



Maynard Dixon

City of Tucson Levee Manual

OFFICIALLY ADOPTED LEVEE MAINTENANCE PLAN
CITY OF TUCSON

Mayor Regina Romero
Council Member Lane Santa Cruz - Ward One
Council Member Paul Cunningham - Ward Two
Council Member Paul Durham – Ward Three
Council Member Nikki Lee – Ward Four
Council Member Richard Fimbres – Ward Five
Council Member Steve Kozachik – Ward Six

Adoption Date: December 8, 2020

Table of Contents:

1. Tucson Emergency Levee Response Planning	2
2. Regulatory Aspects, Adoption and Re-evaluation Process	3
3. Levee Inventory	6
4. Levee Inspection Procedures	7
5. Levee Survey Requirements	8
6. Levee Forms & Other Resources	9
7. Appendices	10

1) Tucson Emergency Levee Response Planning

This section of the manual will be set aside for Tucson Emergency Levee Response Planning (TELRP).

TELRP is a planning guideline that can help to provide procedures for emergency response and help to create protocols for response by City staff for levee emergency response conditions.

See Appendix I for specific emergency response planning information for each levee.

This manual is intended for emergency response planning as well as levee structure requirements and maintenance for those structures owned and maintained by the City of Tucson. Flood control structures including levees outside of the City of Tucson, or structures owned, operated or maintained by others may have consequences for citizens within the City of Tucson even though the levee is not within city limits. For emergency response planning for flood control structures that are not owned, operated or maintained by the City of Tucson, see Pima County Flood Control District https://webcms.pima.gov/government/flood_control/ or other structure owner / operator.

Once estimated inundation maps are finalized, protocols for response by City staff will be developed under the guidance of the City of Tucson Department Continuity of Operations Plan, Multi-Jurisdictional Hazard Mitigation Plan and the City of Tucson Emergency Operation Plan, then emergency response plans for each levee structure will be developed. At that point, letters to property owners within the estimated inundation / shadow area shall be sent a notification letter and that an emergency response plan is being developed or in place. This section of the manual will be reviewed by emergency response staff at the City of Tucson Fire Department and City of Tucson Floodplain Administration for guidance and feedback. Copy of TELRP will be given to City of Tucson Floodplain Board, City Manager's Office, Tucson Fire Department, City Engineer, City of Tucson Floodplain Administration, and those outlined in City of Tucson Department Continuity of Operations Plan, as well as Tucson Office of Emergency Management & Homeland Security (TOEMHS). Multi-jurisdictional Hazard Mitigation Plan shall also receive a copy for next plan update.

- a) Depending on specific aspects for a levee within the City of Tucson, Appendix I of the manual will be set aside for TELRP for each levee for the following scenarios:
 - i) Breach
 - ii) Overtopping
 - iii) Subsidence
 - iv) Other scenarios
- b) Response needed will be described. Responses may include:
 - i) Call/text list shall be initiated
 - ii) Evacuation procedures
 - iii) other
- c) Contact Information for TELRP designated response protocol:
 - i) names of key contacts
 - ii) phone numbers
 - iii) organizations / agencies to be contacted
 - iv) expected time frame within persons to be contacted
 - v) other

TELRP spreadsheet (provided in Appendix I) shall include the information above for each inundation area that impacts properties within the City limits, and shall be revised during Floodplain Management Plan updates and when new levees are constructed. Sample letter notifications are provided in Appendix VI. Additional revisions or updates shall be done as needed.

2) Regulatory Aspects, Adoption, Re-evaluation Procedures

- A. This City of Tucson Levee Manual acts as the emergency response planning document and documents the formal procedure that ensures that the stability, height, and overall integrity of the levee and its associated structures and systems are maintained. The City of Tucson assumes ultimate responsibility for maintenance of levee infrastructure within the limits of the City of Tucson, other than privately owned levees, railroad owned levees, and levees that are maintained by the Pima County Regional Flood Control District (PCRFCDD). Ultimate responsibility includes maintaining the manual and City levees as well as requesting maintenance documentation from other levee owners. City of Tucson Levee Manual specifies maintenance activities to be performed, frequency of their performance, and person by name or title responsible for their performance. Army Corps of Engineers Levee Checklists, Army Corps of Engineers (ACOE) Levee Database, Federal Emergency Management Agency (FEMA) regulations, and the PCRFCDD levee inspection form were used in the development of this manual. See other references in Appendices VII and VIII.
- B. Another purpose of this manual is to provide the community a better understanding of the risks that come with living and working in levee-impacted areas. Although a levee may reduce flood risk, it cannot eliminate the flood risk. This manual is intended to provide a more precise, up-to-date picture of the flood hazards facing levee-impacted areas, which reduces the impact of flooding on residents, businesses, investments, and infrastructure located behind these levees. The City of Tucson encourages those property owners within the estimated inundation areas (levee shadow areas) to consider purchasing flood insurance to mitigate the financial consequences of a flood event or a levee breach.
- C. All appendices including the levee inventory database shall be revised or updated as necessary without Mayor and Council approval. Any changes to the main portion of this manual shall require Mayor and Council consideration for approval. Updates to the City of Tucson existing levee database shall occur every 5 years, or sooner when a new levee is constructed, a levee is modified, or as Floodplain Administrator deems necessary.
- D. Per FEMA Standard ID: 44411/30/2016 (Effective for new applications submitted to FEMA for levee accreditation, Levee Program Standard) levee systems can only be accredited when compliance with 44 C.F.R. § 65.10 is demonstrated. FEMA compliance includes demonstrating that an emergency preparedness plan has been adopted by the community that at a minimum, includes the area impacted by the levee system, and includes procedures for emergency operation and public evacuation, meeting the standards of 44 C.F.R. § 65.10(c)(3). For City of Tucson, levee status – there are several status categories of levees within the City of Tucson: accredited levees, non-accredited levees, provisionally accredited levees, to-be-determined, and under repair / study. For a levee to be shown as accredited on a Flood Insurance Rate Map, the structure shall be certified by a registered professional engineer as meeting federal minimum standards as described in 44 CFR 65.10. The engineer-stamped levee certification package must be complete and current, and then the certification package shall be submitted for FEMA review. If the certification documents are found to adequately meet 44 CFR 65.10 then the levee can be shown as accredited through the map update process. As levee status changes, updates shall be made to the City of Tucson Levee Inventory in the Appendix IV. See Section 3 of this manual for additional Levee Inventory Database requirements.
- E. Two complementary sources (City of Tucson and FEMA) contribute to set the minimum standards for levees and floodwalls in the jurisdiction of City of Tucson. For the City of Tucson, a Levee means a man-made structure designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to reduce risk from temporary flooding. For the City of Tucson, a Classic Levee includes concrete-encased earthen berms or soil cement structures with regulatory scour protection. A Classic Levee may also be a road/railroad prism meeting all FEMA levee requirements including compaction. For the City of Tucson, a Floodwall Levee is a water-tight wall structure with regulatory scour protection meeting all FEMA levee requirements. Channel System Levee is a structure constructed within a channel that meets FEMA levee requirements.
- F. The current City of Tucson Floodplain Administrator (See Appendix VII) is responsible for performance of the City of Tucson maintained levees. At time of each levee inspection of a City maintained levee, City Floodplain Administration shall assess levee status and work toward levee accreditation, provisional accreditation, assure regulatory compliance of levee structures, and/or that there is progress being made toward code / Tucson Levee Manual compliance.
- G. Tucson Levee Manual Inspection Forms shall be periodically reviewed to assure that the forms continue to comply with any state and federal levee requirements.
- H. City of Tucson Flood and Erosion Hazard Management regulations including Tucson Code Sec. 26-11.2(b)4 shall apply to all new levee construction. Generally, new levees are not allowed (as of the date of this manual's adoption)

for new development, unless if necessary after the fact to protect existing dwellings or existing critical facilities. Also, use of a new roadway prism, or modifications to a roadway prism, for levee structure purposes will not be allowed. Specific levee requirements shall be applied for new levee designs within the City limits:

- a) Classic levee style design shall be used for all new levee construction unless limited construction space exists and/or approval for non-Classic levee design is provided in writing from City Floodplain Administrator.
 - b) Materials for levees shall take into consideration long-term maintenance costs, and be constructed with concrete, soil cement or other materials that limit seepage issues. Rubber replacement expansion material, or similar, shall be used for any needed joints. Materials shall be approved by Floodplain Administration.
 - c) New levees shall not be approved unless if necessary to protect existing buildings or existing critical facilities. Only elevated fill for building pads shall be allowed for new development. New, or modifications of, road and railroad prisms that are constructed within City limits or impacting the City shall provide flow conveyance beneath new road/rail infrastructure so as not to create levee or dam conditions.
 - d) Any privately-owned levees shall develop maintenance plans for the structure to be reviewed and approved by City Floodplain Administration. Private levees shall be in compliance with this manual, other City regulations, 44 CFR 65.10 and other FEMA levee requirements.
 - e) Operational aspects including mangates, access gates, pumps, or other infrastructure that requires the operation by human actions, shall be discouraged and not be a part of new levee construction design, unless approved in writing by City Floodplain Administrator.
 - f) New levee design shall comply with and be certified by a registered professional engineer to the following section of the Code of Federal Regulations 44CFR65.10(b) Design criteria. For levees to be recognized by FEMA for accreditation on a flood insurance rate map, an engineer-stamped levee certification package shall be submitted that demonstrates that adequate design and that operation and maintenance systems are in place to provide reasonable assurance that protection from the base flood exists must be provided. Requirements must be met for: (1) freeboard, (2) embankment protection, (3) embankment and foundation stability, (5) settlement, (6) interior drainage, and (7) other design criteria as deemed necessary by Floodplain Administrator; see Levee Inspection checklist.
- I. Agreements shall be kept by Floodplain Administrator for other levee structures, (such as: railroad prisms, road prisms, or non-City owned levees), that outline levee maintenance requirements that meet adopted City of Tucson Levee Manual requirements as well as FEMA and 44CFR65.10 requirements and any official updates.
 - J. Per FEMA, for levee systems to be accredited by FEMA, levee owners must submit data and documentation to show that adequate design and maintenance systems are in place to provide reasonable assurance that the levee has, and will continue to have, base flood risk reduction capability. City of Tucson shall request documentation at least annually for these levees from levee owners.
 - K. The City Engineer or designee shall perform maintenance inspection of levees that are directly maintained by City of Tucson. Road and railroad prisms shall not be included in these levee inspection requirements unless the prism has been considered and maintained for levee accreditation and the levee structures are maintained by City of Tucson.
 - L. Since freeboard is required to be provided for accredited levees, all City levees shall be surveyed to check for freeboard compliance by City Surveyor or a designated registered surveyor. Road and railroad prisms shall not be included in this requirement unless the prism has been considered and maintained for accreditation. See Section 5 of this manual for other Levee Survey Requirements. Agreements with non-City levee owners shall be developed to explain how freeboard height is being checked by those non-City agencies performing maintenance.
 - M. For those levees within the City of Tucson limits which are maintained by Pima County, the City of Tucson shall request copies of maintenance and operation reports from PCRFCDD to be provided to City of Tucson Floodplain Administrator for review. City Floodplain Administration shall work with the PCRFCDD to assure code compliance of levee structures, or that there is progress being made toward compliance.
 - N. Funding for City levee maintenance needs to be identified annually.
 - O. Geotechnical assessments, that may include but not limited to soil compaction, may be required for those levees trying to obtain accreditation. Road or railroad prism levee structures, that have been considered and maintained for accreditation, shall have periodic compaction testing as designated in agreement, or otherwise: every 5 years.
 - P. For new levees or levees becoming accredited, inundation maps and response actions shall be finalized prior to becoming effective emergency response plans. Once inundation maps are finalized, letters to property owners within the inundation / shadow area shall be sent a notification letter and that an emergency response plan is being developed,

or in place. Letters shall be sent out periodically as per Tucson’s National Flood Insurance Community Rating System guidelines.

Q. City of Tucson levee surveying activities shall comply with 44CFR65.10(e).

R. This manual is made a part of the Tucson Stormwater Management System Phase V(a).



Picture: Private Floodwall Levee on Silvercroft (ERZ) watercourse at termination point, with Silvercroft W.A.S.H. shown on the right.

3) Levee Inventory

Levee Inventory database is used for keeping track of data for each levee within the City of Tucson limits. See Appendix IV for levee spreadsheet for those levees within City Limits or impacting City (excluding levees maintained by PCRFC). See also Levee Inundation Maps (Shadow Maps) in Appendix V.

- a) Levee Inventory database shall include the following parameters:
 - i) Identified entity for maintenance responsibility
 - ii) Accreditation status – Provisionally Accredited, Accredited, TBD, non-accredited, under repair / study
 - iii) Date of Last inspection
 - iv) Each levee shall be classified as a “Classic Levee” or a “Floodwall Levee” or a “Channel System Levee”.
- b) Special levee considerations or physical characteristics shall be identified. National Levee database may be utilized for inundation mapping or revised by the City of Tucson Floodplain Administration to provide best estimate of inundation area for each levee structure.
- c) TELRP shall describe the associated response/action needed due to the physical characteristics of each levee system. See TELRP (Tucson Emergency Levee Response Planning) for emergency response.
- d) Public relations or GIS staff shall work with Floodplain Administration personnel to update contact lists for downstream or potential impacted areas in shadow of levees within the City of Tucson.



Picture: Accredited Levees can help to protect properties along regional watercourses

4) Levee Inspection Procedures

a) Annual Inspections

Annual inspection of the levees shall occur for all City of Tucson maintained levee structures and an Engineer shall inspect all items as directed by either the Classic Levee Inspection Form or Floodwall Inspection Form. Levee Inspections shall use inspection forms found in the Levee Manual Appendix II & III. If the inspection is for a classic levee, use the City of Tucson Classic Levee Inspection Form (Appendix II). If the inspection is for a floodwall levee, use the City of Tucson Floodwall Levee Inspection Form (Appendix III). City Tucson Floodplain Administration will update the inspection forms to provide an electronic format that can be utilized in the field for the Levee Inspections.

All Levee Inspections (other than Levee Surveys) must be inspected by a registered Civil Engineer in the State of Arizona. One Levee Inspection Form shall be used for each levee structure for annual inspections. See Section 5 of this manual for Levee Survey requirements.

b) Special Levee Inspections & Procedures

All levees, both City of Tucson Classic Levee and Floodwall Levees, shall have survey for capacity as well as compaction testing according to the following schedule:

New Levee: every year for five years after initial construction
Existing Levee: every 5 years

Existing Levees are those City of Tucson maintained levee structures which are 6 years old or older, and shall fall under the mandatory Existing Levee 5-year capacity & compaction cycle. The survey for flow capacity of the floodplain adjacent to the levee structure (typically, a series of spot elevations along channel bed and section intervals adjacent to the levee) shall be as determined by City Floodplain Administrator. Compaction testing shall be near levee structure to provide support for proper soil conditions to minimize potential for seepage and other potential levee failures or risks. City Floodplain Administrator shall determine type of compaction testing needed for the specific levee.

c) Other Inspections

These Levee Inspections do not preclude general periodic stormwater, flood, and erosion inspections near these levee structure to update the City of Tucson Floodplain Administrator of changing site conditions. General inspections may be performed by stormwater management or other inspection staff and may use other inspection checklists and forms, as required by City of Tucson Stormwater Management regulations, or National Flood Insurance Program Community Rating System requirements.

d) Private Levee Inspections

Any privately owned levees shall use City levee inspection forms. Annual inspection reports shall be submitted to the Floodplain Administrator on or before March 1st of each year.

5) Levee Survey Requirements

City of Tucson Floodplain Administrator shall ensure that record drawings (aka as-builts) for all levees, both Classic Levees and Floodwall Levees, are provided by the Engineer-of-Record to the City of Tucson after construction. City Floodplain Administrator, or their Civil Engineer designee, shall review and accept record drawings. These record drawings shall be made available to FEMA for the purpose of levee accreditation as necessary.

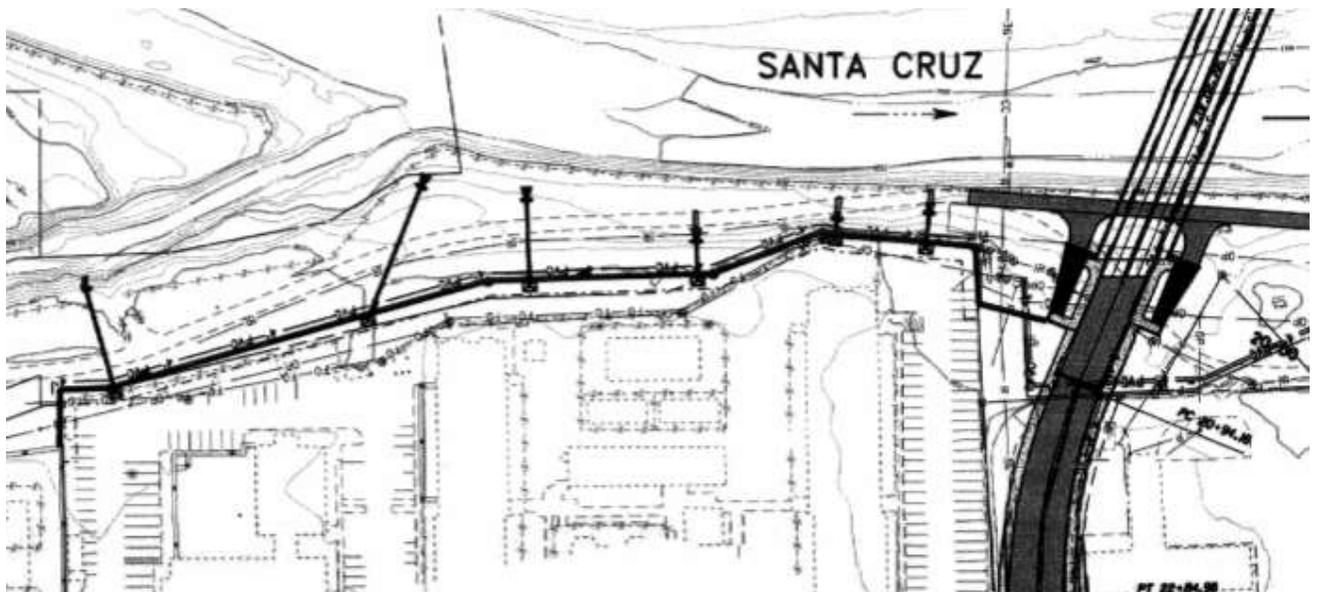
Initial record drawings will verify that the levee was constructed in substantial conformance with the accepted design plans. Subsequent levee surveys made during maintenance activities will identify elevations at top and base of levee structure to assist in determining if there has been substantial settling, reduction of freeboard, lessening of scour protection, capacity issues, or other failure aspect of the levee. City Surveyor or a designated registered surveyor shall review and accept the levee maintenance surveys.

The plan construction benchmark will be the basis of elevation for these record drawing measurements. If this benchmark has been disturbed or destroyed prior to record drawing, a new benchmark from the same datum will be transferred to the site and documented on the record drawing plan set. If this benchmark has been disturbed or destroyed after record drawing accepted, a new benchmark from the same datum will be transferred to the site and documented on both the record drawing and levee maintenance survey plan sets.

Any modification to datum shall be noted on record drawing and any levee maintenance plan sets. Datum conversions shall be clearly identified for base flood elevations referenced on FEMA flood insurance studies or flood insurance rate maps, City of Tucson survey elevations, or any other elevation datum.

City of Tucson Floodplain Administrator, or their Civil Engineer designee, will determine and direct City Surveyor or a designated registered surveyor as to which levee elevations are to be checked.

Record drawings and the levee maintenance surveys will be sealed by a licensed land surveyor or civil engineer registered in the State of Arizona.



Picture: City of Tucson maintained Cushing Floodwall Levee

6) Levee Forms and other Resources

Forms to be used for levee maintenance tasks will be found in the Appendices II, III, IV, and VI of this levee manual. In order to facilitate ease of access to levee documents, all City of Tucson levee plans, maintenance plans, and levee inspection reports shall be compiled and archived in a network drive assigned by Floodplain Administration and Maps & Records Management.

Contact PCRFC D for information on levees that are within the City limits which are maintained by the county.

Documents regarding levee maintenance agreements shall be found in a network drive assigned by Floodplain Administration, Maps & Records Management, and City Attorney's Office.

City Tucson Levee Inspection forms may be in an electronic format that can be utilized in the field for the inspections.

Digital mapping system for City of Tucson shall be updated to show locations and links to plans for all new levee systems within 6 months of Final Acceptance of the levee project construction. Any LOMR (Letter of Map Revision) required for a new levee project shall follow 44CFR65.10 and any other Federal regulations as well as City of Tucson Floodplain, Stormwater, and Erosion Hazard Management Ordinance requirements.

At the time of this edition of this manual, MapTucson is the GIS mapping system, and SAMS stormwater software is the electronic system used for the electronic inspection forms.

7) Appendices

This section of the Levee Manual may be updated (per manual requirements in Sections 1 through 6) by City of Tucson Floodplain Administration at any time without City of Tucson Flood Board approval.

- I) TELRP spreadsheet / documentation (to be developed after estimated inundation maps are finalized)
- II) City of Tucson Classic Levee Inspection Checklist
- III) City of Tucson Floodwall Levee Inspection Checklist
- IV) City of Tucson Levee Inventory Database
- V) City of Tucson Levee Inundation Maps
- VI) City of Tucson historical levee data, sample letters, reports
- VII) Acknowledgements and References
- VIII) National levee information