverside or the landside) will not be allowed where the final location of the buried line will be within the extended template of the levee. For example, a line buried 5 feet deep must be at least 15 feet away from the toe of a levee with a 1 vertical on 3 horizontal slope.

b. Sumps, ditches, swales, or other project features crossed by the buried line shall be restored to their pre-construction condition.

c. Buried lines parallel with the channel bank must be at least 25 feet from the projected river channel slope template.

d. When a proposed buried line crosses an existing pump station outfall or other feature that necessitates an aerial crossing, place the line on piers with the piers aligned to provide minimal obstruction to flow within the outfall channel and designed to catch minimal debris. The preferred alternative would be to place the line under the discharge channel and encase it with concrete. Extend the encasement a minimum of 5 feet beyond the top of the channel side slopes.

11. Crossings of Levees and Channels.

a. Bridges.

(1) The preferred alternative is for the bottom of low steel (or low chord) of the bridge to be 15 feet above the design levee crest elevation or the existing levee crest, whichever is higher. Alternatives to the 15 feet clearance will be considered on a case-by-case basis if 15 feet is not feasible. Notching into the levee will not be allowed.

(2) Proposed new bridges should be designed to minimize the number of bents located within the template of the levee. If bridge piers are required in the levee template, extensive investigation and analyses (seepage and stability) based on site specific conditions will be required to show any potential impacts that the piers may have on the levee. Driving of piles within the template of the levee will not be allowed.

(3) Bridges will not be located where their construction will block maintenance access roads presently located within the project. If maintenance roads are blocked due to the design or construction of a proposed bridge, new maintenance roads must be provided.

(4) All storm water runoff from bridge decks must be piped to grade to prevent erosion within the existing Federal project.

(5) Revetment slope protection must be provided from the top of the levee to the levee toe within the shadow line of the bridge.

(6) The bridge must be designed to minimize the number of piers within the existing Federal project. If the new bridge is within 500 feet of an existing bridge, the proposed new piers should be in alignment with the adjacent bridge.

(7) Provide a minimum freeboard between the low point of the bridge crossing and the design water surface elevation of three feet or to the top of the levee at the bridge location, whichever is higher.

(8) Any obstruction caused by the proposed bridge and its piers shall not significantly reduce the hydraulic conveyance of the existing Federal project.

(9) Submit final plans and hydraulic computations to indicate that the proposed project would not reduce the hydraulic conveyance of the existing Federal project. The analysis shall include a comparison of With-Project Conditions and Baseline Conditions.

(10) Projects crossing navigable waterways shall require a U. S. Guard permit. Clearances and requirements shall be as directed by the U. S. Coast Guard.

b. Crossings Under Rivers and Channels by Open Excavation. This is not the preferred alternative but will be considered as an option if site conditions dictate that this is the only cost effective alternative.

(1) The minimum clearance distance from the top of the pipe encasement to the existing river bottom elevation or to the existing channel bottom shall be 7 feet, per Texas Administrative Code.

(2) Sufficiently anchor or encase the line to prevent floatation.

(3) Backfill the excavation with material similar to that excavated. If soil is excavated, backfill with compacted impervious fill material. If rock is excavated, backfill with concrete.

(4) Generally, no cofferdam fill crossings shall be allowed in water greater than 6 feet in depth. Cofferdam fill crossings in water greater than 6 feet may be allowed if geotechnical and structural designs prove that sheet piling would not be a viable method.

c. Aerial Crossings for Rivers and Channels.

(1) Provide a minimum freeboard of three feet between the low point of the crossing and the design water surface elevation.

(2) The obstruction caused by the supporting structure and its piers shall not significantly reduce the carrying capacity of the river or channel. No longitudinal cross bracing will be used.

(3) Submit final plans and hydraulic computations to indicate that the proposed project would not reduce the hydraulic conveyance of the river, stream, or existing Federal channel project.

(4) Projects crossing navigable waterways shall require a U. S. Coast Guard permit. Clearances and requirements shall be as directed by the U. S. Coast Guard.

12. Headwalls, Chutes, Gate Valves, Flap (Automatic) Gates, etc.

a. Install headwalls, gate valve structures, flap (automatic) gates, and other types of outfall structures in such a manner to prevent obstruction of flow or creation of scouring conditions within the project. All headwalls must transition with the appropriate slopes and all flow discharge points must be at the flow line of a channel or ditch, or at the normal water surface. Chutes will not be allowed unless they are the only viable alternative.

b. All structures shall be installed in such a manner to prevent or minimize operation and maintenance problems.

13. Pump Discharge Pipelines Over Levees.

a. The invert of the discharge shall be at the toe of the protective works (levee) and shall be free-vented at the highest point. For very large lines, deviation from these criteria may be considered, however, under no condition shall excavation be permitted into the levee. See Paragraph 6 for requirements for crossing over a levee on grade.

b. Flap (automatic) gates are not required at the outfall of the discharge lines.

14. Electrical and Telephone Criteria for Overhead Wire Crossings.

a. The Sponsor may require directional boring under the levee as opposed to an overhead crossing.

b. No structure (poles or otherwise) shall be located closer than 15 feet from the toe of any levee.

c. No structure (poles or otherwise) shall be located closer than 15 feet from the top of any channel slope.

d. Provide a minimum vertical clearance of 28 feet between the crown of the levee and the low point of the sag of the wire where it crosses the levee, computed under the most adverse conditions of temperature, wind, and other loading.

e. Provide a minimum vertical clearance of 28 feet between the natural ground and the low wire at the low point of the sag in the area of the project channel, or three feet above the project design water surface level, whichever is higher (check the National Electrical Code for minimum clearance of high voltage lines.)

f. Locate guy wires and anchors in such a manner that they do not interfere with the operation and maintenance of the existing Federal channel, levees, or related structures. No anchors may be placed on the levee.

15. Low Dams or Diversion of Flows.

- a. Submit plans, hydraulic and structural computations, and specifications for low dams or other obstructions for review prior to the construction of any type dam structure in a project area. These plans will be reviewed to determine the hydraulic and structural impacts of the proposed construction within the project. Prior to an extensive engineering study for any type of water barrier within a Federal project, the Sponsor and CESWF will review the concept plan, proposed location, and purpose.
- b. Diversion of flows into or out of a project area shall be reviewed to evaluate adverse hydraulic or structural impacts.

16. Process for Abandoning Existing Pipelines.

- a. Requests to abandon existing buried pipelines within a project shall be submitted in writing to the Sponsor and CESWF. No buried line within a project may be abandoned without the review and approval of the Sponsor and CESWF.
- b. As a minimum, the portion of the abandoned pipeline under a levee shall be completely filled with concrete or grout to prevent seepage through the abandoned line during flood conditions.
- c. Abandoned buried pipelines that are located on project property, but are not located under a levee, shall be plugged at each end with concrete or grout.
- d. Any structures associated with abandoned buried pipelines, for example, manholes, shall be removed and the resulting hole filled and compacted in accordance with the provisions in Paragraph 4j.
- e. Aboveground abandoned pipelines shall be removed from the project right-of-way, including any associated structures.

17. Construction of Recreation Facilities. Submit plans to the Sponsor and CESWF for review and approval on any proposed recreation type facilities. Each plan shall include hydraulic computations and will be reviewed for individual and cumulative effects to determine if the proposed construction would produce adverse effects on an existing or approved project area. If adverse effects on the carrying capacity of the project are determined, the project will be disapproved. The Sponsor may construct minor recreation improvements as needed providing final as-built plans are submitted to CESWF.

18. Trees and Other Vegetation.

- a. Background. The integrity of levees and, floodwalls, and other critical structures is paramount to the public health, safety, and welfare. The presence of undesirable vegetation can undermine that integrity and may lead to system failure if not corrected. Trees and other vegetation, such as shrubs and vines, may create both structural and seepage instabilities, prevent adequate inspection, surveillance and monitoring, and create obstacles to operation, maintenance, repairs, and flood fighting activities.
- b. Vegetation Free Zone. The Vegetation Free Zone (VFZ) is defined as the three-dimensional space that surrounds and encompasses levees and, floodwalls where no vegetation, except short grass cover, is permitted. The VFZ is required to insure acceptable project performance under all design conditions, and must be of sufficient dimension to provide access for surveillance, inspection, monitoring,

maintenance, repairs (routine and emergency, including slide repairs), and floodfighting. Accessibility is essential to the reliability of FRM projects, therefore, the VFZ must be accessible by personnel and equipment at all times. This includes four-wheel-drive vehicles, as well as larger equipment, such as tractors, bulldozers, and dump trucks. Figure 2 and Figure 3 illustrate the limits of typical vegetation free zones associated with levees and floodwalls. The minimum width of the VFZ includes the entire cross-section of levees and floodwalls, plus 15 feet clear distance on each side. The width of the VFZ shall be measured from the centerline of the tree trunk, or plant stem, to the limit of the levee cross-section or floodwall.

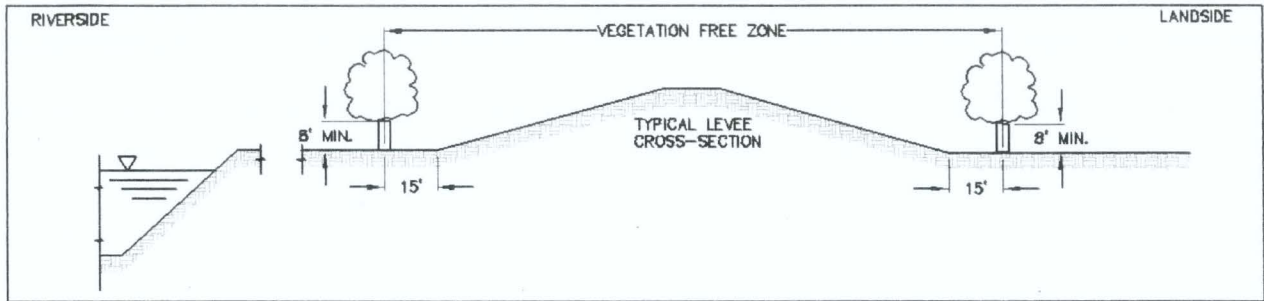


Figure 2. Levee Vegetation Free Zone

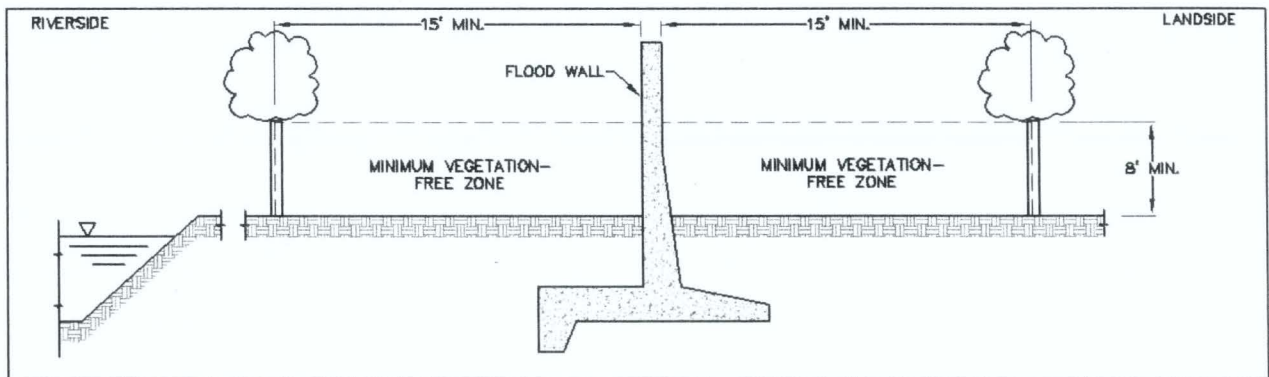


Figure 3. Floodwall Vegetation Free Zone

c. There may be additional restrictions on tree plantings, depending on soil conditions, access and repair buffers, local tree types, and levee performance history (see Reference 4.t, ETL 1110-2-571).

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