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October 16, 2008

Public Workshop for

Draft Interim Levee Design Criteria for Urban and Urbanizing Areas

Senate Bill 5

- Requires urban level protection by 2015, or "adequate progress" thereafter
- Urban level protection is 200-year level of protection using criteria approved or developed by DWR
- Applies to urban areas (10,000 people) and urbanizing areas (10,000 within 10 years) in Sacramento and San Joaquin watersheds
- Without urban level protection or "adequate progress," no further development permitted in 200-year floodplain
- "Adequate progress" limited to 2025 for areas protected by project levees

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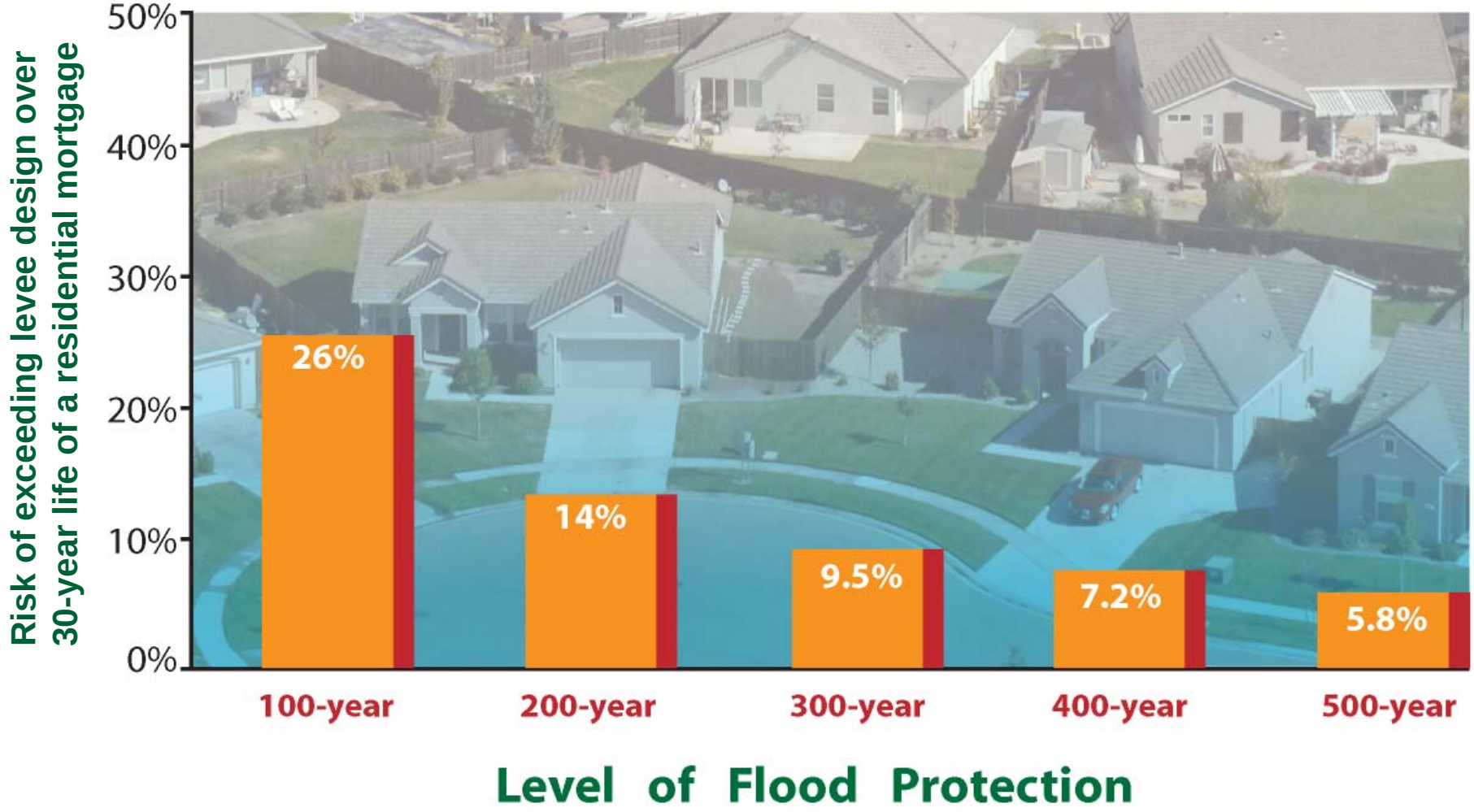
Risk of Exceeding Levee Design Over 30-year Life of a Residential Mortgage



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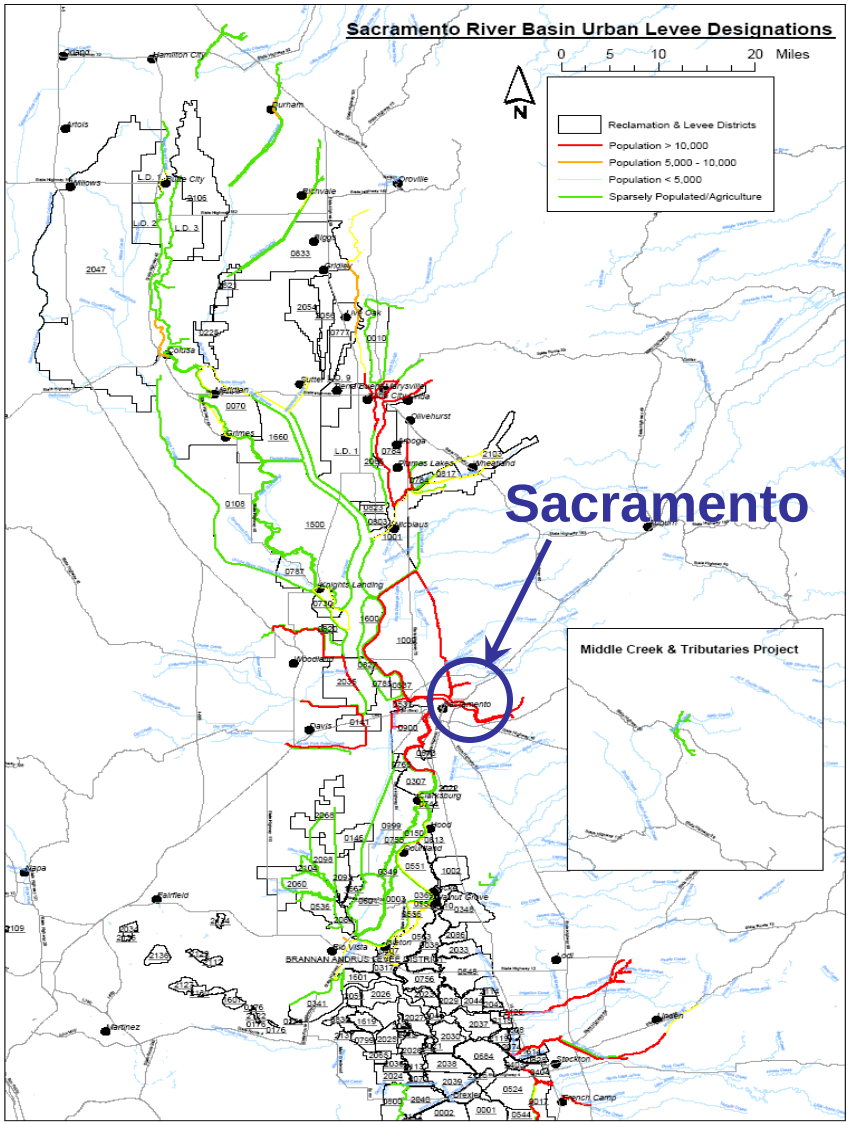
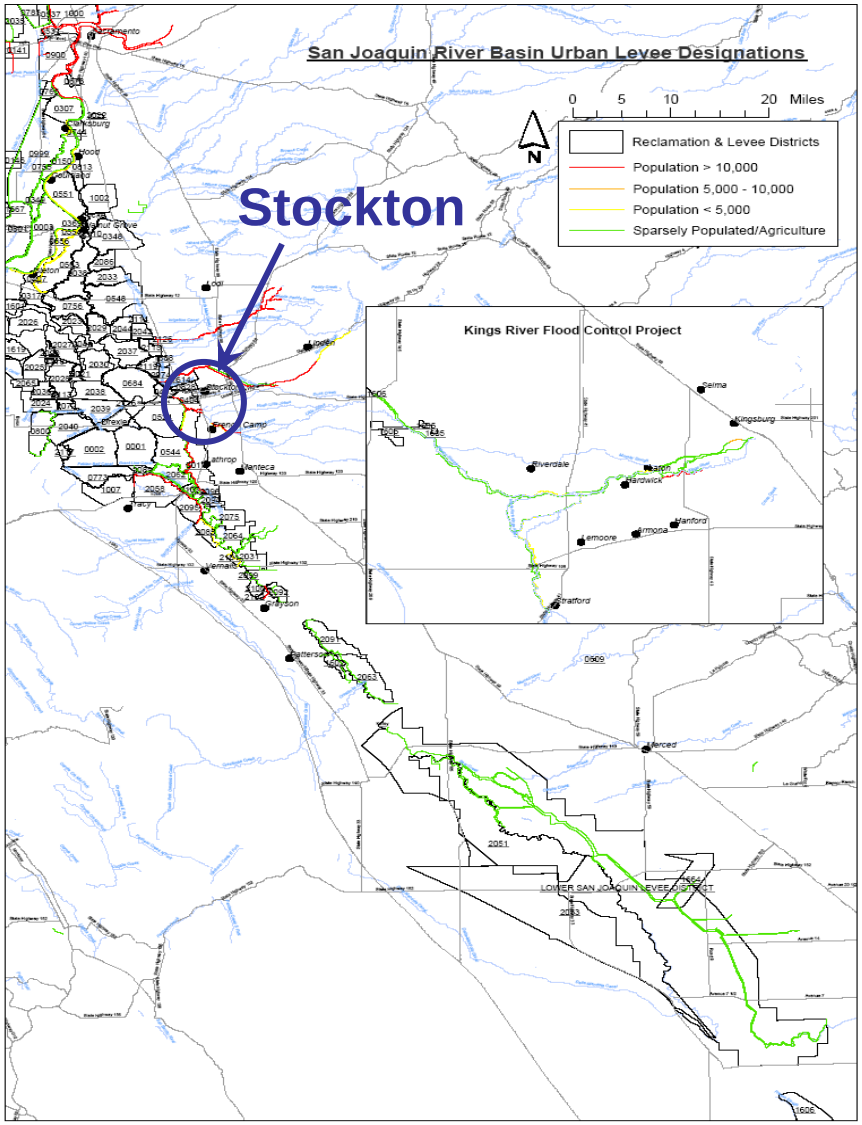
Sacramento Valley



San Joaquin Valley



Initial Interim Criteria

- December 7, 2007 version sent out for agency and public review
- Proposed two alternative approaches
  - Modified FEMA Approach
  - Modified Corps Approach
- Comments
  - Object to requiring 1-foot increase in WSE for climate change and sea level rise
  - Question requirement for top-of-levee WSE check for geotechnical adequacy
  - 1.5 factor of safety required for slope stability too high
  - Cannot interfere with FEMA certification for 100-year

FEMA Approach

- Deterministic
- Assumes conservative storm centering and other levees in system do not fail
- Best estimate of conservative 100-year water surface elevation for design
- At least 3 feet of freeboard required
- Slope stability and seepage analyses using best estimate 100-year WSE

Corps Approach

- Conditional Risk and Uncertainty (Hybrid)
- Use most severe storm centering
- Make an assumption regarding system levee performance (typically may assume levees do not fail and act like weirs when overtopped)
- Develop 50%, 90%, and 95% assurance WSE
- Use 90% assurance WSE for setting levee crown elevation and for geotechnical analyses if 3 feet of freeboard exists (above 50% assurance WSE)
- Use 95% assurance WSE for setting levee crown elevation and for geotechnical analyses if less than 3 feet of freeboard exists
- 2 feet of freeboard minimum

Standard Approaches

- Design and certification details can be found in:
  - EM 1110-2-1913
  - ETL 1110-2-569
  - ETL 1110-2-570
  - FEMA's MT-2 Form instructions for LOMRs
- Use steady state phreatic surface (exceptions allowed)
- FS = 1.4 minimum for landside slope stability
- Exit gradient = 0.5 maximum near levee toe
- Exit gradient = 0.8 maximum near berm toe
- Consider 10% in 50-years (475-year) earthquake for certification

Addressing Risk to Life

- To date, levees optimized for protecting property
- Highly reliable/predictable performance is the key for protecting life
- Levee designs -- from most ideal to least ideal for protecting life:
  - Sufficient mass to never fail or overtop (Dutch)
  - Flow relief capability (bypass or outflank)
  - Accommodate overtopping
  - Fail from overtopping
  - Fail when water is at top
  - Fail when water is slightly below the top
  - Fail when design stage exceeded
  - Fail below design stage

- Failure from overtopping is a similar concept to standard building designs

Draft Interim Criteria Key Principles

- Criteria apply to urban and urbanizing areas
- Either federal approach is acceptable with clarifications and modifications
- Levee designs should not rely on other levees to fail at the 200-year event
- Criteria should not vary between 100 and 200-year events (i.e., 200-year has half the risk of 100-year protection)
- Any levee failures should be from overtopping
- Climate change and sea level rise should be considered
- Seismic risk should be considered

Draft Interim Criteria Accomplishments

- Provides a choice of methodologies
- Provides criteria that result in 200-year protection having half the chance of being exceeded as 100-year protection
- Provides guidance on how to develop the design water surface
- Provides guidance on levee design to avoid failure before overtopping
- Provides guidance on how to address seismic risk

Clarifications

- Use Comp Study, updated where possible
- Assume other urban/urbanizing levees raised to 200-year + 3 feet
- Assume non-urban levees restored
- Assume other levees do not fail for the 200-year event or less
- Encourage up to 1-foot increase in design water surface until new hydrology is available (with climate change)

Modifications

- Require seepage and stability analysis with water at the hydraulic top of levee
- Lower factors of safety for hydraulic top of levee check allowed, except at toe of berm
  - FS = 1.3 minimum for landside slope stability
  - Exit gradient = 0.6 maximum near levee toe
  - Exit gradient = 0.8 maximum near berm toe
- For light soils (<112 pcf) use Seepage FS
  - FS = 1.6 minimum for design water surface
  - FS = 1.3 minimum for hydraulic top of levee

Modifications (continued)

- Use 90% assurance WSE (not 95%) with Modified Corps Approach
- Evaluate 200-year seismic stability
  - Select more robust remediation alternatives
  - Evaluate seismic damage for 200-year project
  - Develop post-EQ response plan with quick restoration of 10-year protection
  - Remediate where damage exceeds response capability
  - Non-intermittent levees should maintain 10-year protection during and after EQ

Post-Seismic Risk

$$P = 1 - (1 - 1/L)^n$$

Where: P = Probability of exceeding design
L = Level of Protection
n = years

P = 0.22 for 200-year protection over a 50-year period (i.e., 22% chance of exceeding design)

P = 0.19 -- 0.27 for 10-year protection over a 2 - 3-year period (i.e., 19 -- 27% chance of exceeding design)

Current Status

- Public comments originally requested by September 30
- Comment period extended 30 days by request
- Comments due October 30

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Three Ways to Provide Comments

- Email to floodsafe@water.ca.gov
- Mail to 3310 El Camino Avenue, Sacramento, CA 95821, Attention: Flood Project Repairs & Improvements-Early Implementation Projects
- Leave written comments at this workshop.

Other Criteria to Consider Adding

- Levee Vegetation
- Pipe Invert Elevation/Remediation
- One Method for One Flood Protection System
- Adjacent Urban Areas
- Seismic Analysis Procedures
- Data Requirements
- Performance Based Investigations
- Sea Level Rise
- Erosion
- Procedure for 200-year Certification

Questions / Comments?

Thank You