FEMA

Levee Approach for Public Review Online Forum

Bill Blanton
Mary Jo Mullen
FEMA

RiskMAP
Increasing Resilience Together

Introductions

- Bill Blanton – FEMA Project Manager
- Mary Jo Mullen – FEMA Stakeholder Engagement Lead

- We value your participation today, and strongly encourage you to submit comments
- We are looking for the good, the bad and the ugly.
- If we hear only negative comments, we may change something that ultimately you liked about the approach. So if you like it, let us know that too.

Online Forum & Public Review

- The entire "Revised Analysis and Mapping Procedures for Non-Accredited Levees" available at www.regulations.gov
- For a compilation of the questions and answers asked during the Online Forums, please visit: http://www.fema.gov/plan/prevent/fhm/lv_lamp.shtm.
- To be considered, you must provide Comments through Public Review online www.nfip-levees.com or www.regulations.gov

Outline

1. Introduction and Overview
2. FEMA Levee Evaluation and Mapping Procedures during Flood Studies
3. Levee Analysis and Mapping Process
4. Levee Analysis and Mapping Procedures
5. Questions

FEMA

1. Introduction and Overview

RiskMAP

Increasing Resilience Together

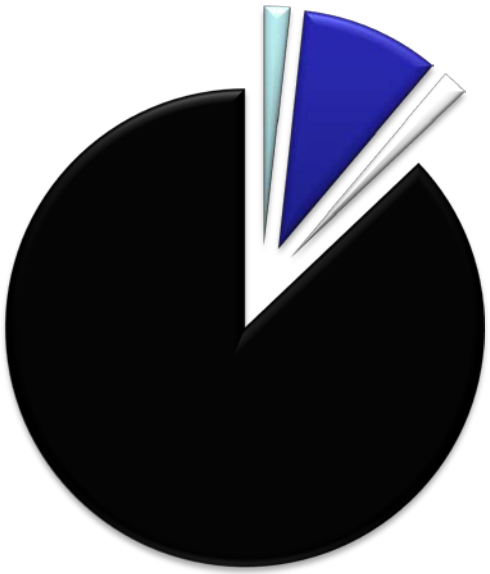
What is a Levee?

"Building a levee is initially an economic decision. A levee may not always eliminate the misery, it may only delay it until that point in time when nature's forces exceed man's willingness to invest in greater risk protection."

Information provided by Ed Thomas, Michael Baker, Inc

Who Owns and Maintains the Nation's Levees?

- A small percentage of levees are built and maintained by the USACE
- Some levees are designed and built by the USACE and then a local authority assumes operations and maintenance
- For a small percentage of levees the USACE assists in their repair, but the local authority built and operates and maintains them
- Most levees are locally owned and maintained (total number of miles unknown)



- USACE O&M (2,000 miles)
- USACE Built/Local O&M (10,800 miles)
- Local Built/Local O&M/RIP (2,000 miles)
- All Others in the Nation (Not in USACE's Program and miles unknown)

FEMA's Role is Mapping, Not Levee Certification

- FEMA does not own, operate, maintain, inspect, or certify levees
- FEMA's role is mapping levee-related flood risk and "accredits" levees for mapping purposes only.
- FEMA only accredits levees based on the *certification documentation provided by the community or other interested party*

FEMA's Mission is Mapping, Not Levee Certification

- If certification and an officially adopted O&M plan are provided and accepted, FEMA will accredit/map the levee as providing the required level of risk reduction
- If levee certification is not provided, the area will traditionally be mapped as a Special Flood Hazard Area
- FEMA's accreditation is *not* a health and safety standard. It defines insurance requirements.

The new approach does not change any regulations or the process for certifying and accrediting levees.

How Does an Owner Get a Levee Certified & Accredited?

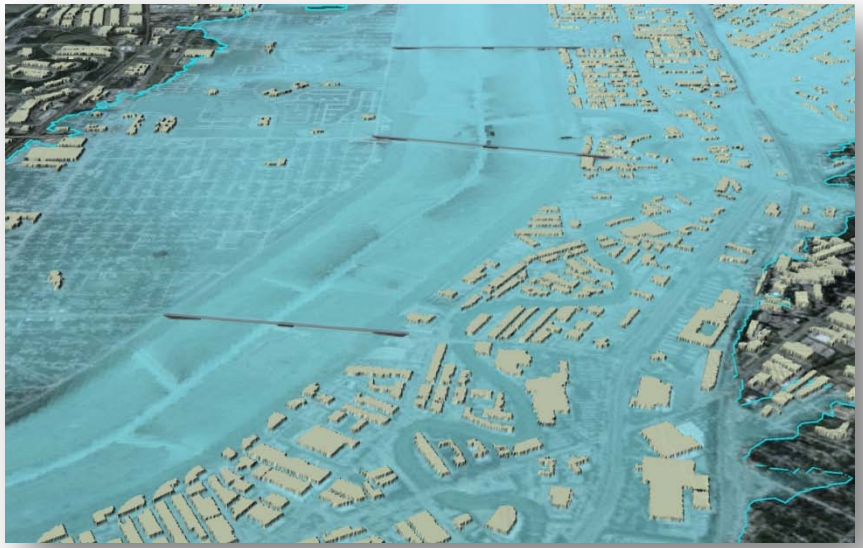
- FEMA uses a review process to determine if all required elements of 44 CFR 65.10 are included in an accreditation submittal
- Design criteria include:
  - Freeboard
  - Closure
  - Embankment Protection
  - Embankment and Foundation Stability
  - Settlement
  - Interior Drainage
  - Other Criteria, including High Vulnerability

Accreditation Requirements

- Operations Criteria
  - Flood Warning System
  - Plan of Operation
  - Periodic Operation of Closures
  - Interior Drainage Plan
- Maintenance Criteria
  - Must be documented in an officially adopted plan including inspection frequency and responsibilities

Impacts of Levees on FEMA Analysis and Mapping of Flood Hazards

- Levees that are accredited and show the flood being contained
- Levees that are not accredited and traditionally show the flooding outside the levee



Why are we here?

- Throughout Map Modernization, stakeholders expressed concern on the “without-levee” procedures used to map non-accredited levees
- In February 2011, a group of U.S. Representatives and Senators wrote to FEMA requesting a revision to the current practice of mapping levees and their associated risks.
- Stakeholders and Congress feels this approach doesn’t reflect the hazard reduction that some non-accredited levees may still afford.

Process of Developing New Approach

- FEMA placed a hold on ongoing studies that include non-accredited levees.
- FEMA established a Project Team that:
  - Comprised of FEMA, US Army Corps of Engineers, Industry and other experts
  - Explored a spectrum of possible approaches;
  - Evaluated the approach scenarios;
  - Assessed the feasibility and implementation through "proof of concept" case studies;
  - Sought feedback from internal and external audiences.

Requirements for New Approach

- **The new Approach had to be:**
  - Flexible;
  - Collaborative;
  - Cost-effective
  - Repeatable
  - Understandable; explainable
  - Engage local knowledge and data
  - Must address both riverine and coastal levees
- **FEMA's Constraints**
  - No statutory or regulatory changes (44 CFR 65.10 remains in effect for full levee accreditation)
  - Cannot make changes to the overarching National Flood Insurance Program

What the new Approach is NOT:

- A holistic solution for levee issues in the NFIP:
  - There will be a “Phase 2” to discuss a comprehensive NFIP solution for levees
  - National Academy of Sciences study kicked-off
  - NFIP Reform
- A solution addressing recommendations of other entities, such as Levee Task Force or National Committee on Levee Safety
- A communication of the broad risks associated with levees and potential failures

External Reviews and Stakeholder Engagement

- Feasibility Review – FEMA and USACE review to ensure consistency with the Feasibility Criteria
- Independent Scientific Body – focused on technical aspects solution
- Community Roundtable – focus group related to community impacts and input
- *Public Review* - approach posted online for general public review and comment, includes 3 Online Forums
- Guidance Development – input from these events and further stakeholder engagement before Guidance is finalized

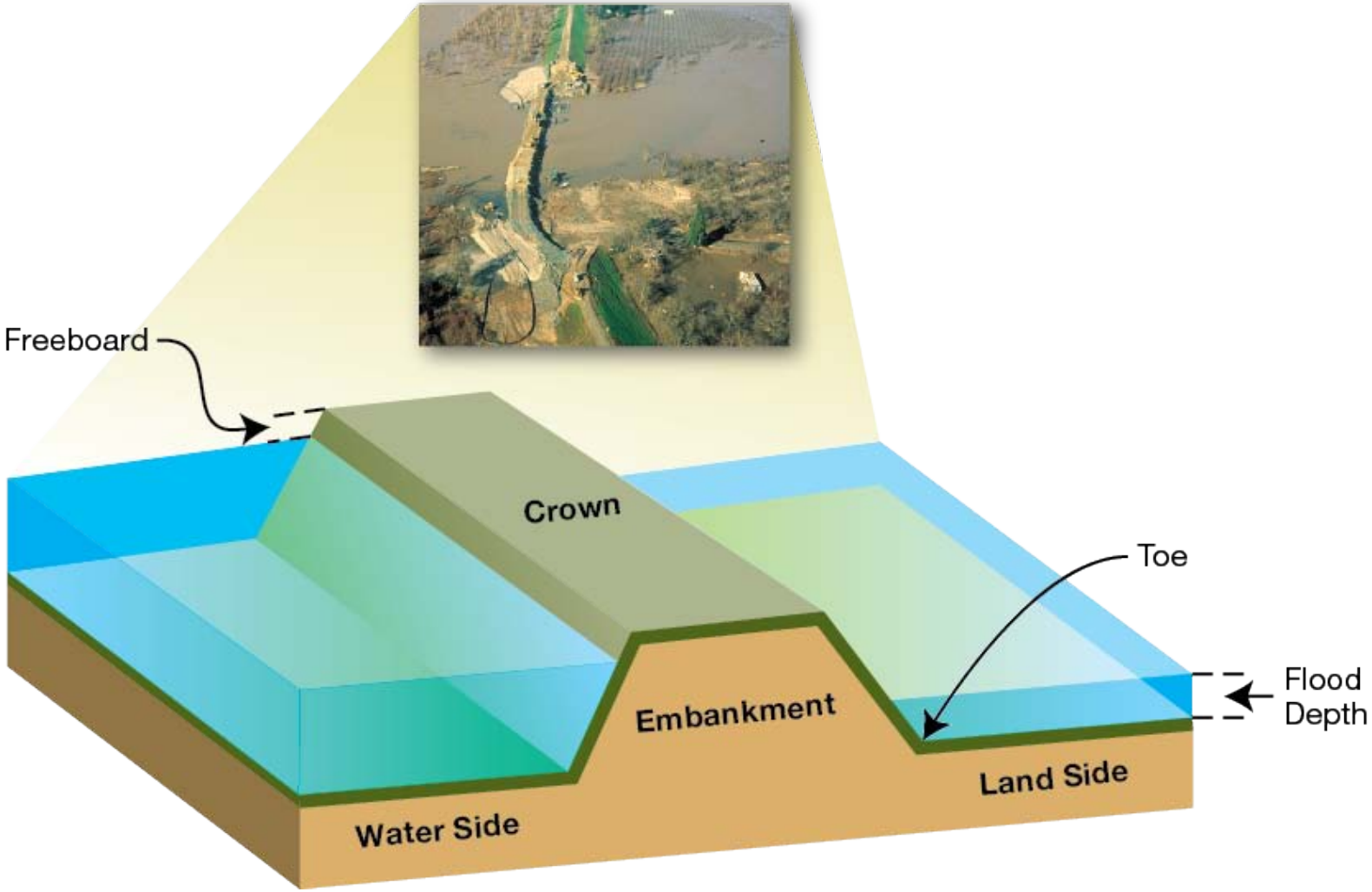
FEMA

2. Levee Evaluation and Mapping Procedures during Flood Studies

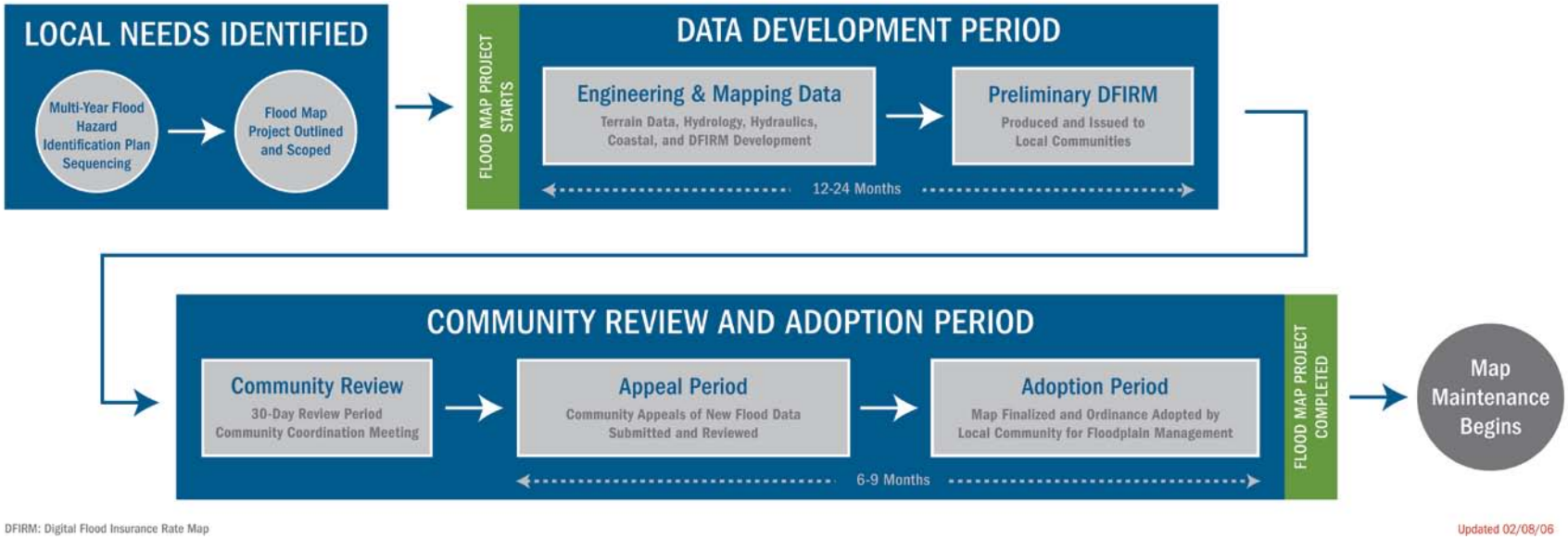
RiskMAP

Increasing Resilience Together

A Levee and Its Components



Flood Study Engineering and Mapping Process



With and Without Levee Analysis

- Levee systems are constructed to contain, control, or divert flow
- FEMA analyzes whole levee systems, not sections
- Hydraulic analysis is performed:
  - With levee intact
  - Was traditionally performed with levee's ability to impede flow removed

Previous Approach

BLACK	WHITE
Non-accredited	Accredited

Proposed Approach

FEMA

3. Levee Analysis and Mapping Process

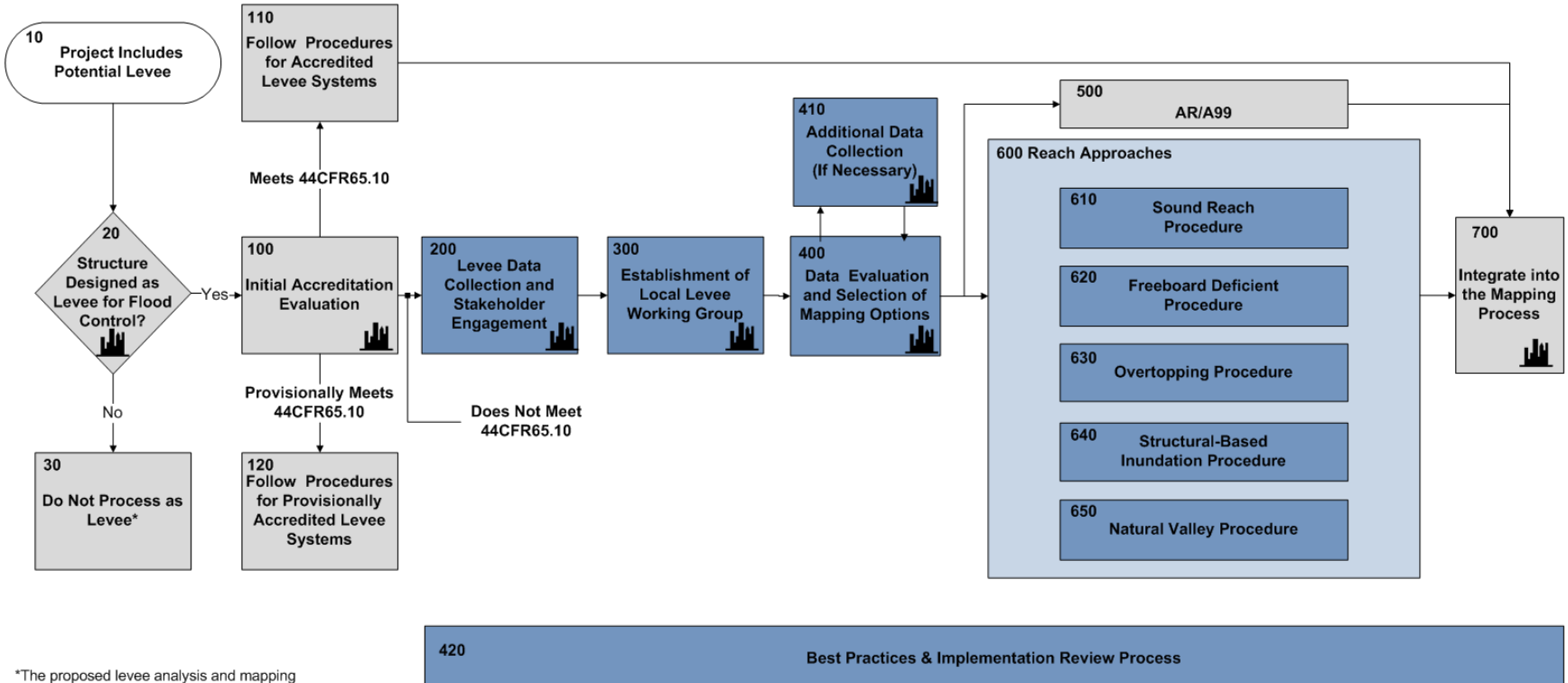
RiskMAP

Increasing Resilience Together

Hallmarks of New Process

- Interactive stakeholder engagement throughout the process.
- A suite of analysis and mapping procedures of the hazard associated with levees.
- Recognition of the uncertainty associated with hazard identification behind levees.
- Ability to split a levee system into distinct reaches that are analyzed based on the attributes of the specific reach.

Proposed Levee Analysis and Mapping Process - Overall



*The proposed levee analysis and mapping approaches are not intended to change the current treatment of non-levee embankments or other structures not designed and constructed for flood control purposes. The application of sound engineering methods for such structures continues to be the acceptable practice.

is Figure Element ID

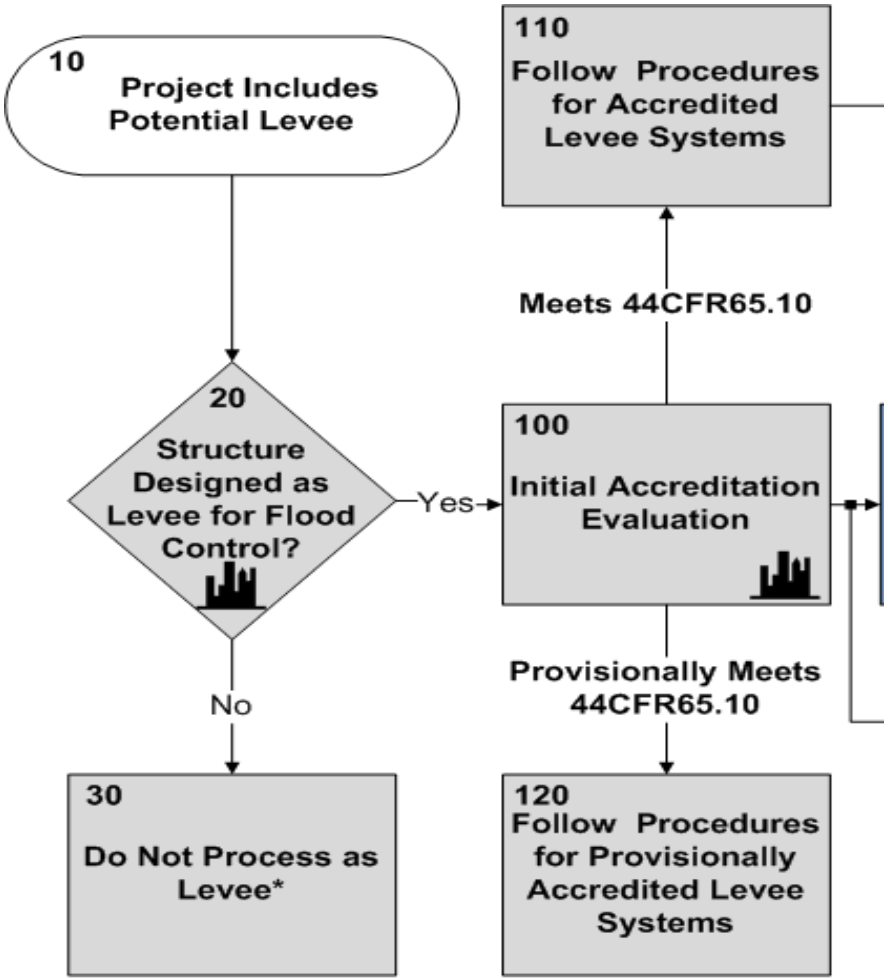
indicates community engagement

Part of Current FEMA Levee Analysis and Mapping Procedures (Not Revised)

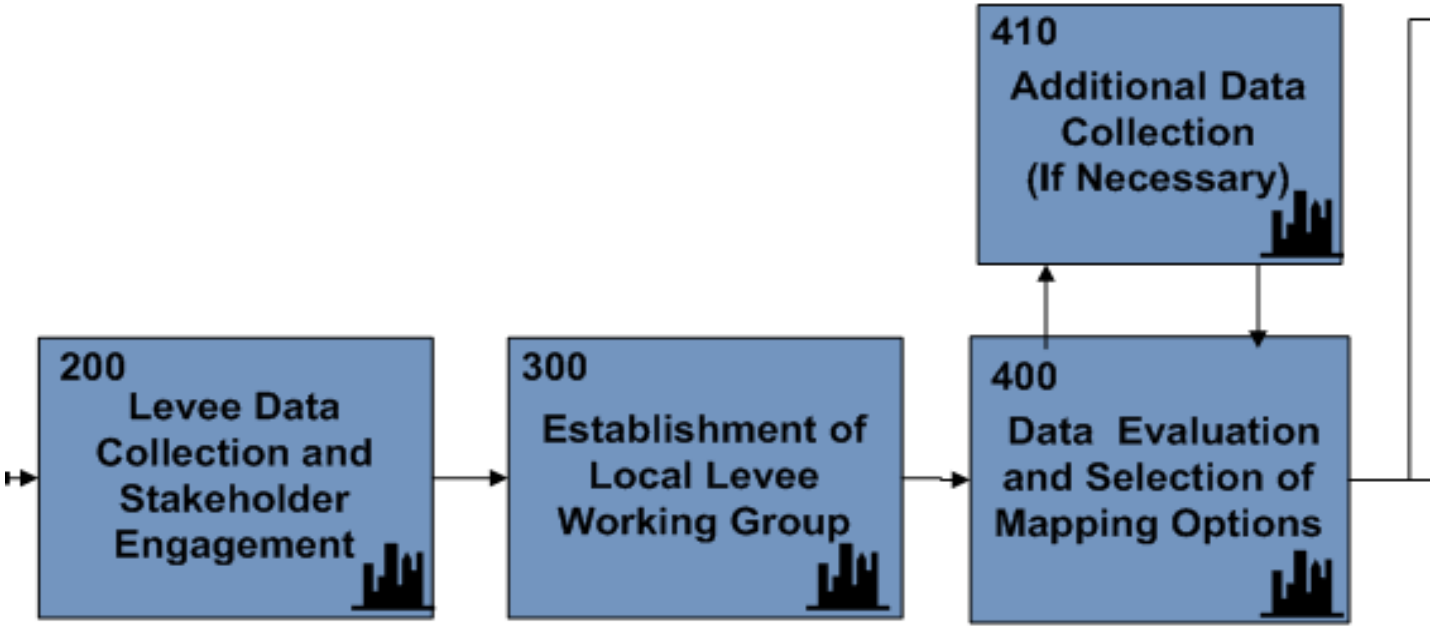
Part of Proposed Levee Analysis and Mapping Procedure

Proposed Levee Analysis and Mapping Process – Project Entry

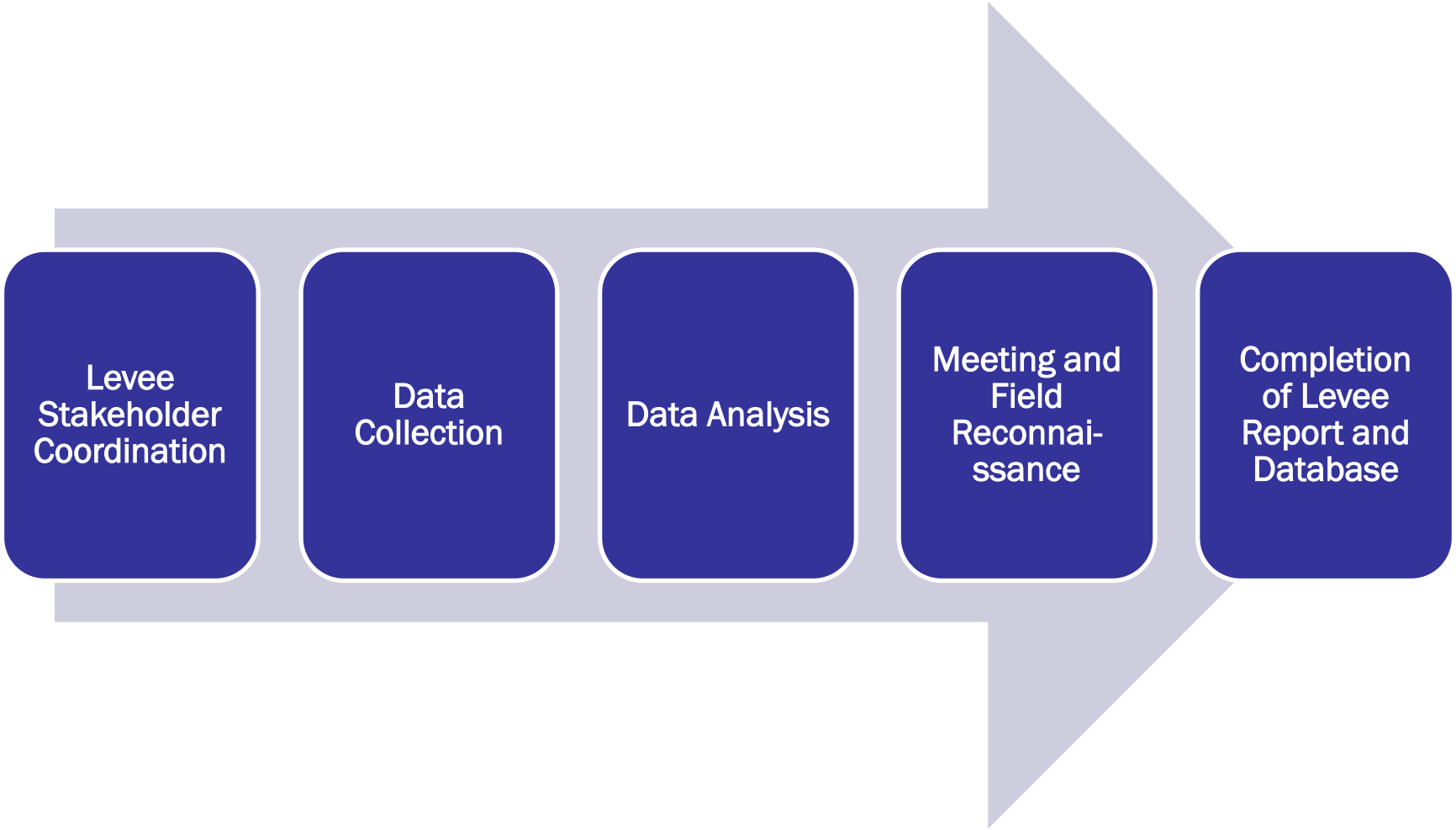
These procedures remain as-is and are not changed in the proposed approach.



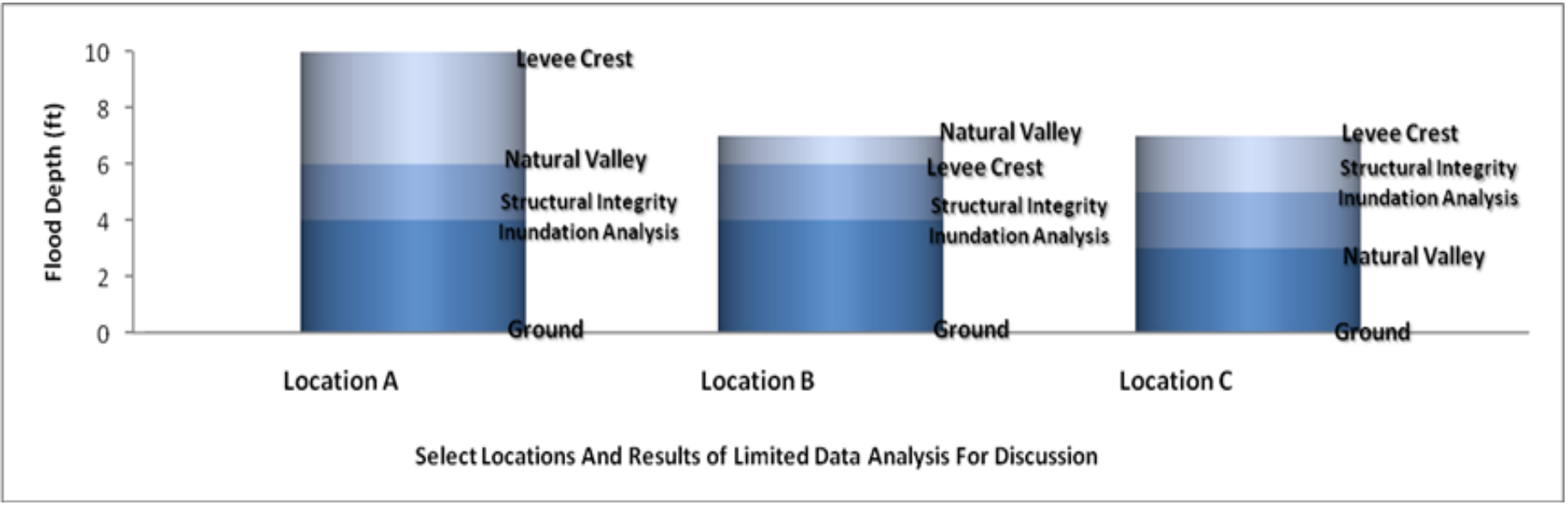
Proposed Levee Analysis and Mapping Process - Coordination



Levee Data Collection and Stakeholder Engagement



Data Analysis



- During Data Analysis phase, FEMA will produce a comparison of elevations using cost-efficient methods.
- Used to give the locals an idea of what results they may see for each potentially applicable procedure.
- The table above represents a variety of scenarios that may be encountered.

Local Levee Working Group

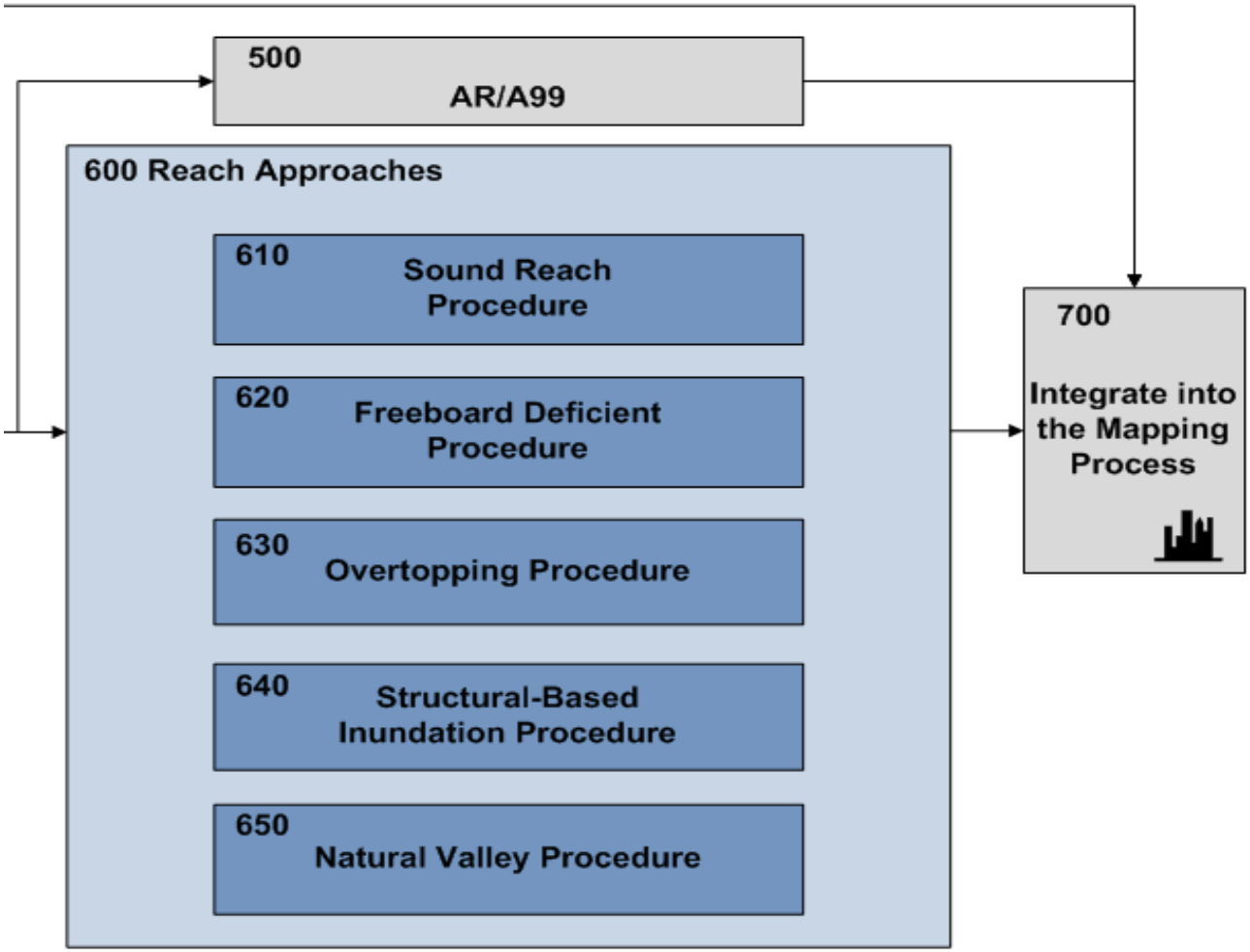
- Purpose – provide feedback and data so FEMA can make a final decision on how the levee system should be modeled and how the levee-impacte area should be mapped.
- Participants
  - CEO or designee (someone with decision making authority)
  - Levee owner
  - Floodplain manager
  - Local engineer
  - FEMA regional representative
  - USACE representative (if appropriate)
  - CTP or FEMA contractor for project
  - Others as determined by the community or region

Hazard Potential Classification

Hazard Potential Classification	Sound Reach	Freeboard Deficient	Overtopping	Structural-Based Inundation	Natural Valley
High	Y	Y	Y	Y	Y [1]
Significant	Y	Y	Y	Y	Y [1]
Low	Y	Y	N [2]	N [2]	Y

Hazard Potential Classification	Number of People Potentially Inundated	Number of People Potentially Inundated to Depths ≥ 3 feet	Additional Considerations
High	≥ 10,000	≥ 10,000	Includes areas of consequences where critical life safety infrastructure is at risk (e.g., major hospitals, regional water treatment plants, and major power plants)
Significant	> 1,000	< 10,000	Includes areas of consequence where the number of people potentially inundated is low, but there may be significant potential for large economic impact or losses
Low	< 1,000	0	

Proposed Levee Analysis and Mapping Process - Analysis



FEMA

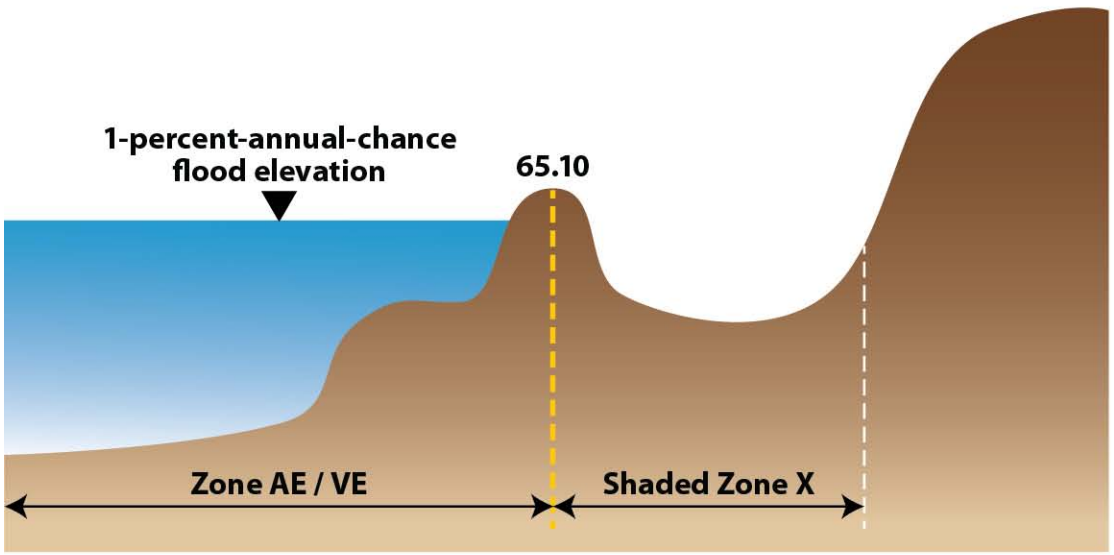
4. Levee Analysis and Mapping Procedures

RiskMAP

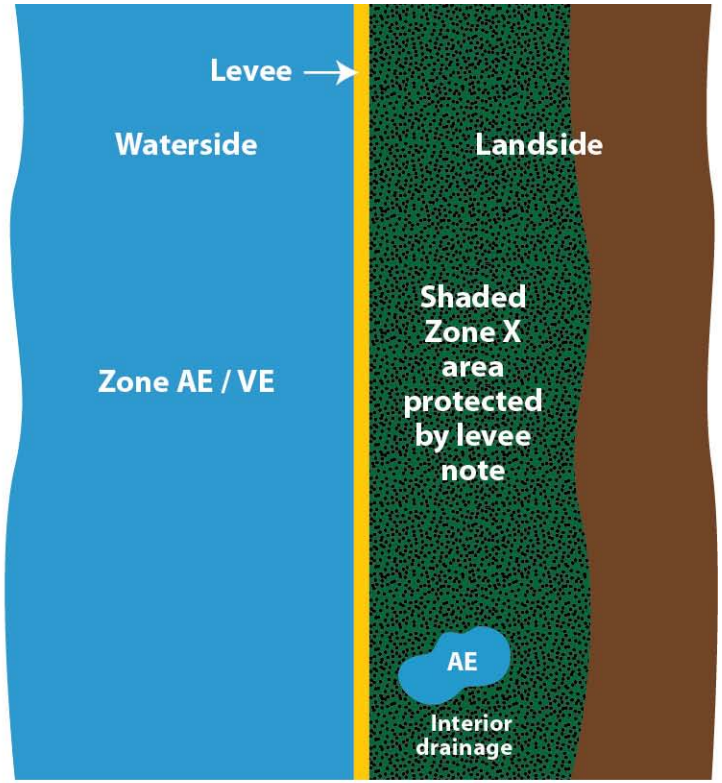
Increasing Resilience Together

Accredited System

- Accredited System
  - Criteria: Levee System Meets 65.10 Criteria
  - Mapping Approach: Mapping as Fully Accredited; Natural Valley Floodplain Analysis to Map Shaded Zone X and Levee Protection Note



CROSS SECTION VIEW

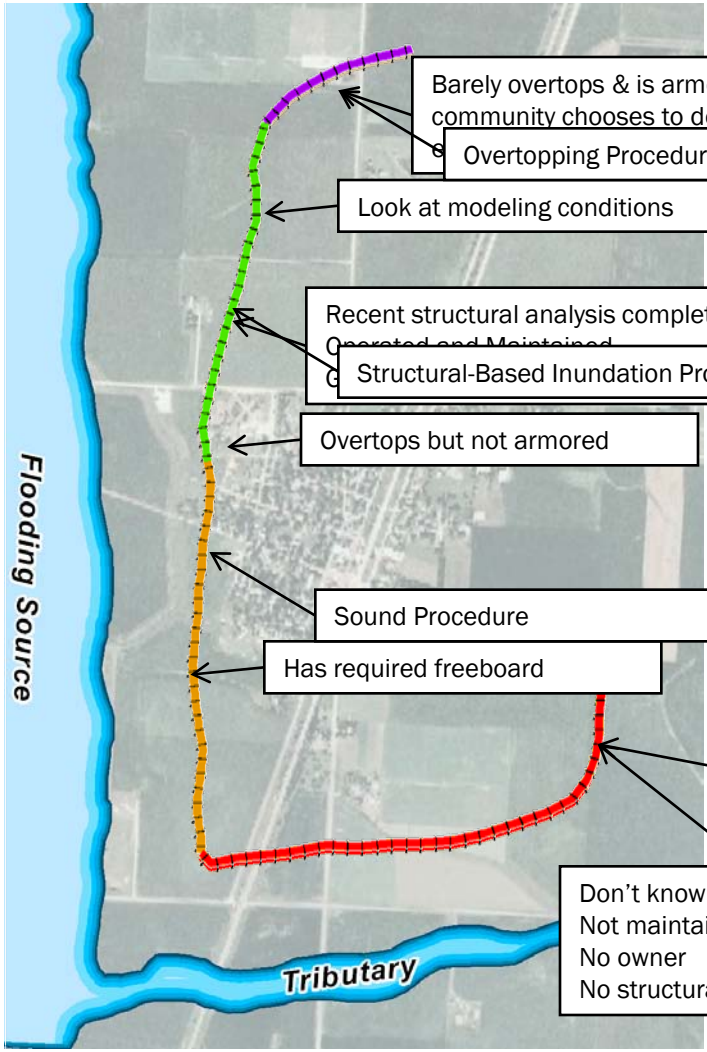


PLAN VIEW

Definition of a Reach

- **A "reach" is a discrete section of a levee for which one of the five levee analysis procedures can be applied**
- **Primarily data dependent:**
  - O&M Plan available?
  - As-Builts/Levee Survey?
  - Structurally sound?
  - Closures/Tie-Ins?
  - Evaluation of overtopping erosion?
- **Also depends upon modeling conditions:**
  - BFE compared to levee crest?
  - Topographic/hydraulic conditions landward of the system

Definition of a Reach



Barely overtops & is armored: community chooses to do extra o

Overtopping Procedure

Look at modeling conditions

Recent structural analysis completed

Operated and Maintained

Structural-Based Inundation Procedure

Overtops but not armored

Sound Procedure

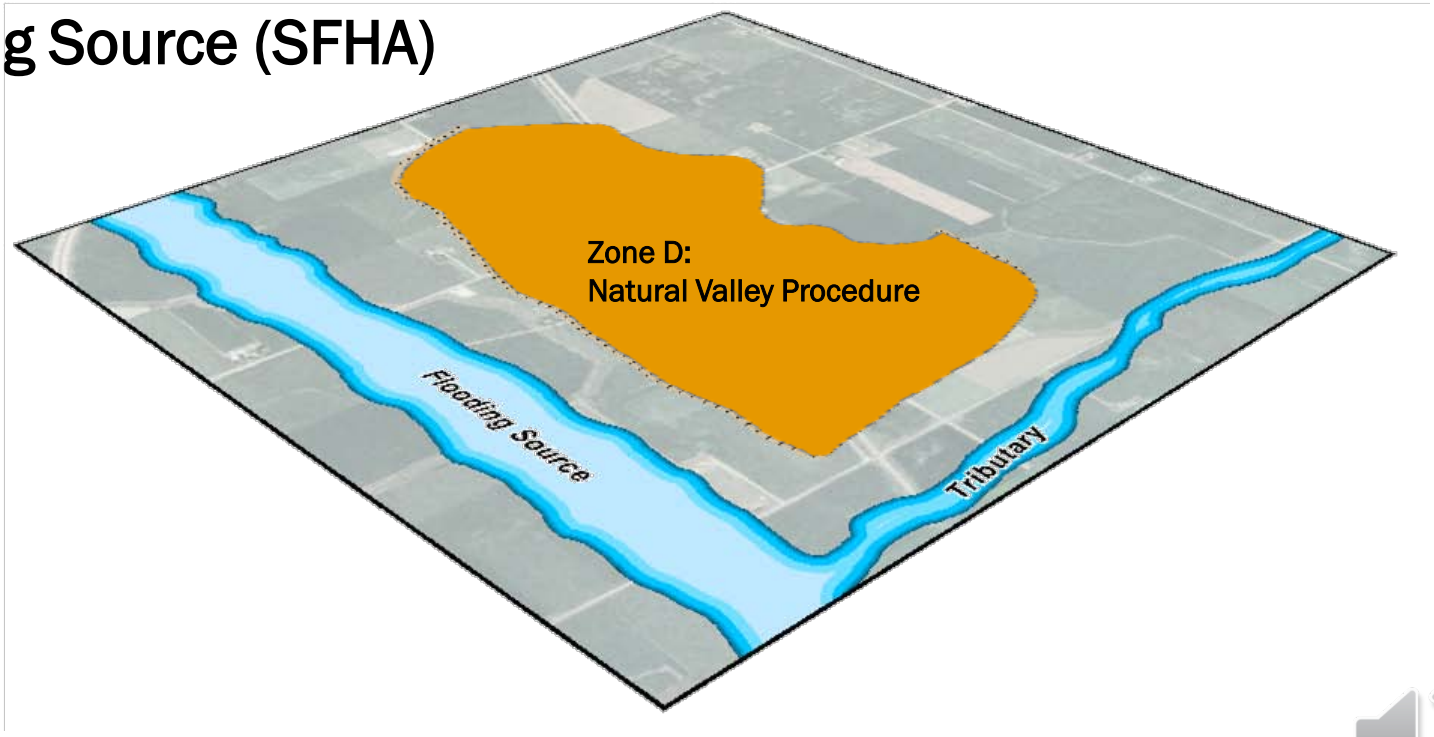
Has required freeboard

Natural Valley Procedure

Don't know anything about
Not maintained
No owner
No structural analysis

Four Main Layers of Mapping

1. Natural Valley (Zone D)
2. Interior Drainage (Special Flood Hazard Area)
3. Landside Hazard (SFHA)
4. Flooding Source (SFHA)

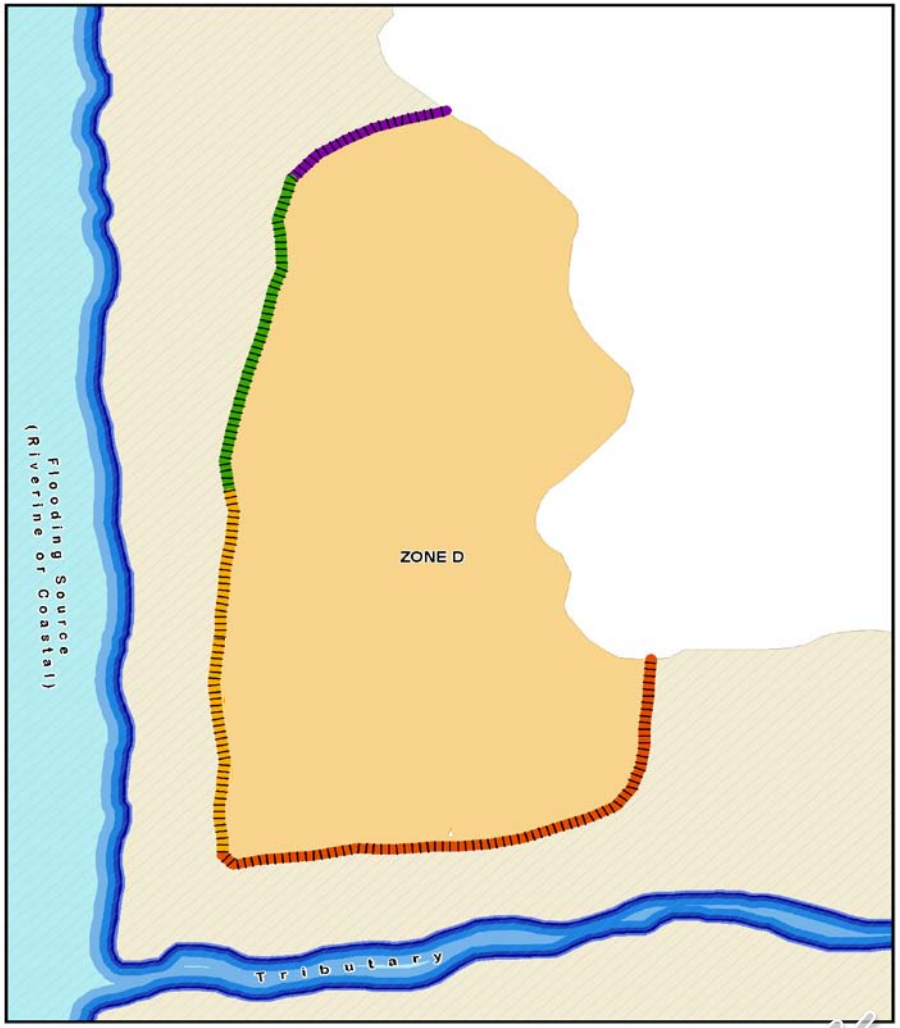


Zone D

- Defined as “undetermined, but possible, flood hazards”
- No federal mandatory purchase requirement
- Insurance rates are similar to a Zone A
- Complicated for an individual to get a reduced insurance rate
- Minimal NFIP-required floodplain management, but possible to use for floodplain management purposes

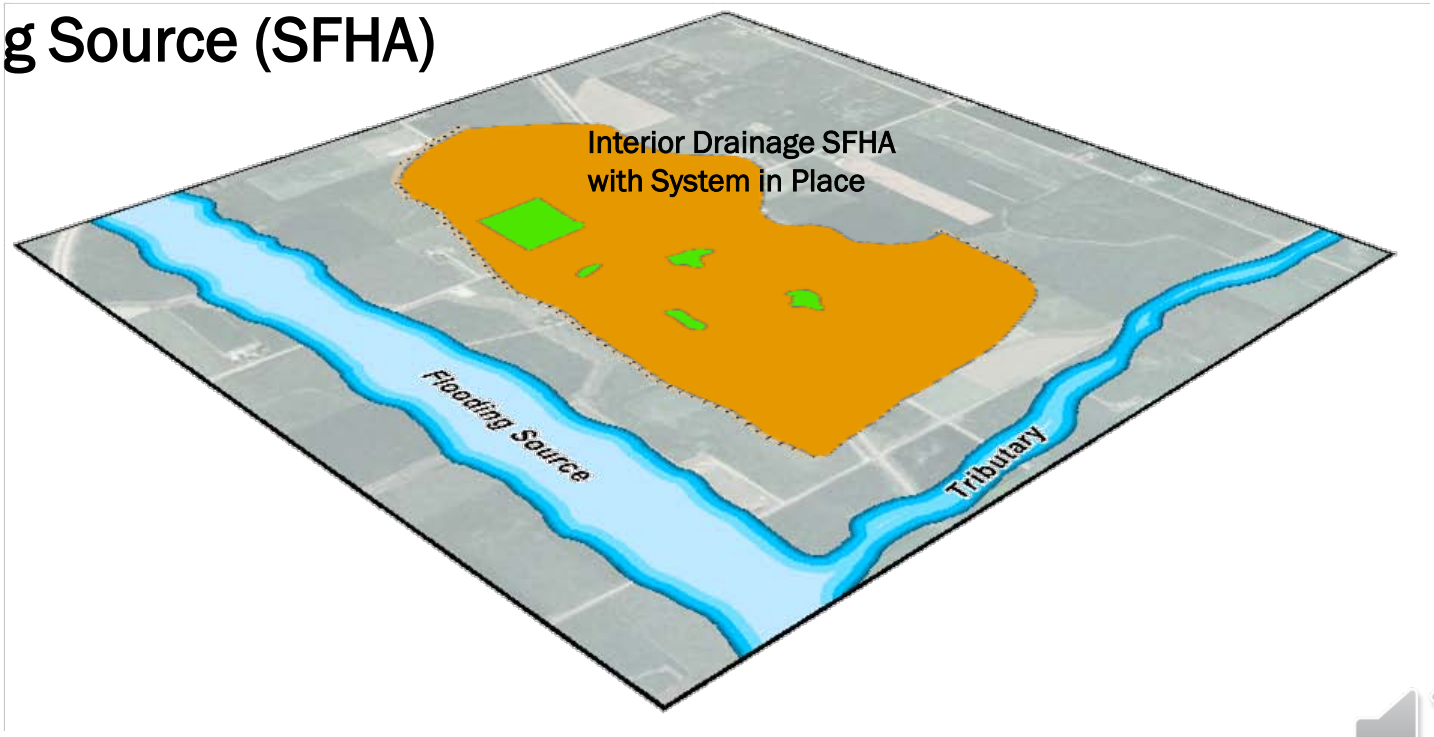
Identify Area of Uncertain Hazards

- The Zone D designation represents the uncertainty associated with the potential flood hazards associated with levee systems.
- The Zone D area will supplement the SFHA identified through the application of the various procedures.
- May not have Zone D if the whole non-accredited system is analyzed with Natural Valley



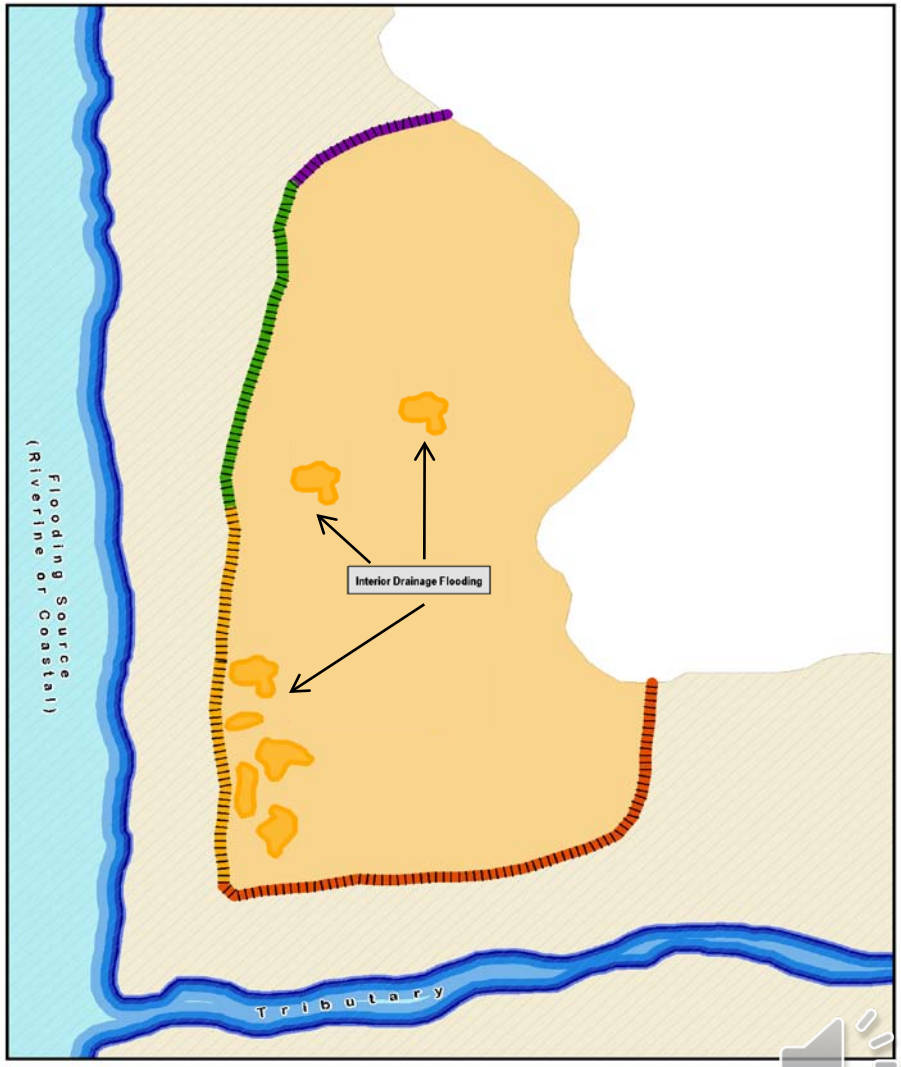
Four Main Layers of Mapping

1. Natural Valley (Zone D)
2. Interior Drainage (SFHA)
3. Landside Hazard (SFHA)
4. Flooding Source (SFHA)

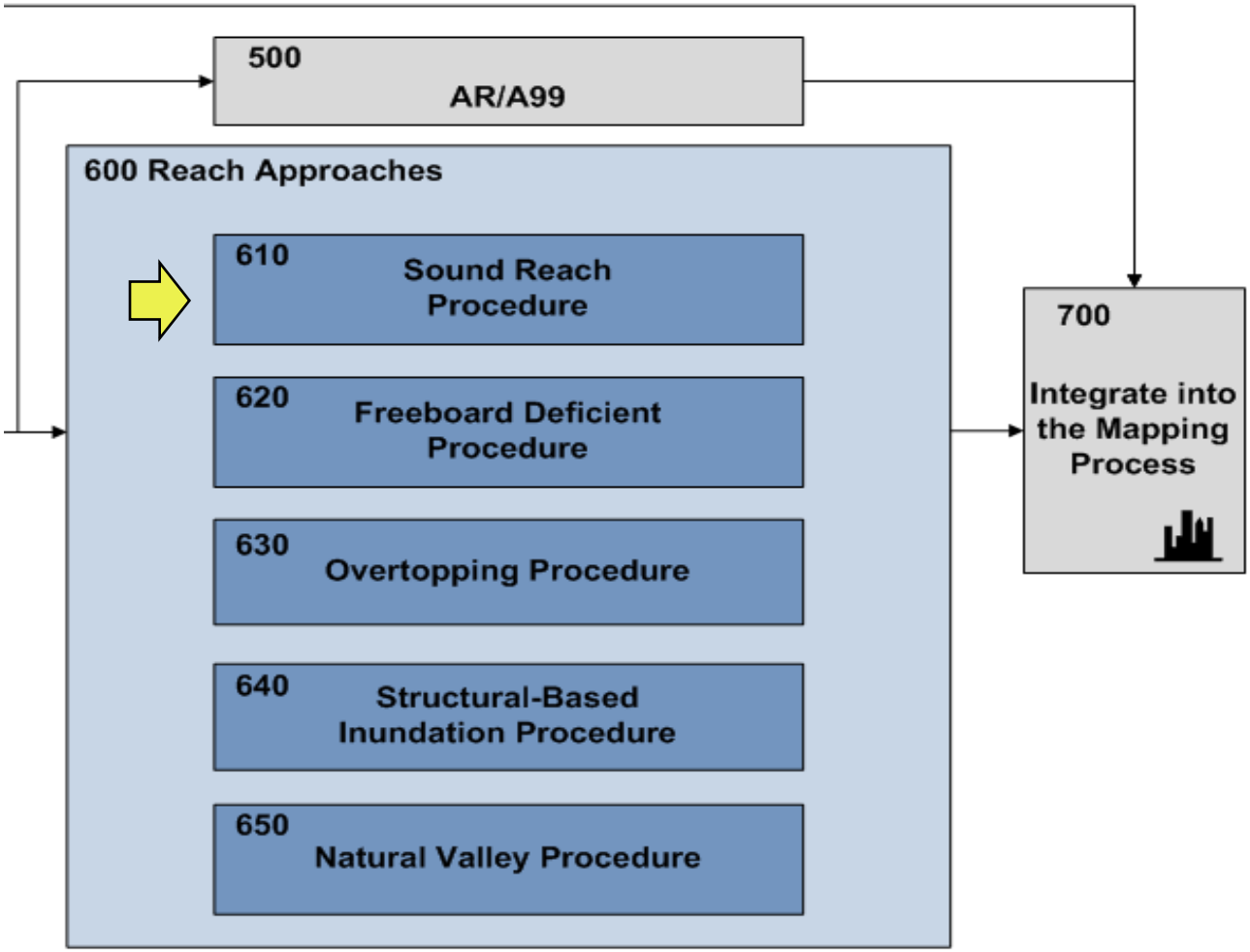


Interior Drainage

- Analyzed as if the levee <u>system</u> remains in place during 1-percent-annual-chance flood
- SFHA shown if depth is greater than 1 foot
- May use Zone AH or AO designation
- Reflects flooding sources that are behind the levee, low-lying areas that are not pumped dry

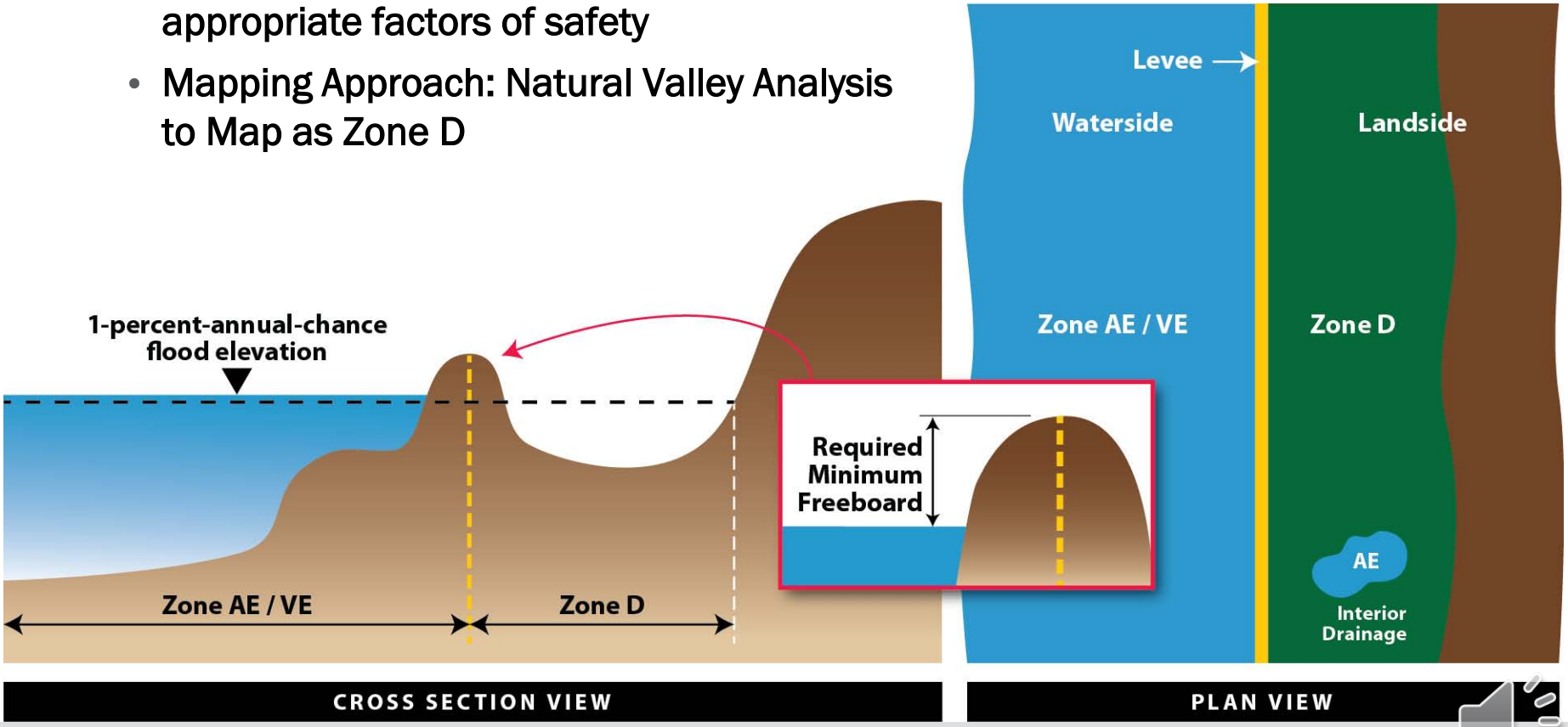


Proposed Levee Analysis and Mapping Process



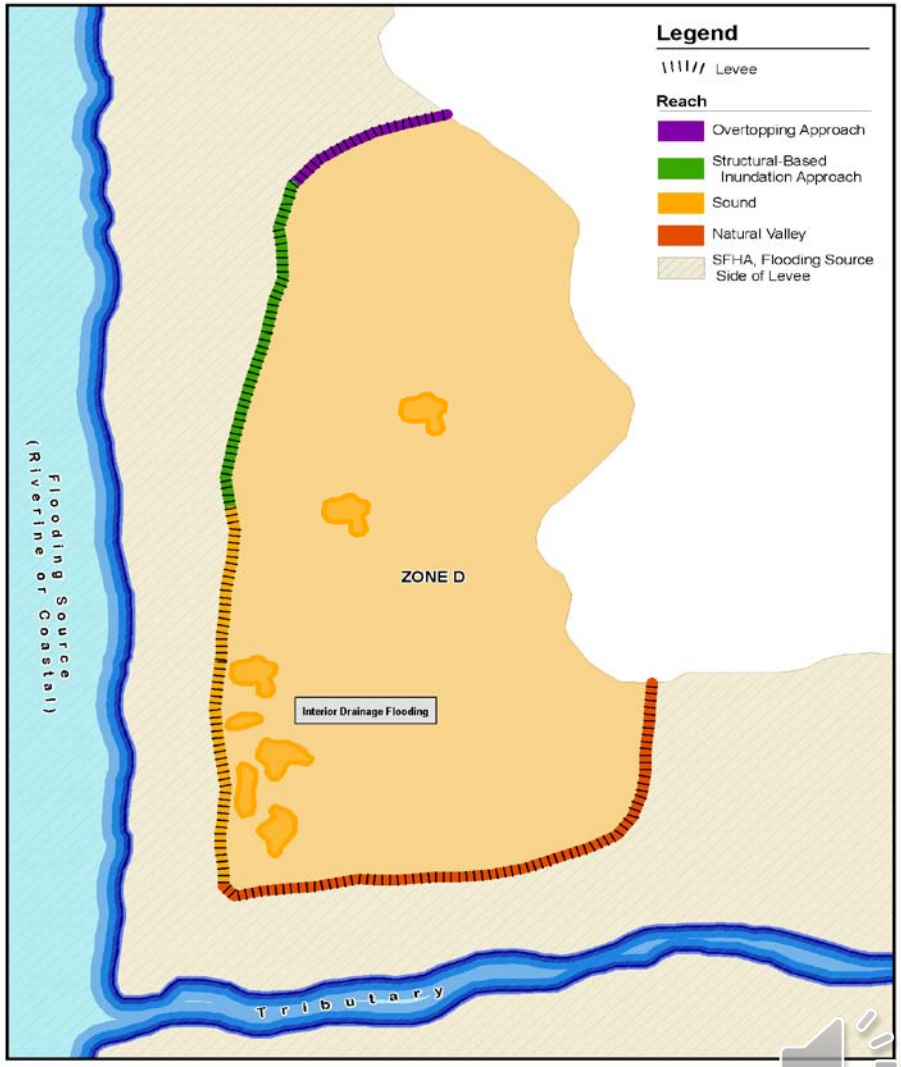
Sound Reach

- Sound Reach
  - Criteria: Levee is designed and constructed to be structurally sound and meet appropriate factors of safety
  - Mapping Approach: Natural Valley Analysis to Map as Zone D

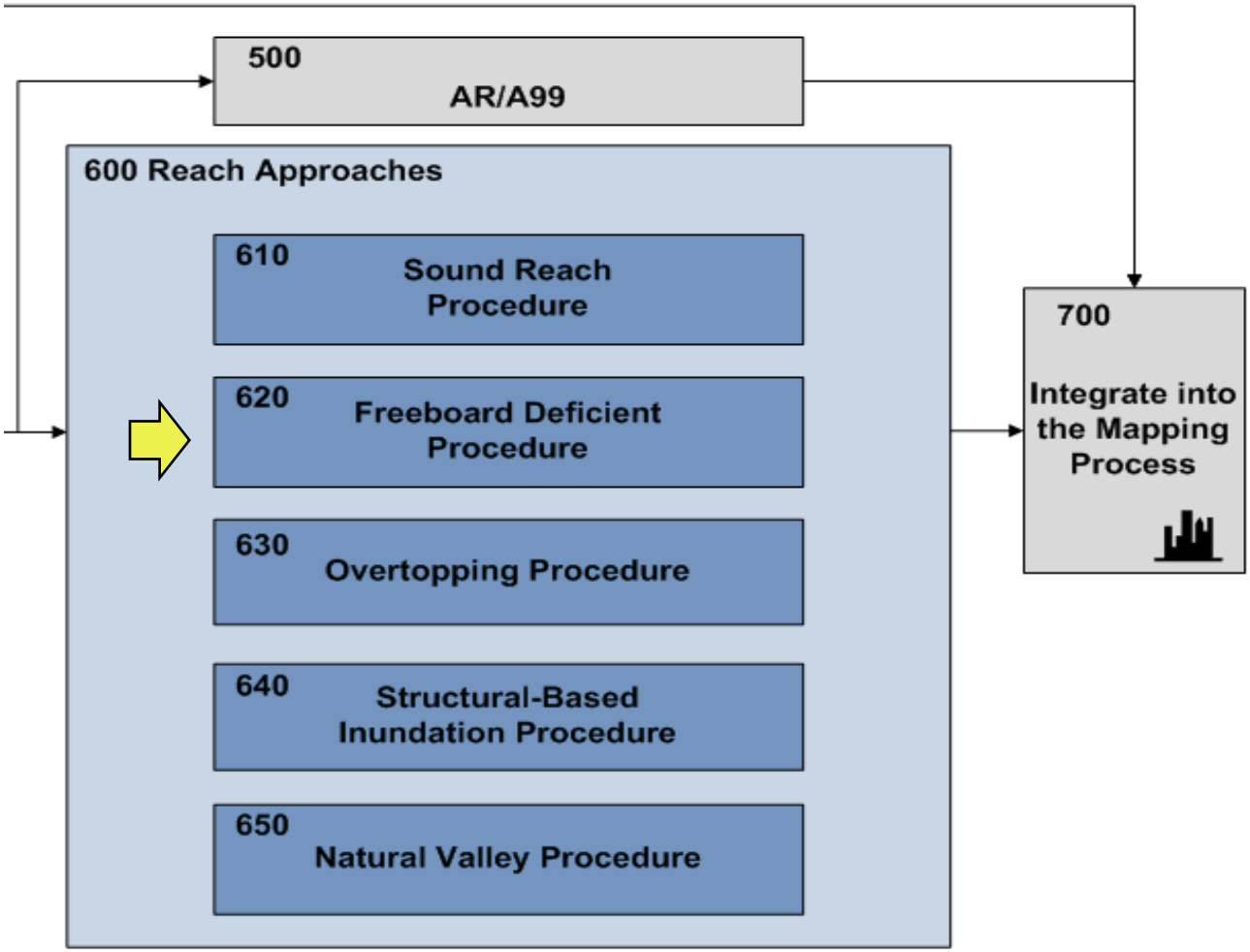


Sound Reach

- Designed and constructed to withstand, and provide protection from, the 1-percent–annual-chance flood, in accordance with sound engineering practices with regard to structural concerns and factors of safety.
- O&M Plan & maintained
- No additional specific modeling required

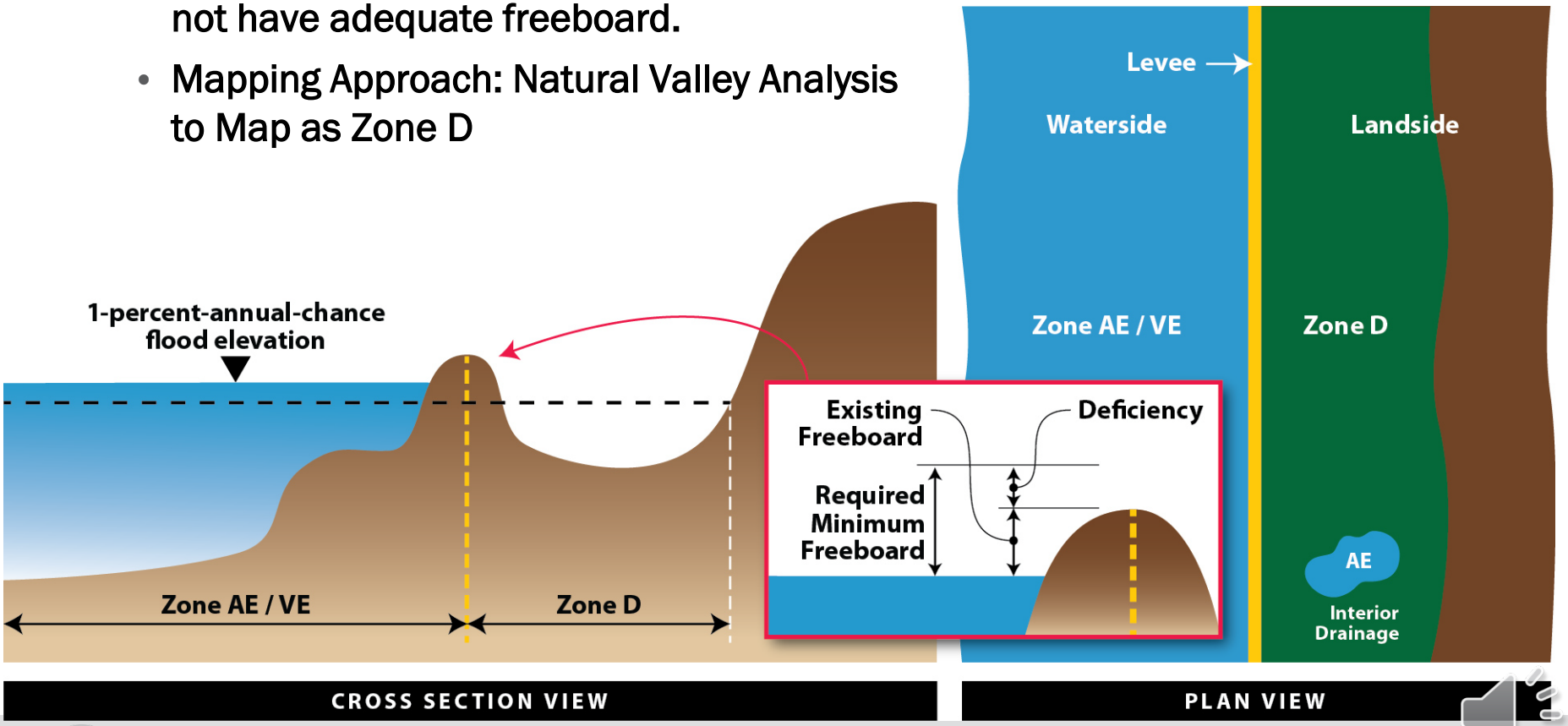


Proposed Levee Analysis and Mapping Process



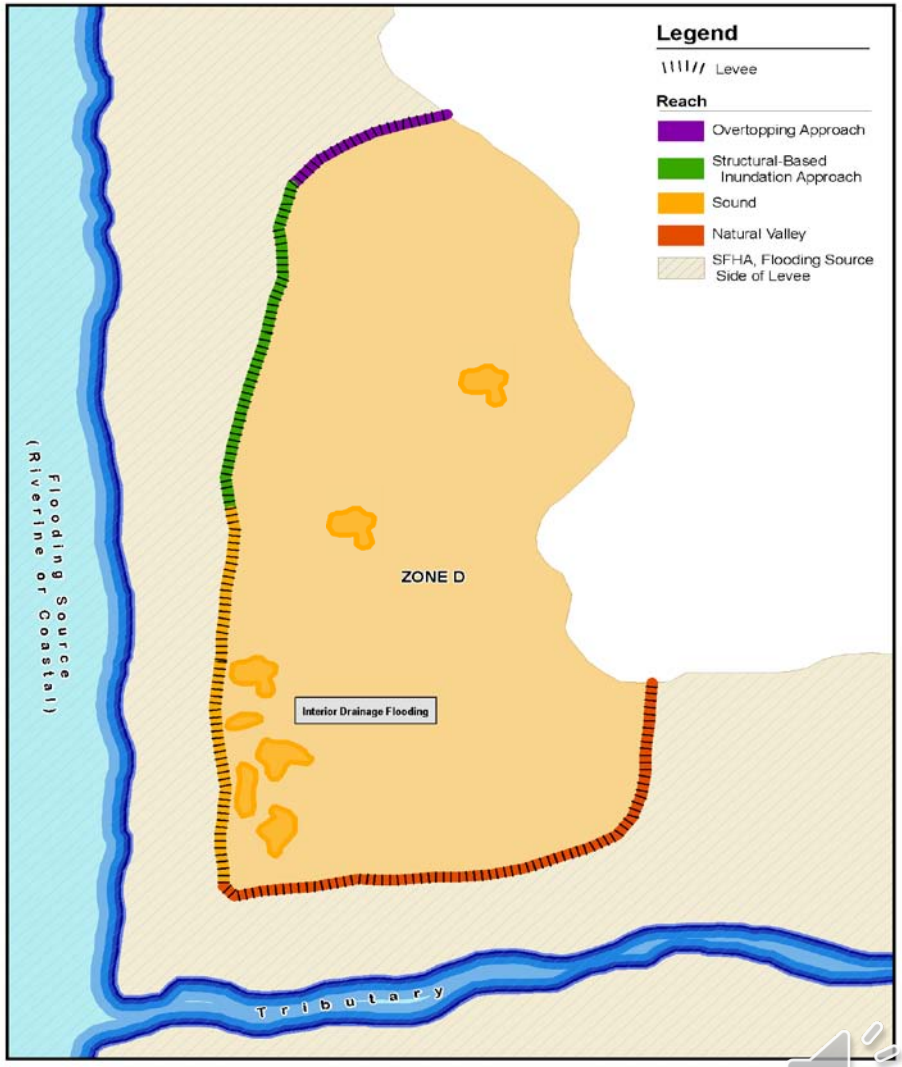
Freeboard Deficient

- Freeboard Deficiency – Reach or System
  - Criteria: Levee is structurally sound and top is higher than the flood elevation, but does not have adequate freeboard.
  - Mapping Approach: Natural Valley Analysis to Map as Zone D

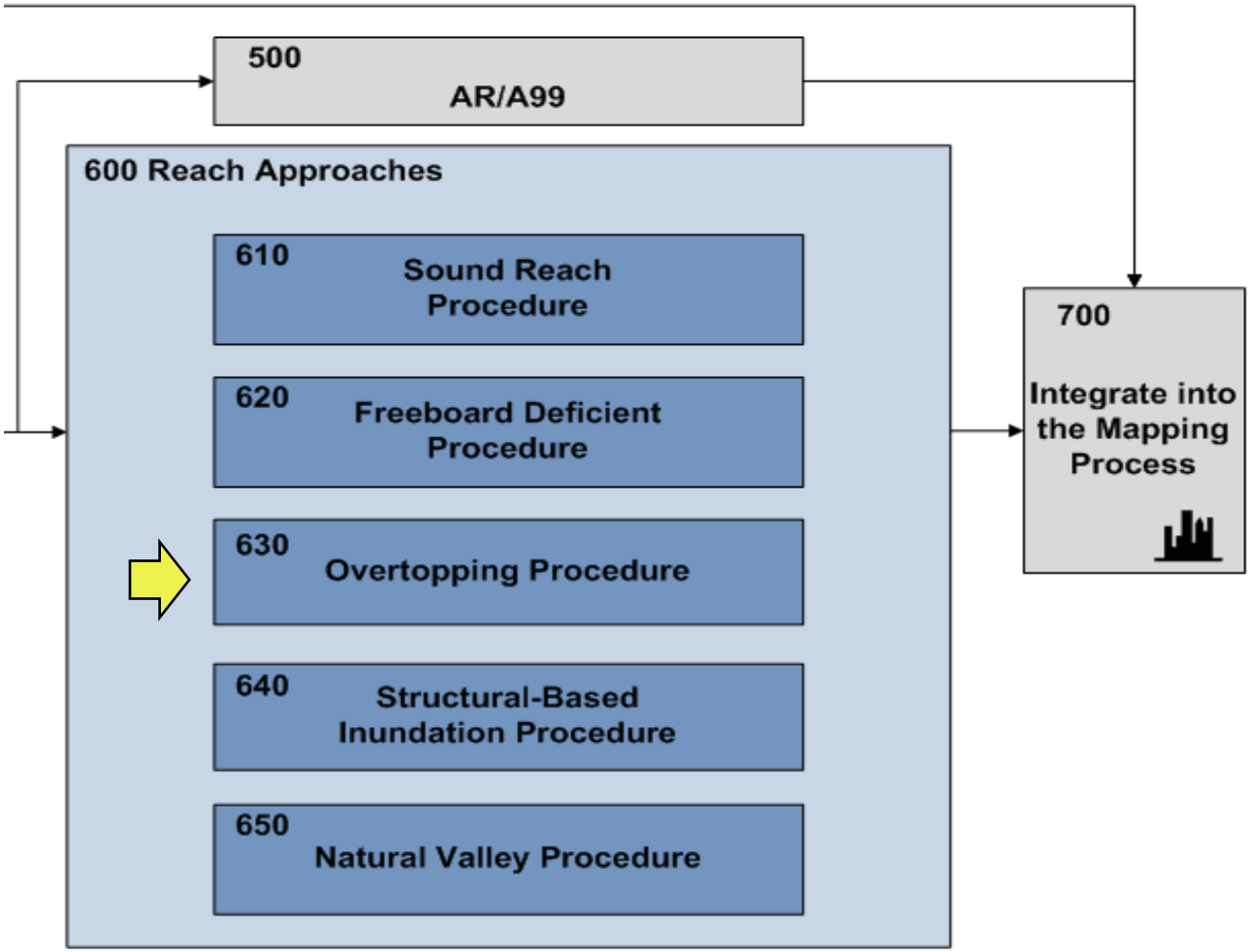


Freeboard Deficient

- Lack of adequate freeboard is the *only* reason the levee cannot be sound
- The base flood does not overtop the levee, but lacks freeboard
- Cannot meet the freeboard exception defined in 44 CFR 65.10
- No additional specific modeling required

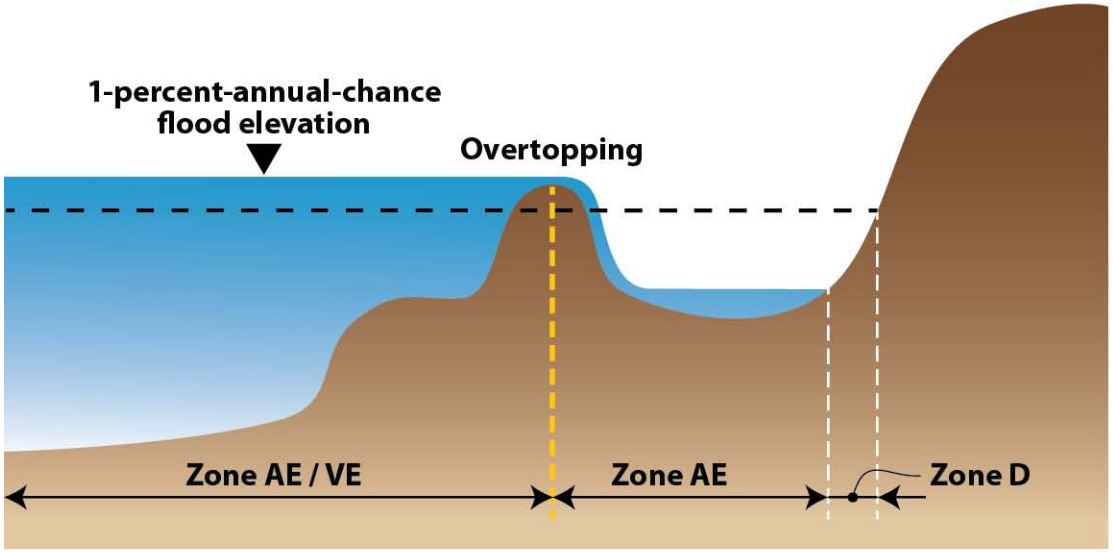


Proposed Levee Analysis and Mapping Process

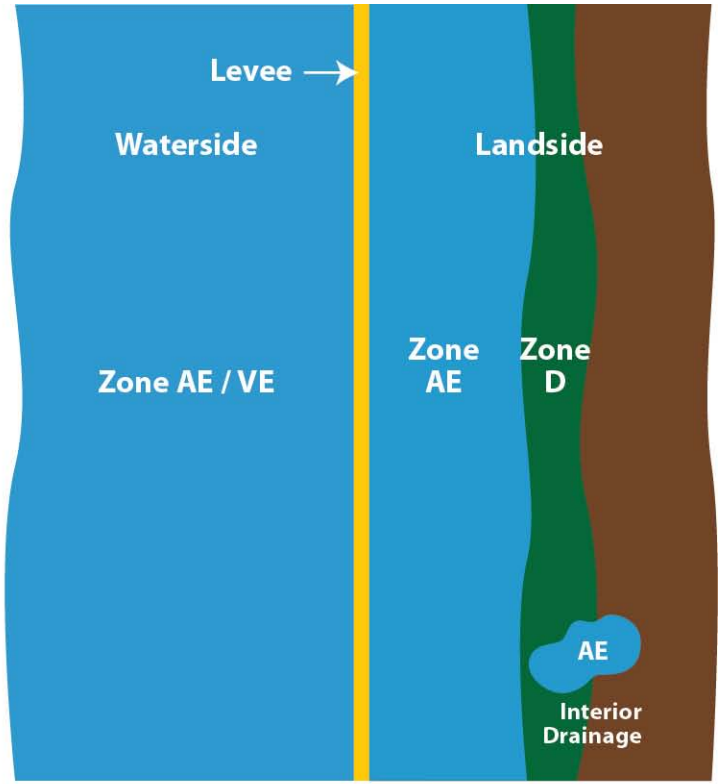


Overtopping

- Overtopping Inundation Analysis
  - Criteria: Levee Crest is Lower than the flood elevation, but it can be documented that the levee can structurally withstand the 1% flood
  - Mapping Approach: Overtopping Analysis to Map Special Flood Hazard Area; Natural Valley Floodplain Analysis to Map Zone D



CROSS SECTION VIEW



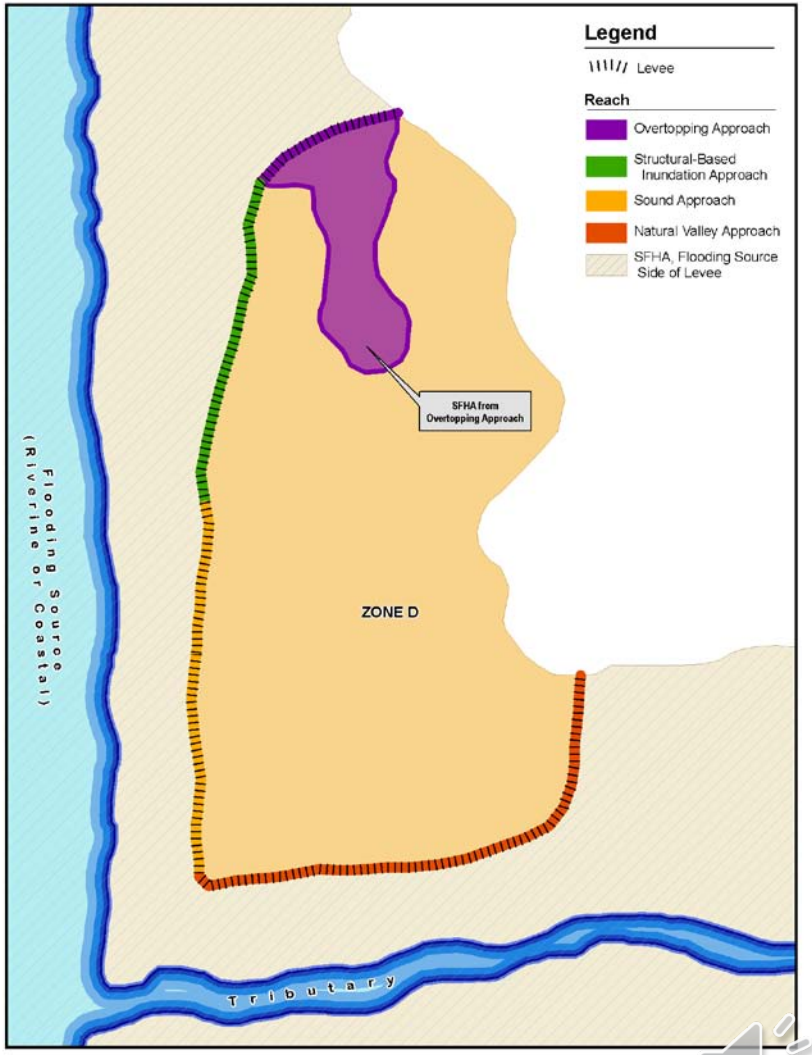
PLAN VIEW

Overtopping

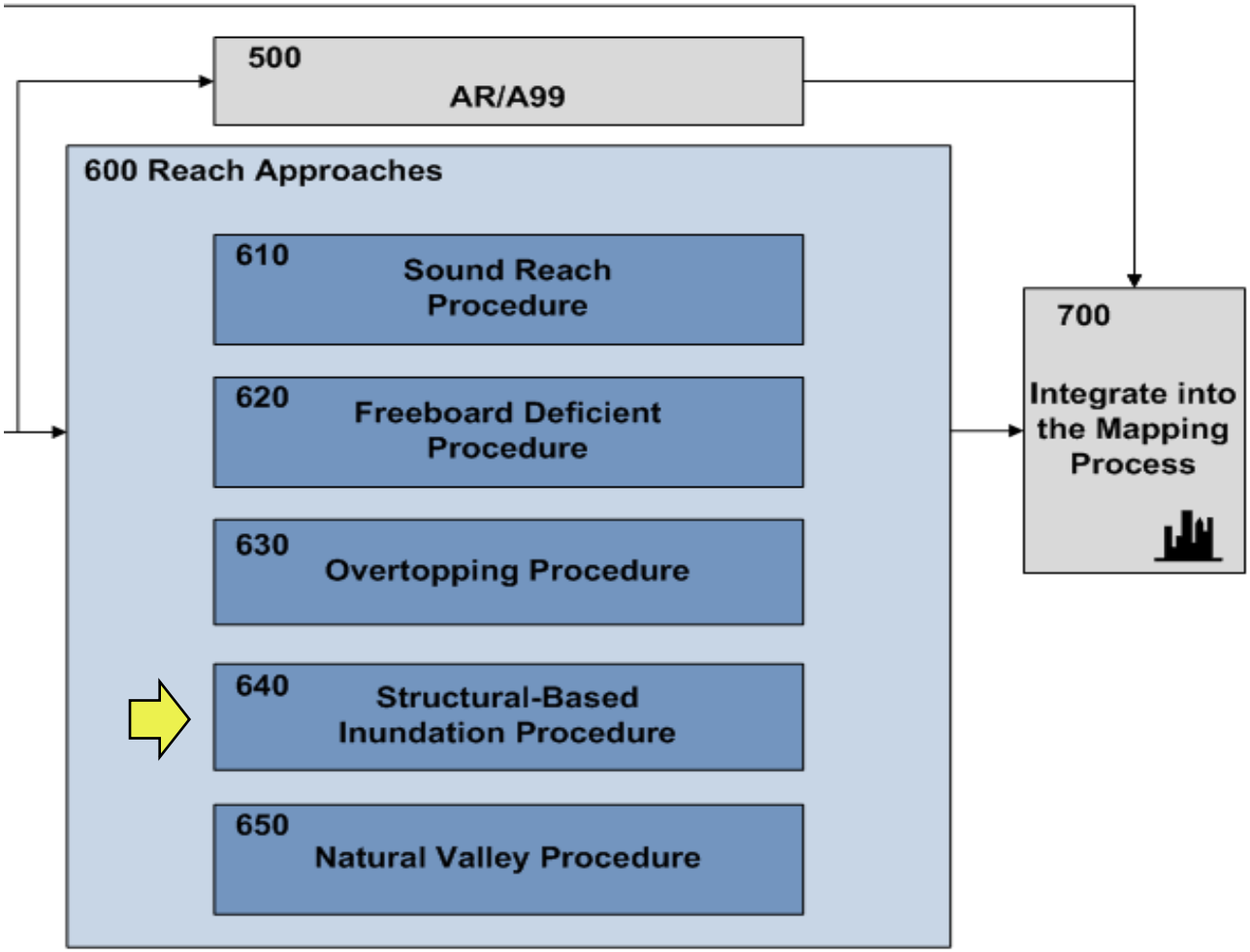
- **Purpose is not to dictate design standards**
- **Best practices for overtopping of dams will likely be used**
- **Factors to consider are:** slope and toe protection techniques, duration, depth and velocities of flood and overtopping at various stages.....

Overtopping

- Certified engineering analyses required regarding structural ability to withstand the 1% flood
- May happen with designed control structures
- Modeling likely will be unsteady

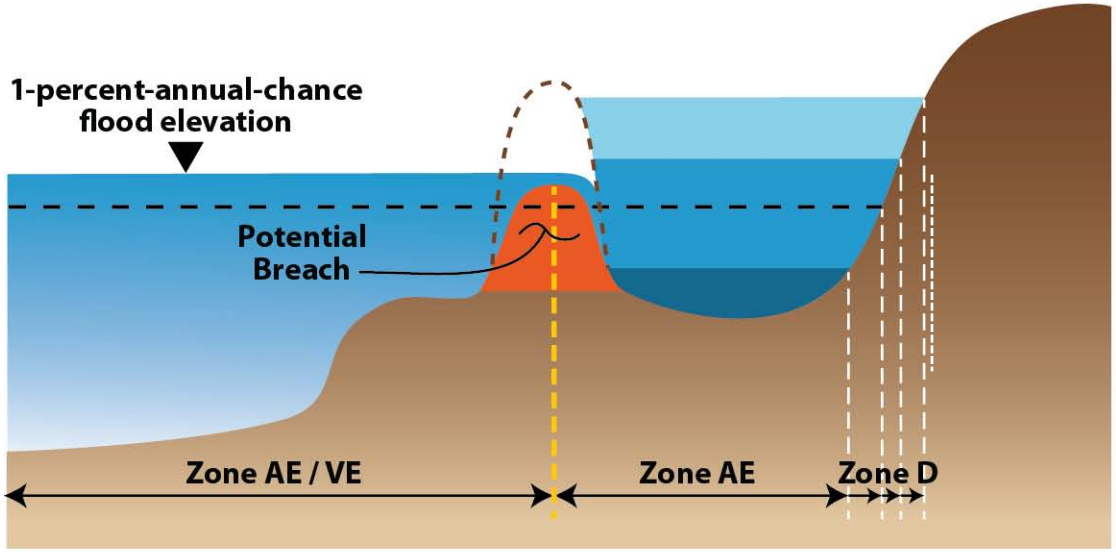


Proposed Levee Analysis and Mapping Process

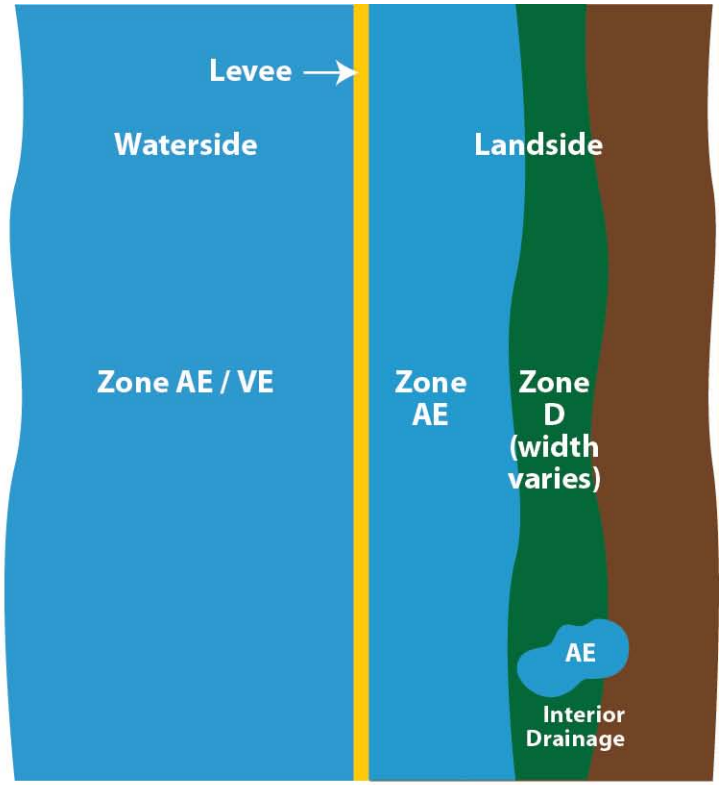


Structural-Based Inundation Procedure

- Structural-Based Inundation Analysis
  - Criteria: Levee Doesn't Meet 65.10 Criteria and accurate levee elevation information
  - Mapping Approach: Breach Analysis to Map Special Flood Hazard Area; Natural Valley Floodplain Analysis to Map Zone D



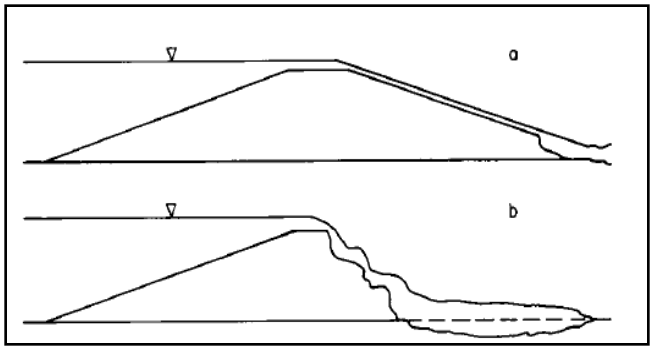
CROSS SECTION VIEW

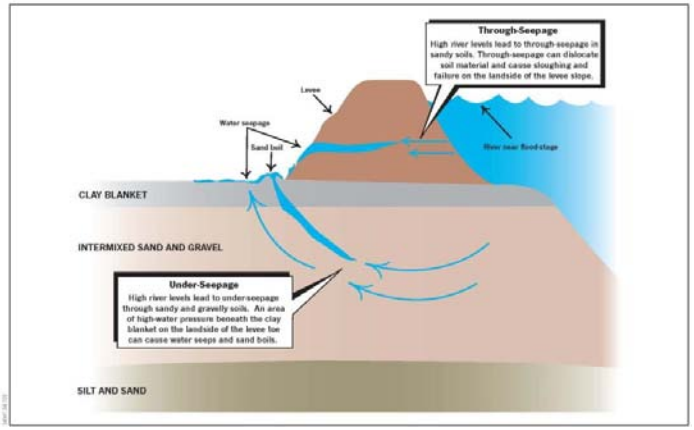


PLAN VIEW

Structural-Based Inundation Procedure

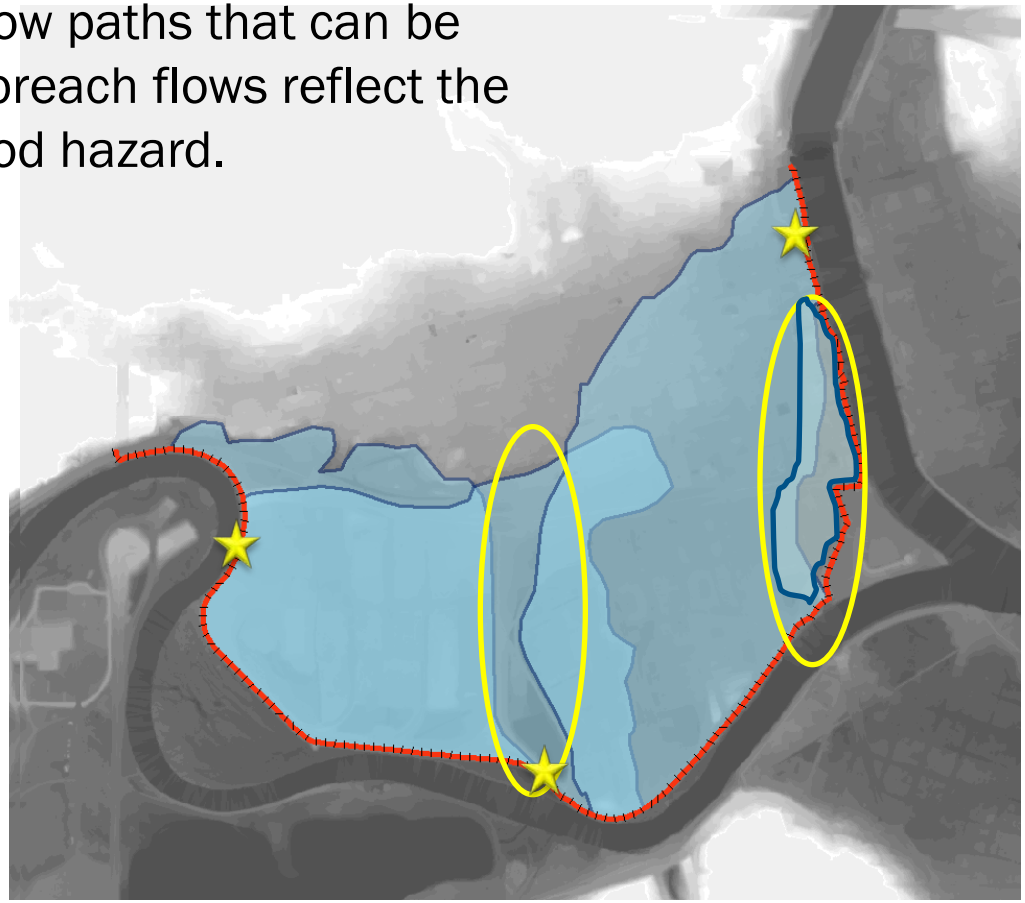
- **Failure Modes**
  - The failure mode can be either overtopping or internal, depending on which portions of the 44 CFR 65.10 the levee reach fails to meet.
- **Modeling Mapping Methodology**
  - Accurately predicting actual breach locations and shapes is not feasible
  - Expected minimum of two modeled breaches per reach
  - Modeled breach locations will not be evident on final map
  - Each breach is independent
  - Any length along the reach is subject to breaching





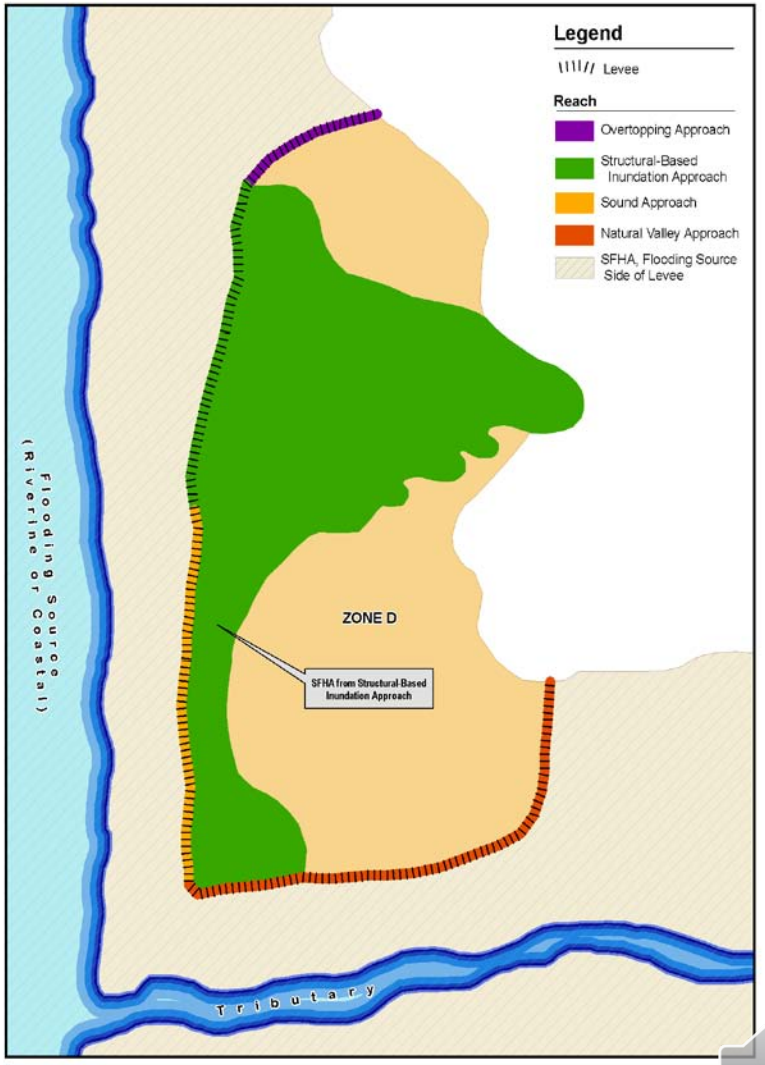
Structural-Based Inundation Procedure

The flood hazard is reasonably identified when all potential storage areas and flow paths that can be reached by breach flows reflect the potential flood hazard.

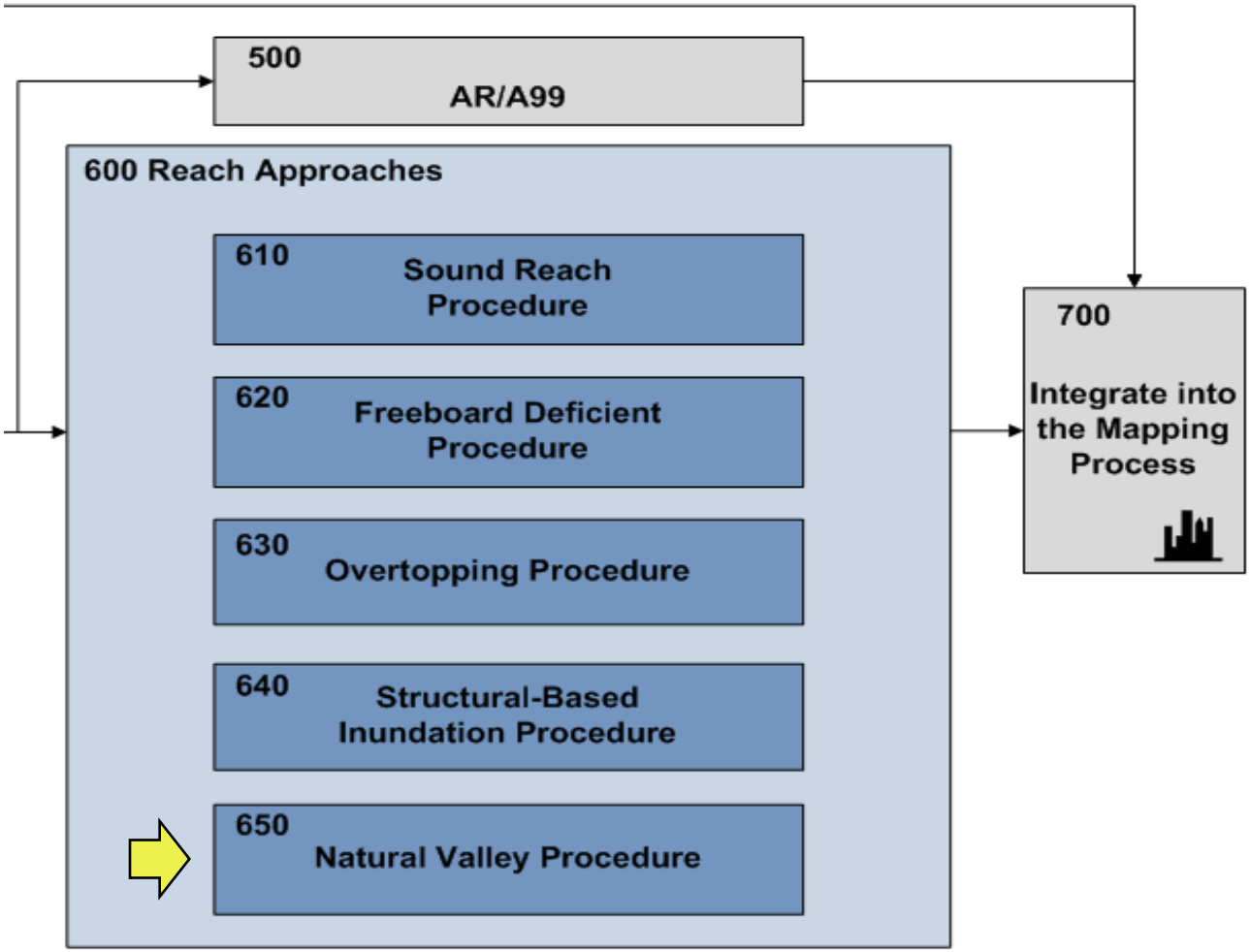


Structural-Based Inundation Approach

- **Will be used in:**
  - Easily identified areas of weakness
  - Higher risk areas
  - Extensive, good quality data
- **Mapping results from a composite of the analysis of inundation at each potential breach location**

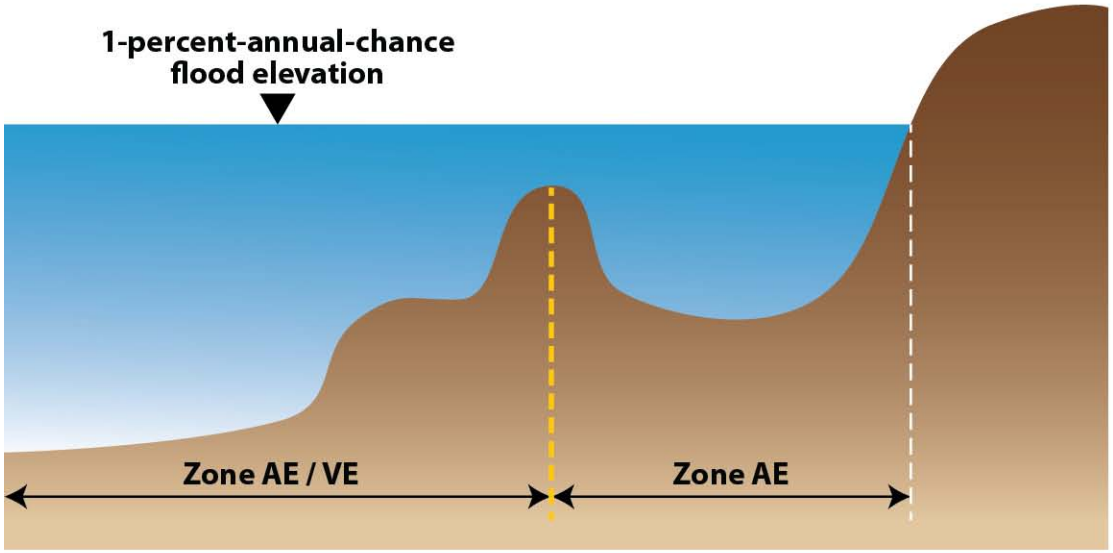


Proposed Levee Analysis and Mapping Process

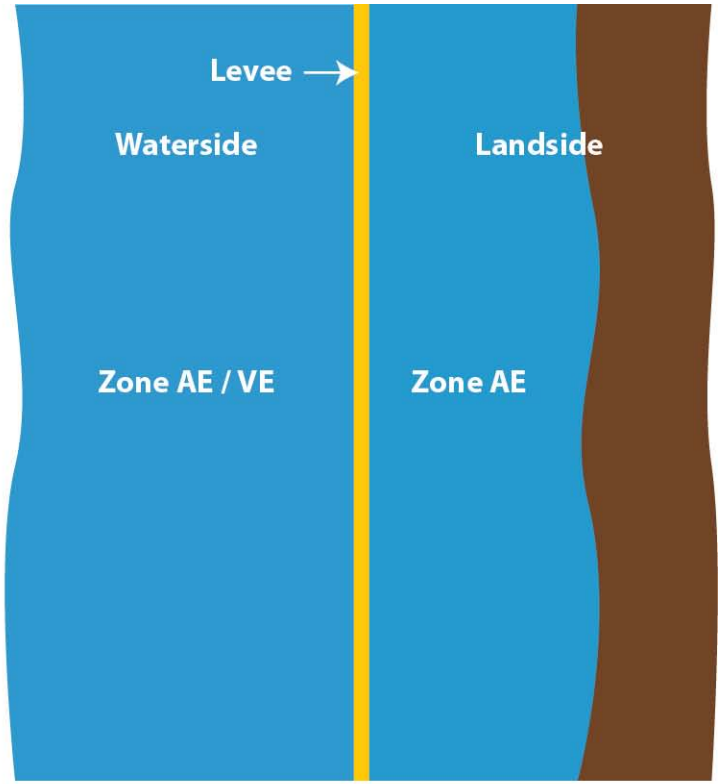


Natural Valley

- Natural Valley
  - Criteria: Levee Doesn't Meet 65.10 and Doesn't Impact the Flood Elevation
  - Mapping Approach: Natural Valley Floodplain Analysis Only to Map Special Flood Hazard Area



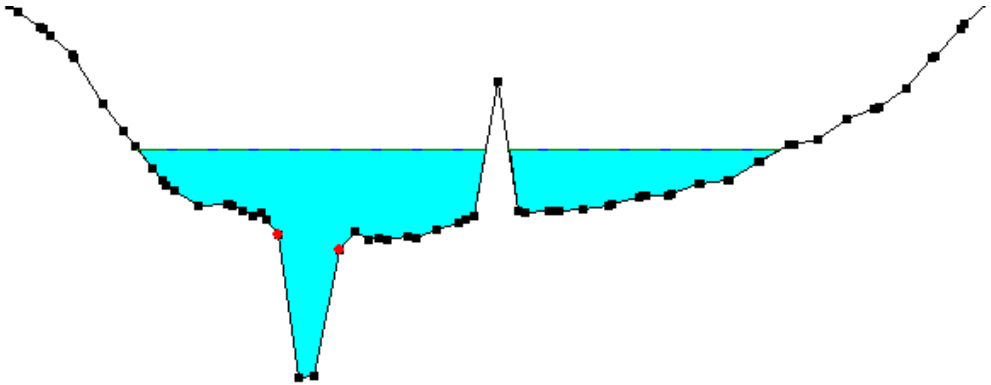
CROSS SECTION VIEW



PLAN VIEW

Natural Valley Modeling

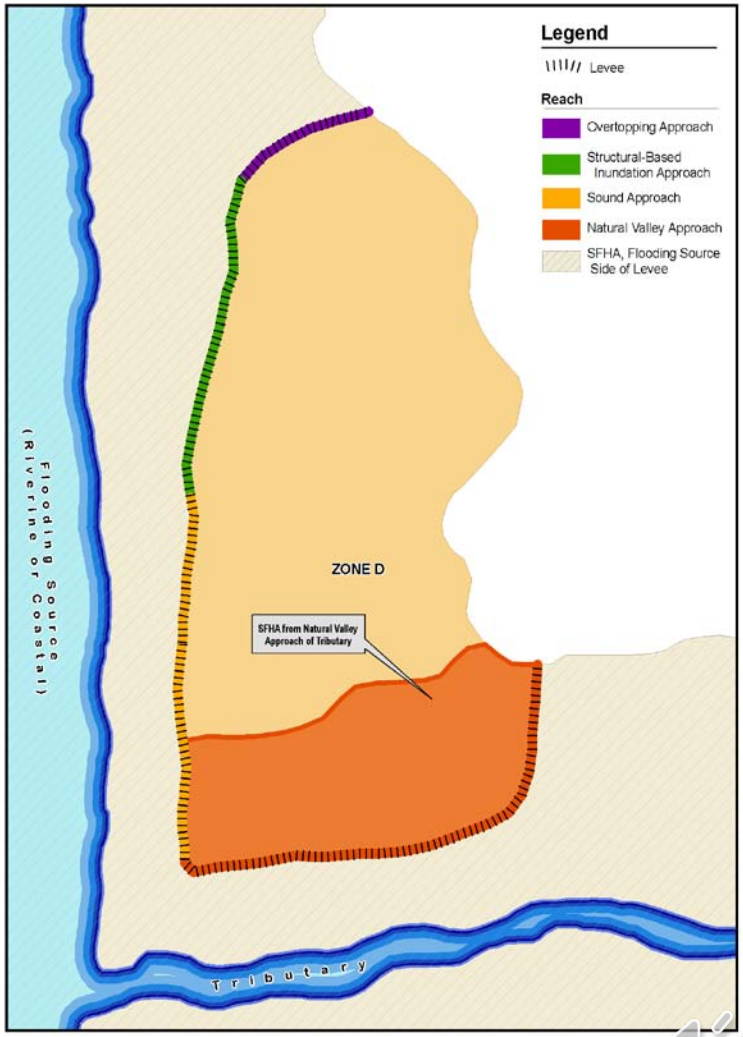
- **Riverine: Modeled without the levee impeding flow**
  - Levee will remain in ground profile,
  - Will not prevent water from moving landward
- **Coastal: coastal levee included in storm surge model setup**
  - This BFE will be extended landward
  - No wave conditions analyzed landward of levee, unless deemed to be the actual conditions.



Natural Valley

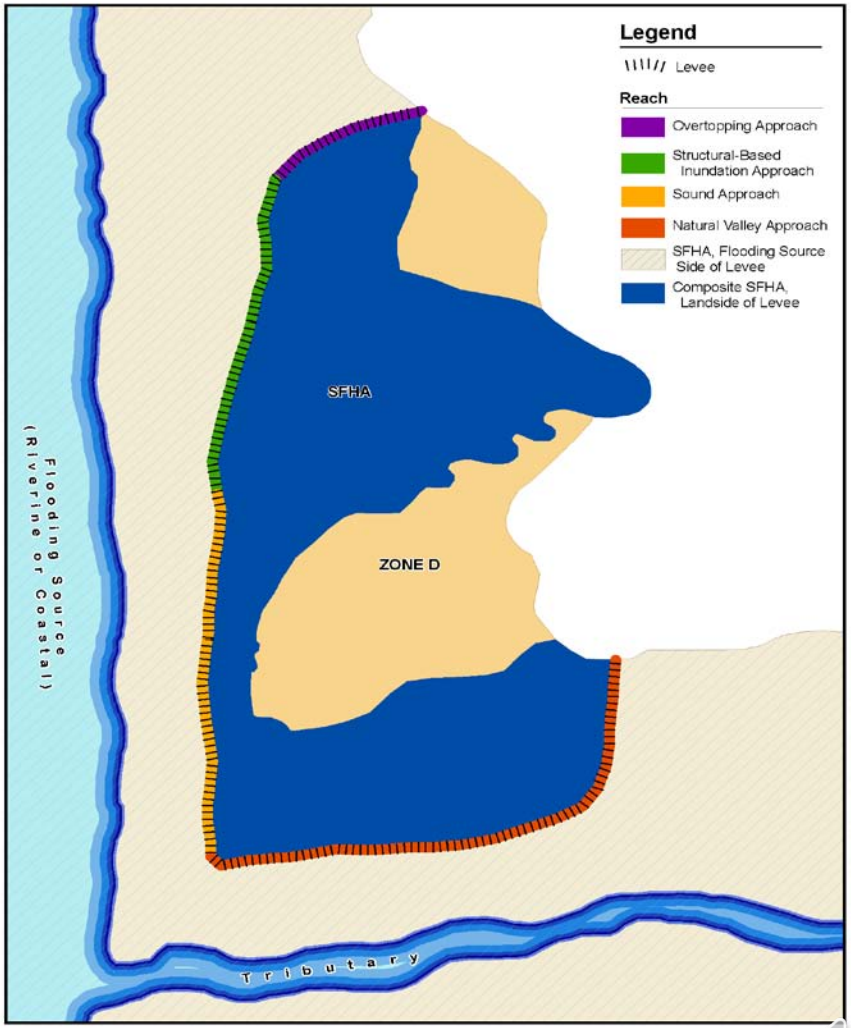
This method is appropriate when:

- The levee reach is so significantly overtopped that the existence of the levee does not have a noticeable effect on the water surface elevation
- The level of risk is deemed low (based on initial review of Hazard Potential Classification and discussion with community)
- There is no data available to support another method.
- A community prefers to use this method



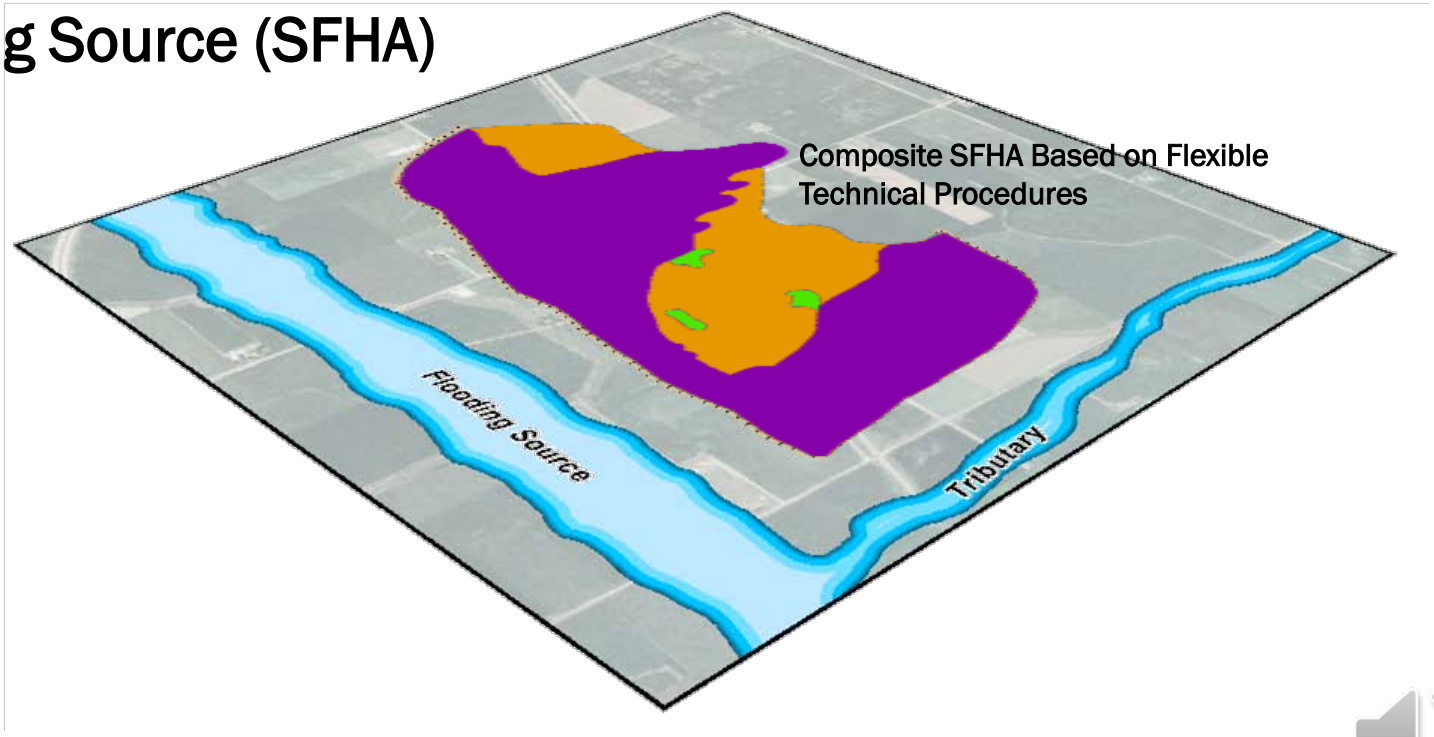
Final Composite Map

Once each reach is analyzed and mapped, a composite map is created.



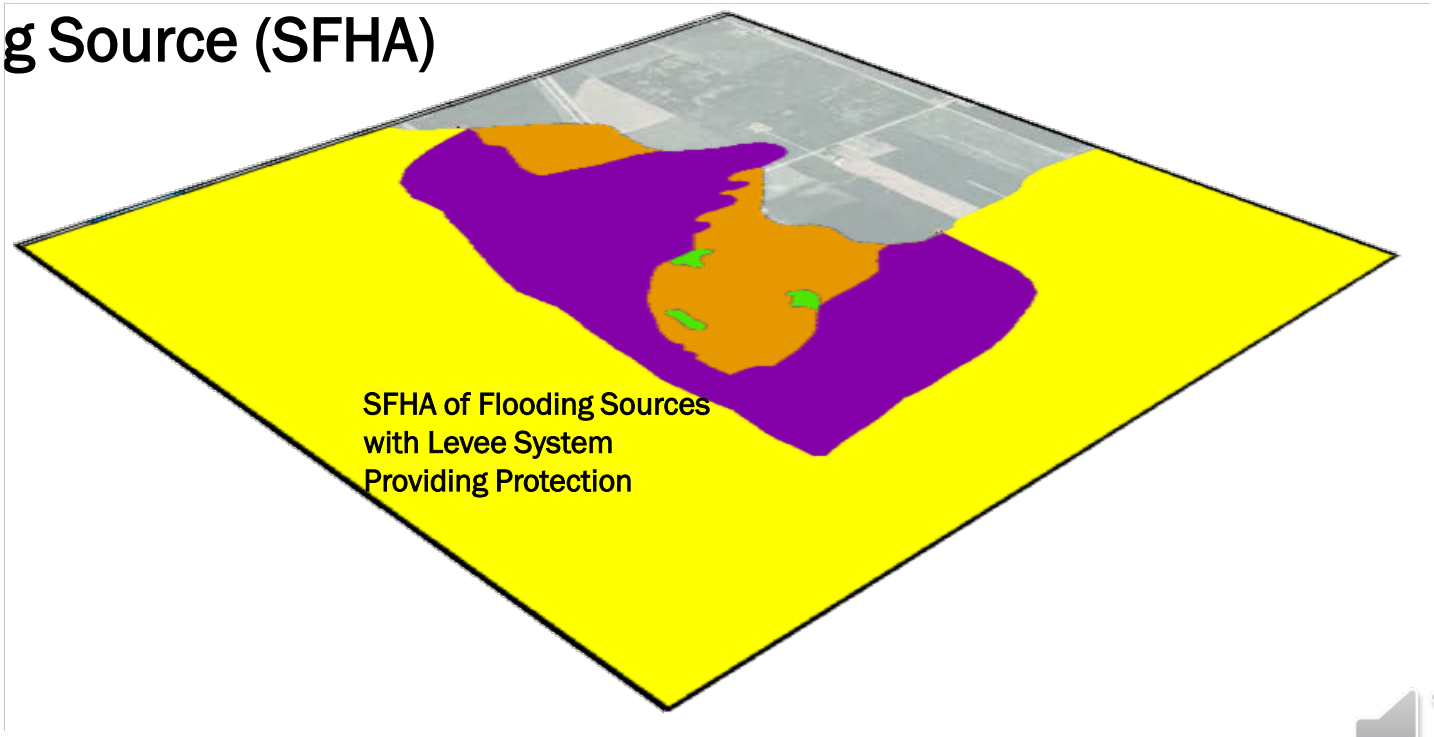
Four Main Layers of Mapping

1. Natural Valley (Zone D)
2. Interior Drainage (SFHA)
3. Landside Hazard (SFHA)
4. Flooding Source (SFHA)



Four Main Layers of Mapping

1. Natural Valley (Zone D)
2. Interior Drainage (SFHA)
3. Landside Hazard (SFHA)
4. Flooding Source (SFHA)



Riverine Hydraulic Analysis

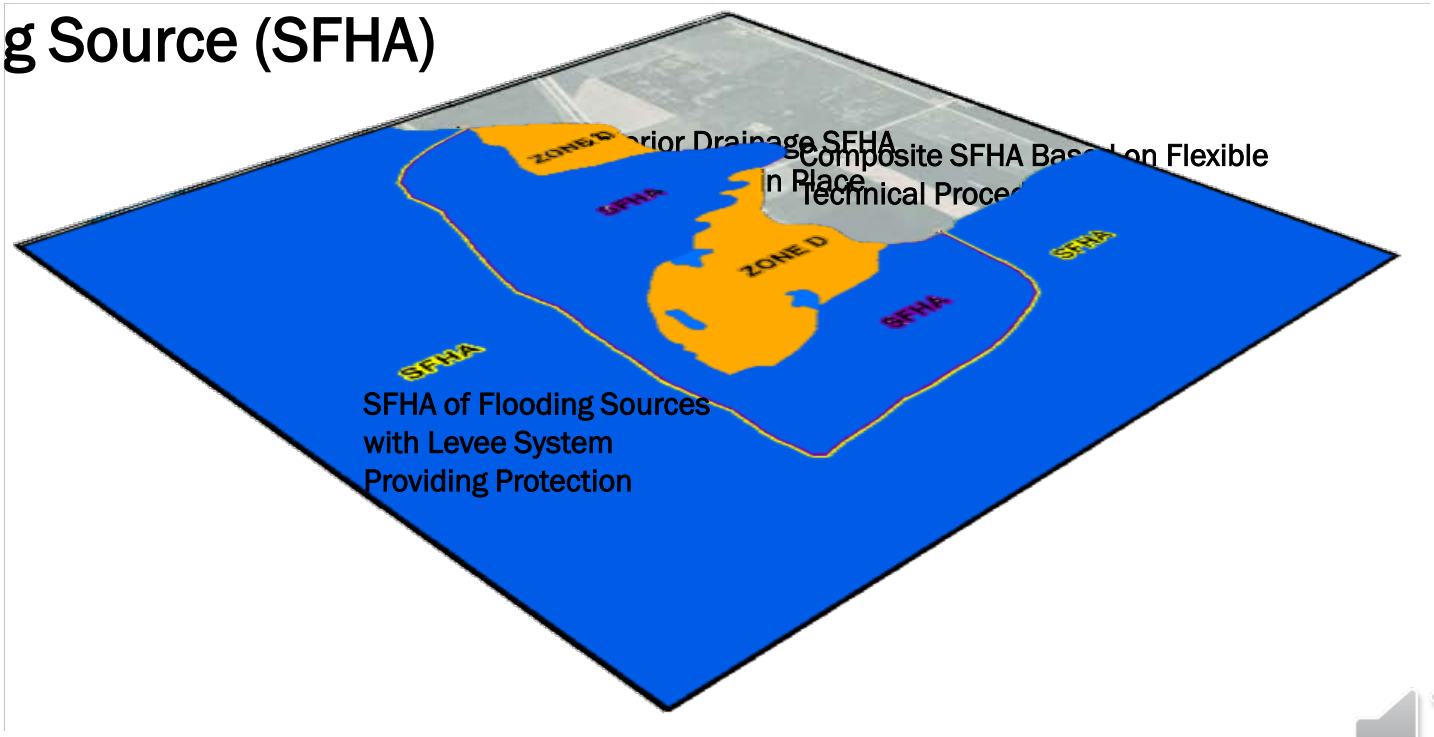
- The proposed methods for levee analysis and mapping generally do not impact the modeling and mapping of the flooding source on the flooding source side of the levee.
- For the Structural-Based Inundation Approach, the flow in the flooding source is <u>not</u> to be reduced by the amount that is computed as lost through a breach.
- The flow in the flooding source can be reduced by the amount of flow lost during overtopping of the levees.

Riverine Floodway Analysis

- Floodway will be analyzed assuming levee is providing protection if it is determined to be hydraulically independent ("with levee" model)
- Community always has the choice to move to landside toe of levee
- A levee reach that is hydraulically significant will not have floodways on landward side, unless the community requests an administrative floodway.
- A levee reach that is hydraulically significant will be considered to absorb ½ of the normal surcharge limit.

Four Main Layers of Mapping

1. Natural Valley (Zone D)
2. Interior Drainage (SFHA)
3. Landside Hazard (SFHA)
4. Flooding Source (SFHA)



Questions and Answers

A compilation of the questions and answers asked during the Online Forums will be available at:
http://www.fema.gov/plan/prevent/fhm/lv_lamp.shtm

FEMA