Relating Future-Conditions Coastal Flood Hazards to Existing-Conditions FEMA Maps

ESA

June 20, 2018

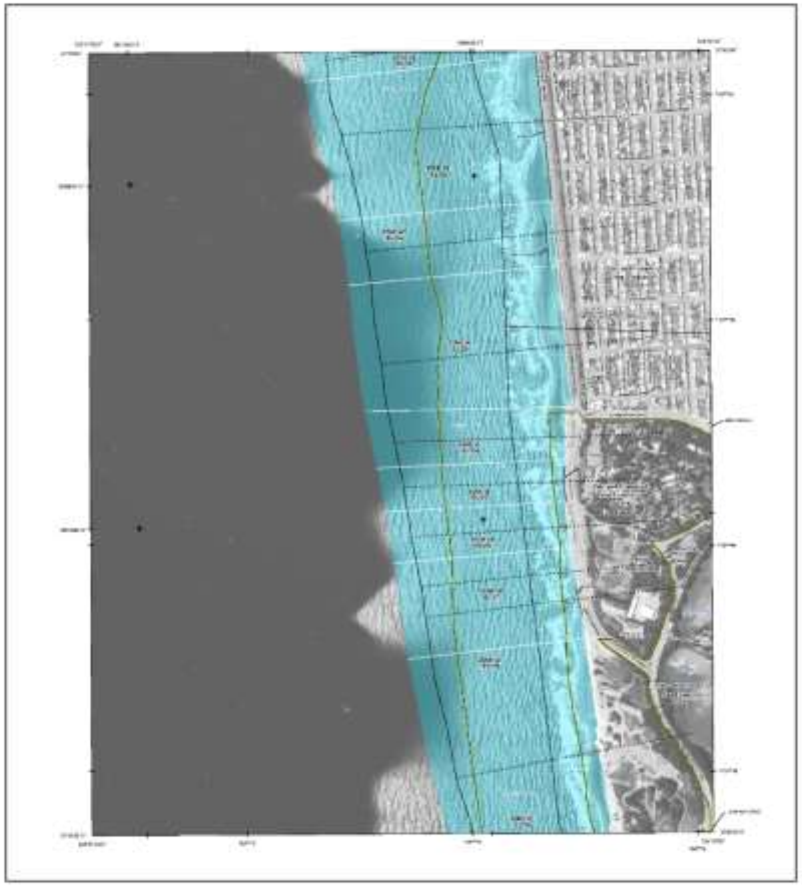
Alex Trahan, P.E.

Outline

- The FEMA Maps of Today
- Methods from the Technical Methods Manual
- Terminology
- Estimating Future V-Zones
  - Elevations (vertical)
  - Extents (horizontal)
- Conclusions

The FEMA Maps of Today

- Base Flood Elevation
- No future conditions
- Wise to consider SLR…
  - Improved Safety
  - Adaptation Planning
- Limited tools (-ish)



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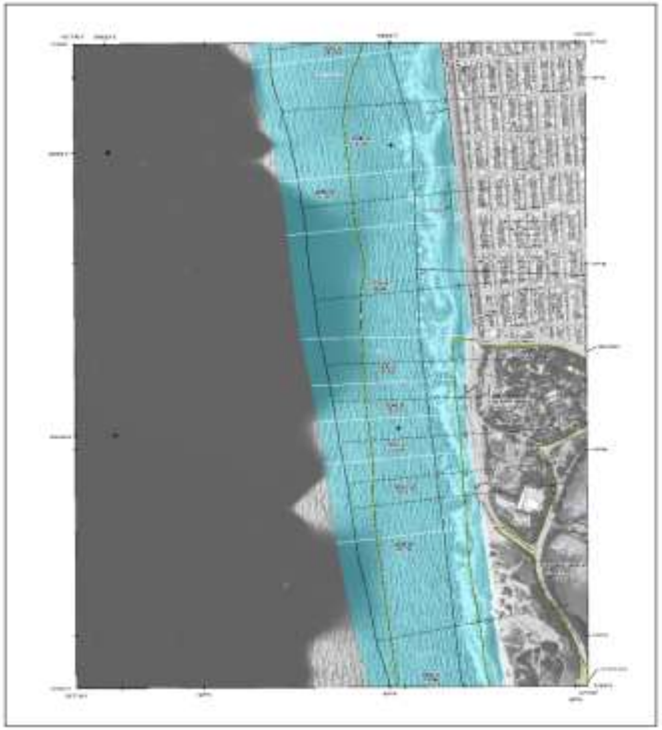
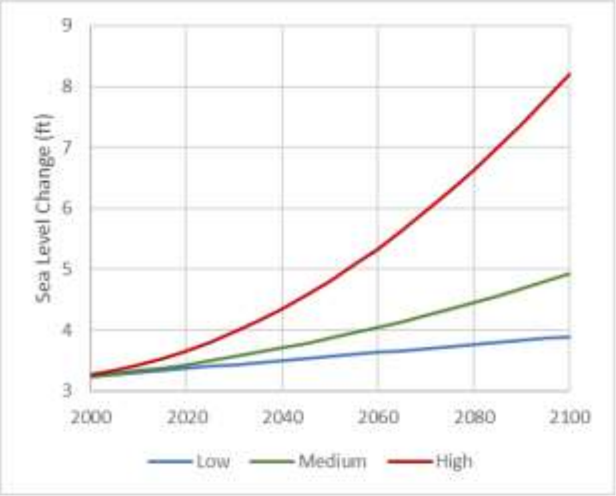
The FEMA Maps of Today, with SLR





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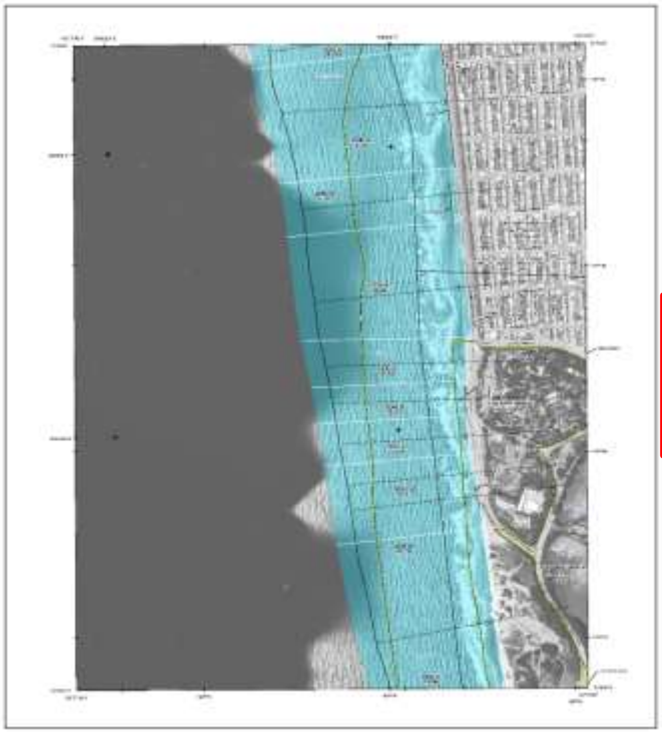

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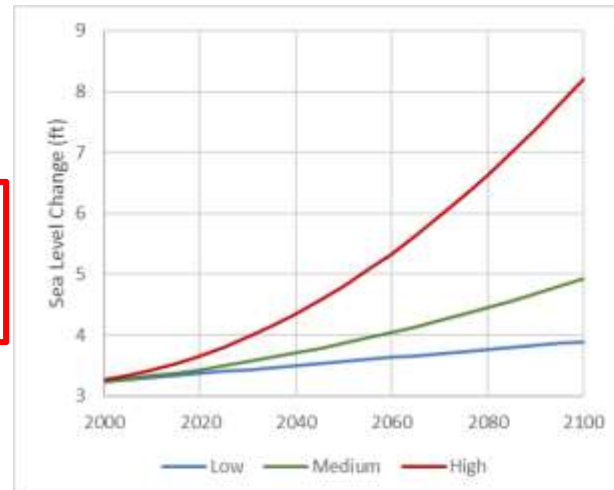

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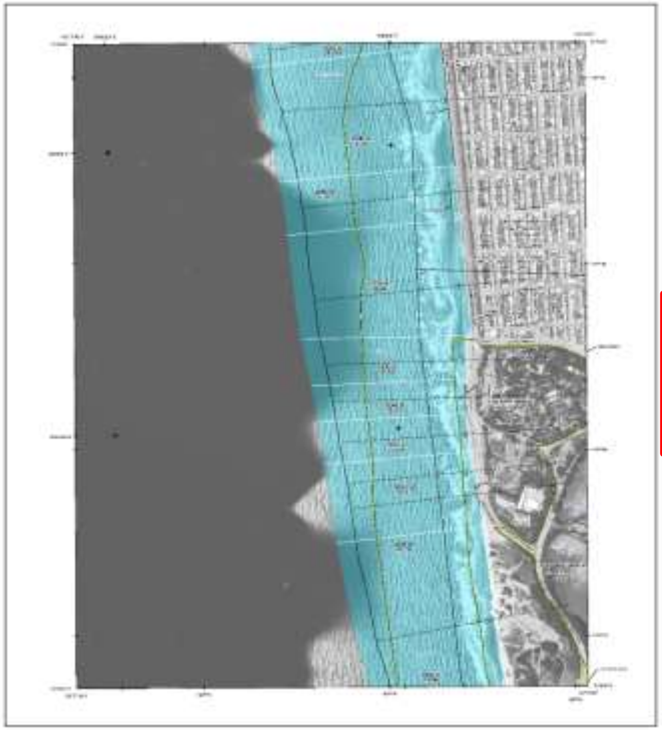

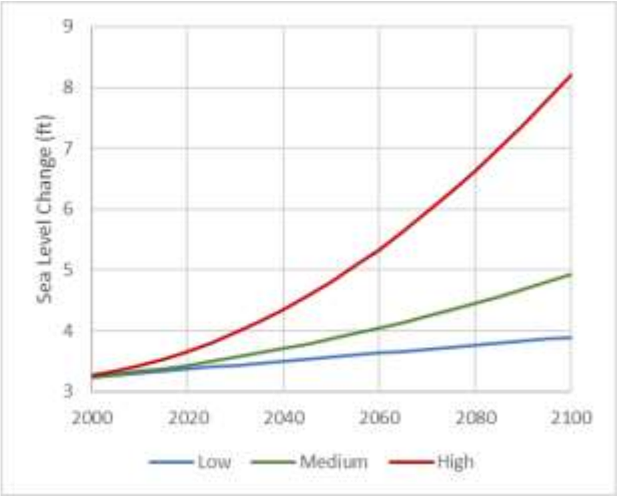

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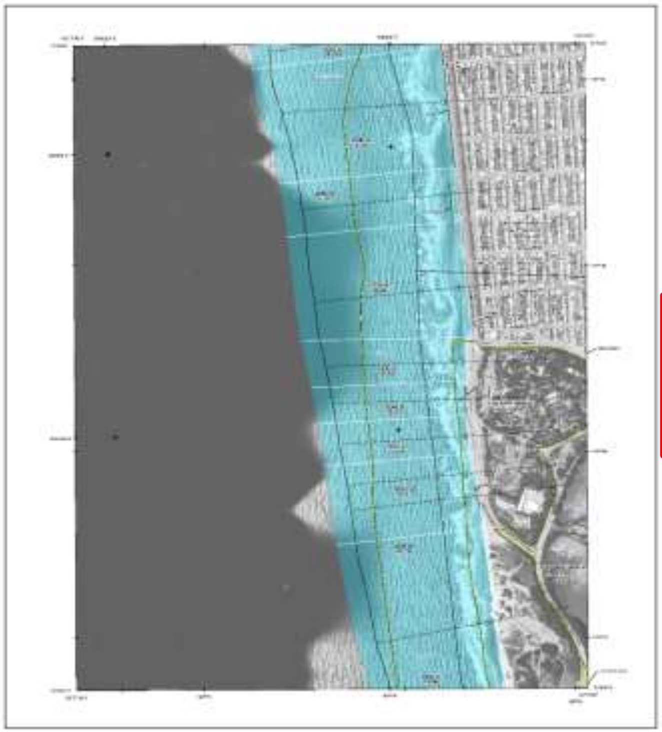

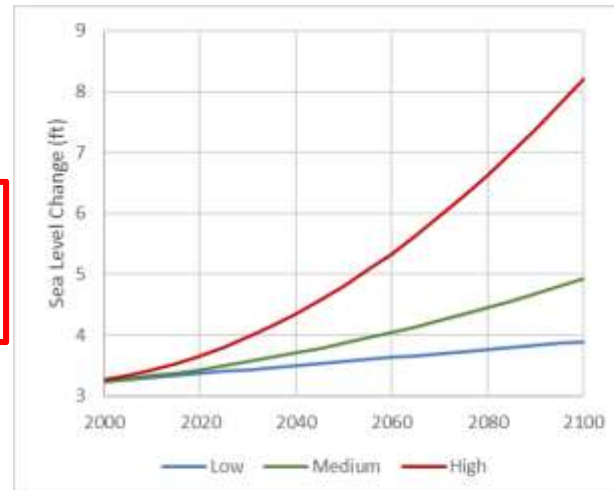

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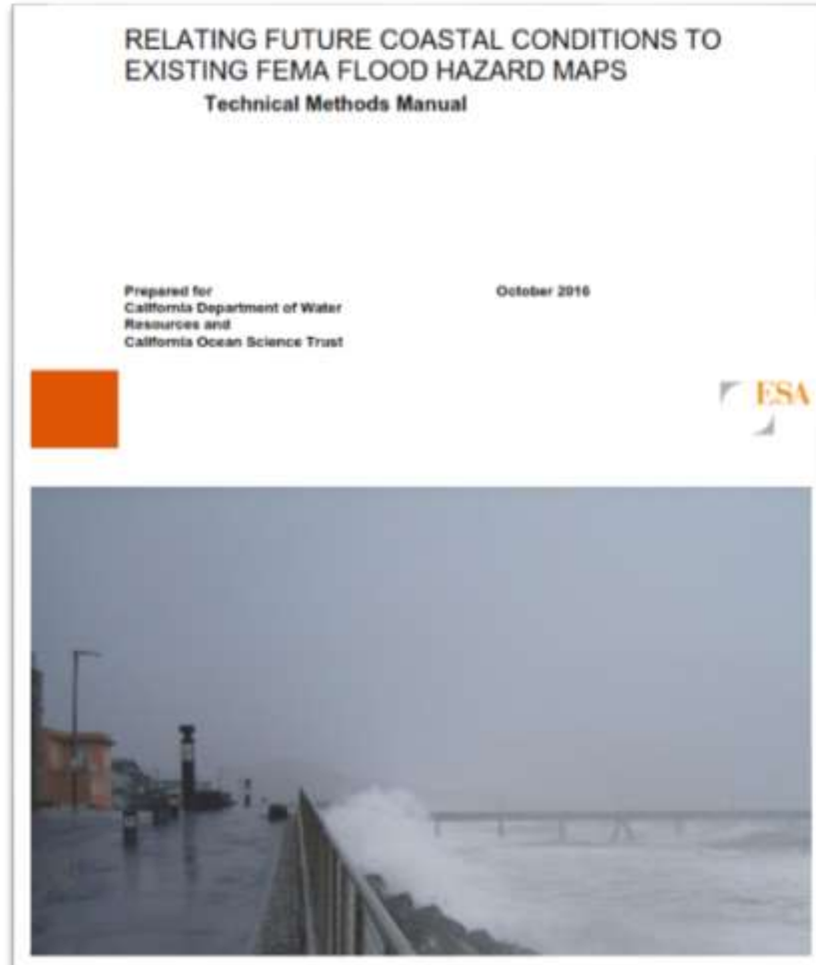
Relating Future Coastal Conditions to Existing FEMA Flood Hazard Maps

Technical Methods Manual by…

- ESA
- Scripps Inst. of Oceanography
- NOAA
- CA Dept. of Water Resources
- CA Ocean Science Trust


RELATING FUTURE COASTAL CONDITIONS TO EXISTING FEMA FLOOD HAZARD MAPS

Technical Methods Manual

Prepared for
California Department of Water Resources and
California Ocean Science Trust

October 2016

Methods from the TMM

- Level 1 – Compare to Local/Regional Studies

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- Level 1 – Compare to Local/Regional Studies
- Level 2 – Adjust V-Zones

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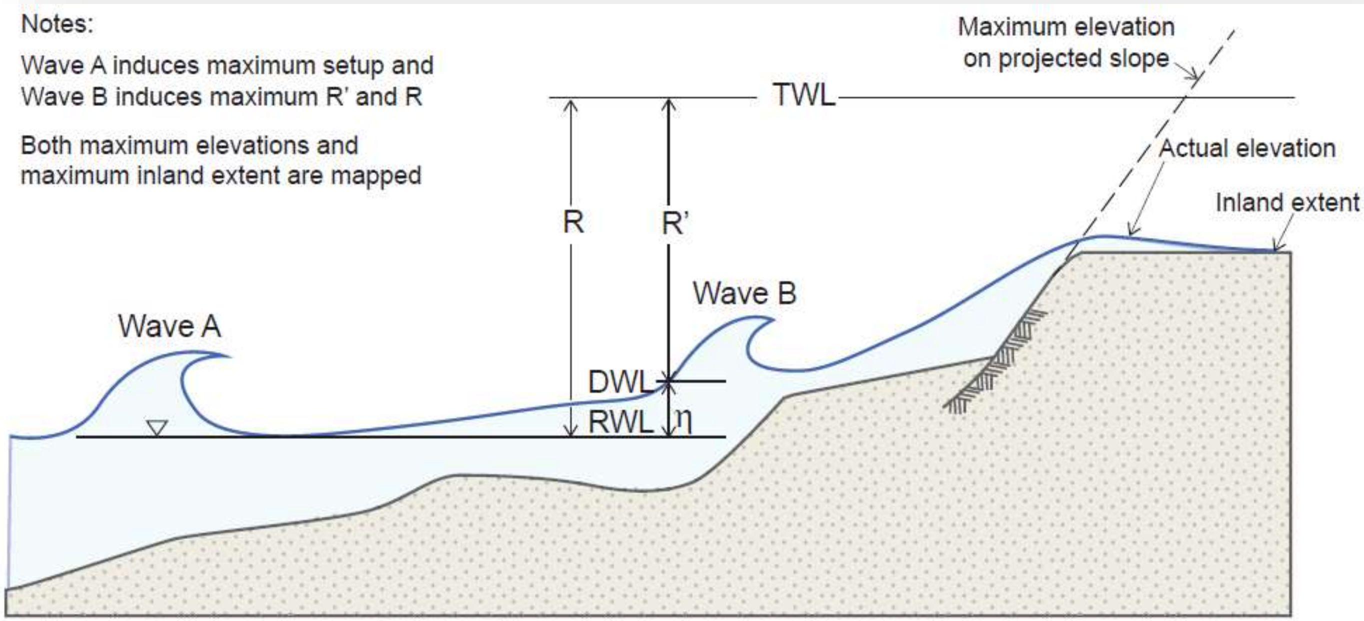
Terminology



TWL = Total water level = RWL + R

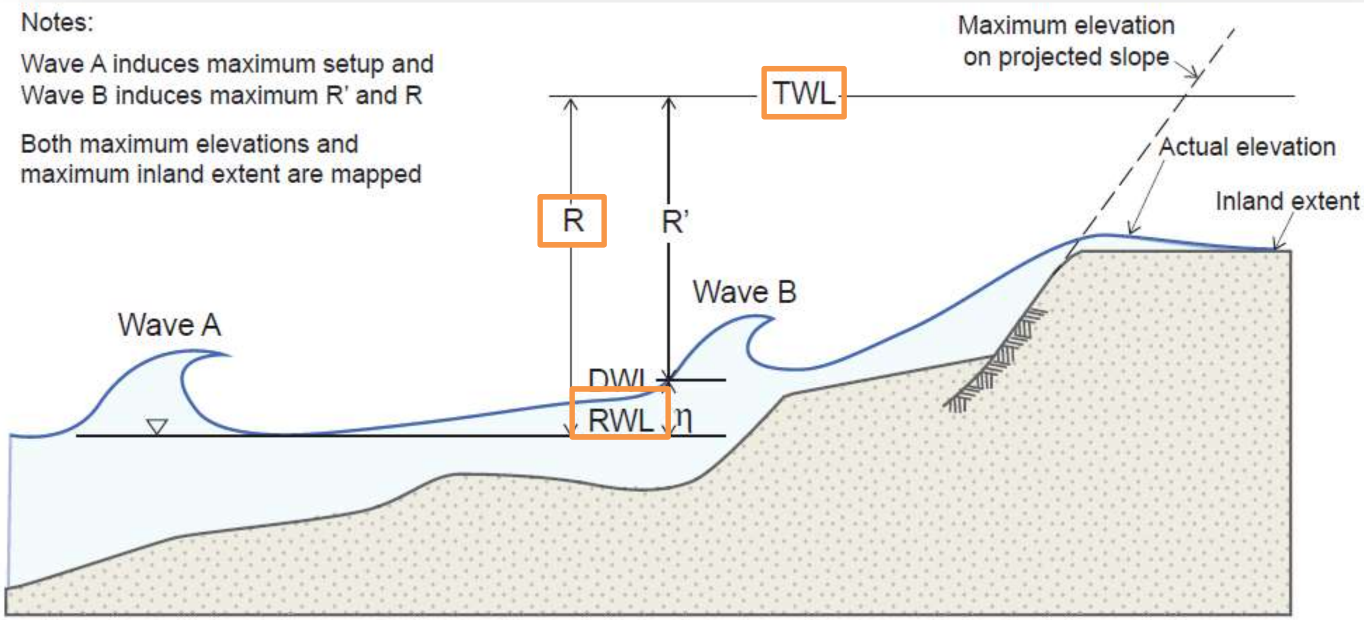
RWL = Reference water level ~ still water level

DWL = Dynamic water level, typicallly 2% exceedence ~ mean setup (aka "static") + 2x standard deviation

η = 2% setup at RWL shoreline, wave A

R = runup, including setup, above RWL, wave B typically on projected slope above back shore

Terminology



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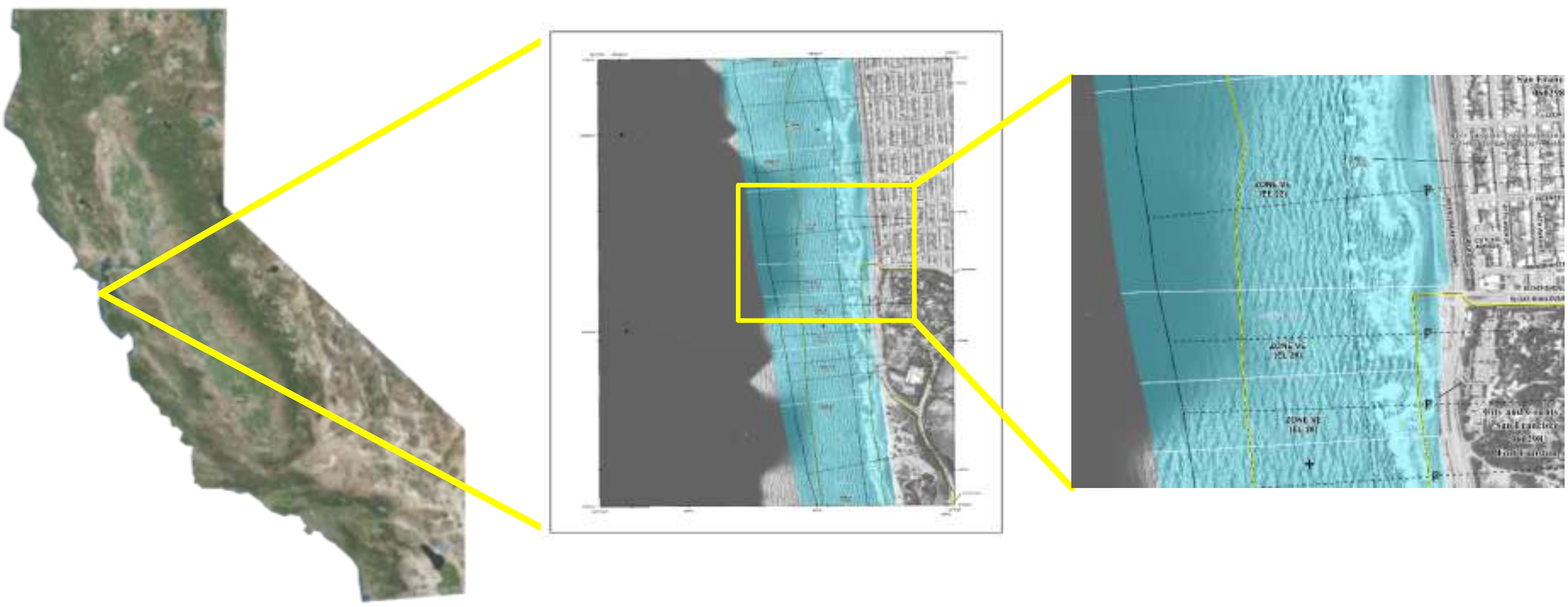
Level 2 – Adjust V-Zones

Method 2a – Add SLR to FEMA end-product



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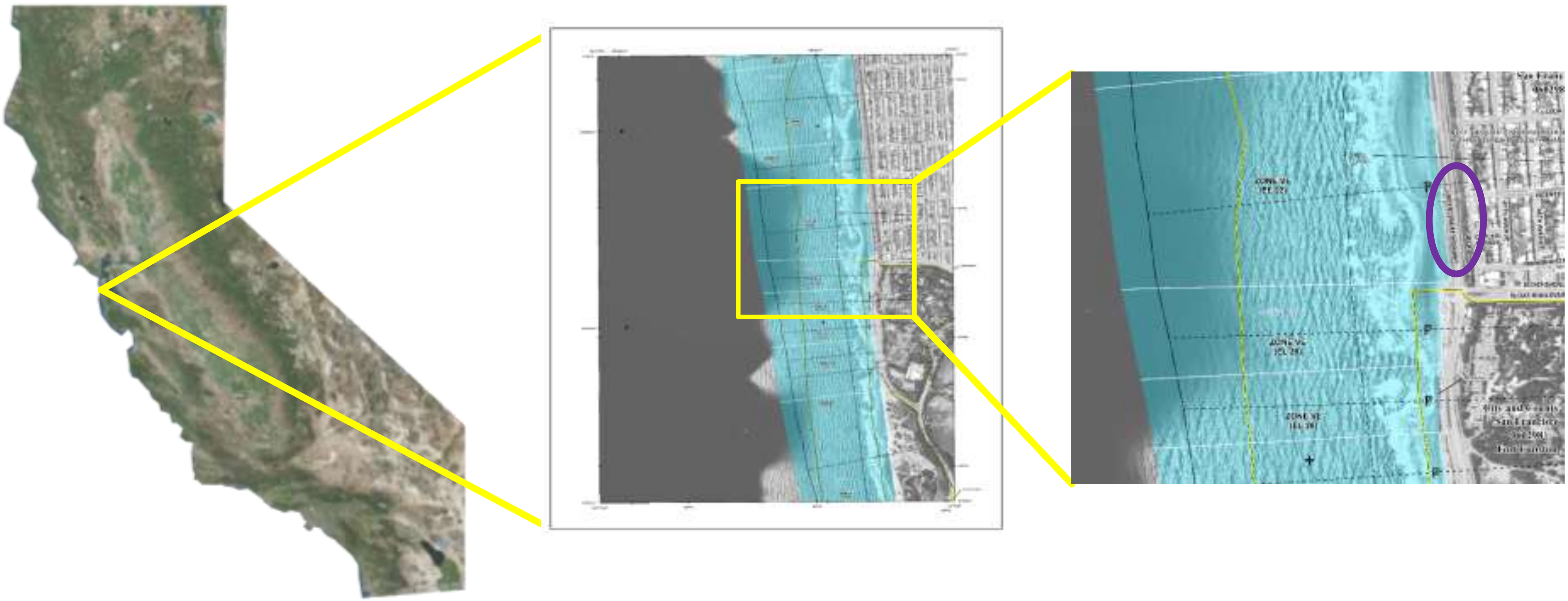

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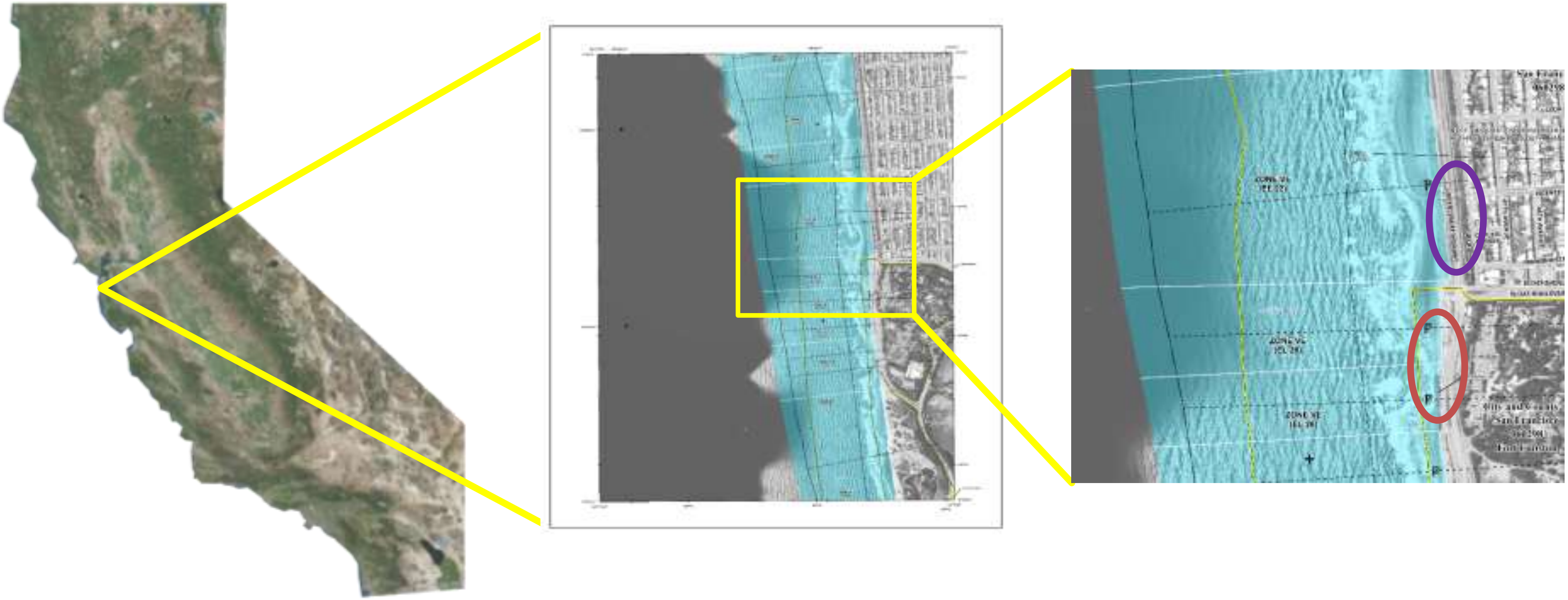

Method 2a – Add SLR

Vertical

$$TWL_{future} = TWL_{current} + SLR \ * F(Morph)$$

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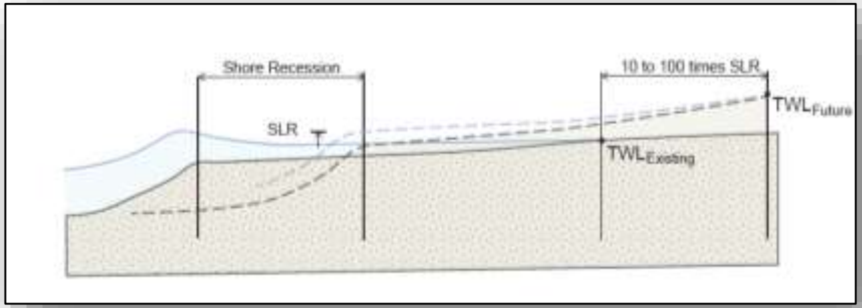


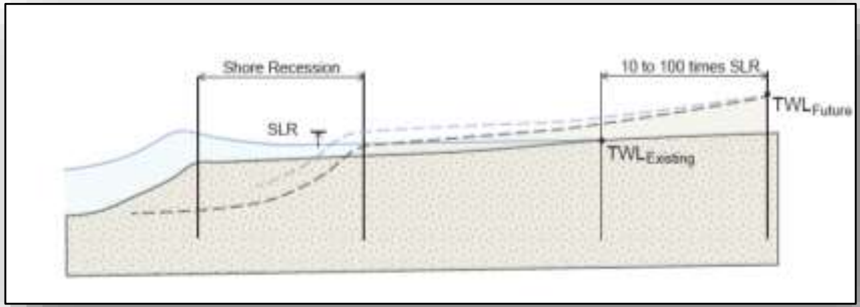
Erodible and free to transgress

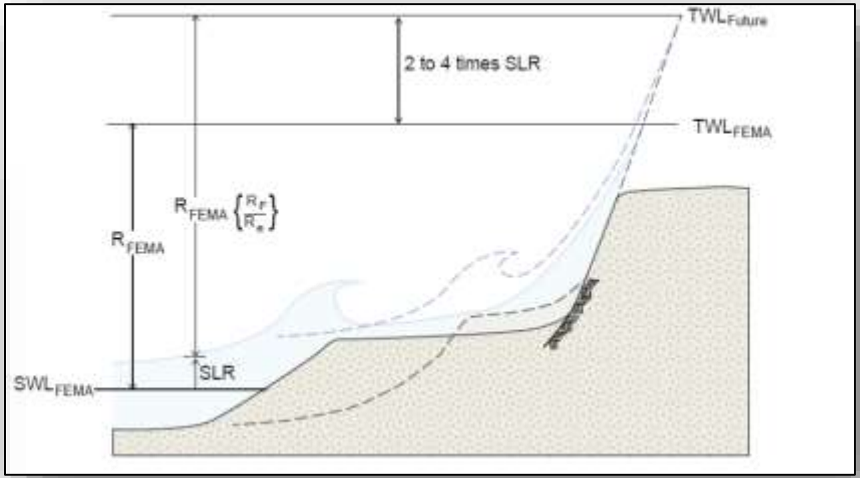
F(Morph) = 1.0

Method 2a – Add SLR

Vertical

$$TWL_{future} = TWL_{current} + SLR \; * F(Morph)$$





Erodible and free to transgress

F(Morph) = 1.0

Armored and rigid

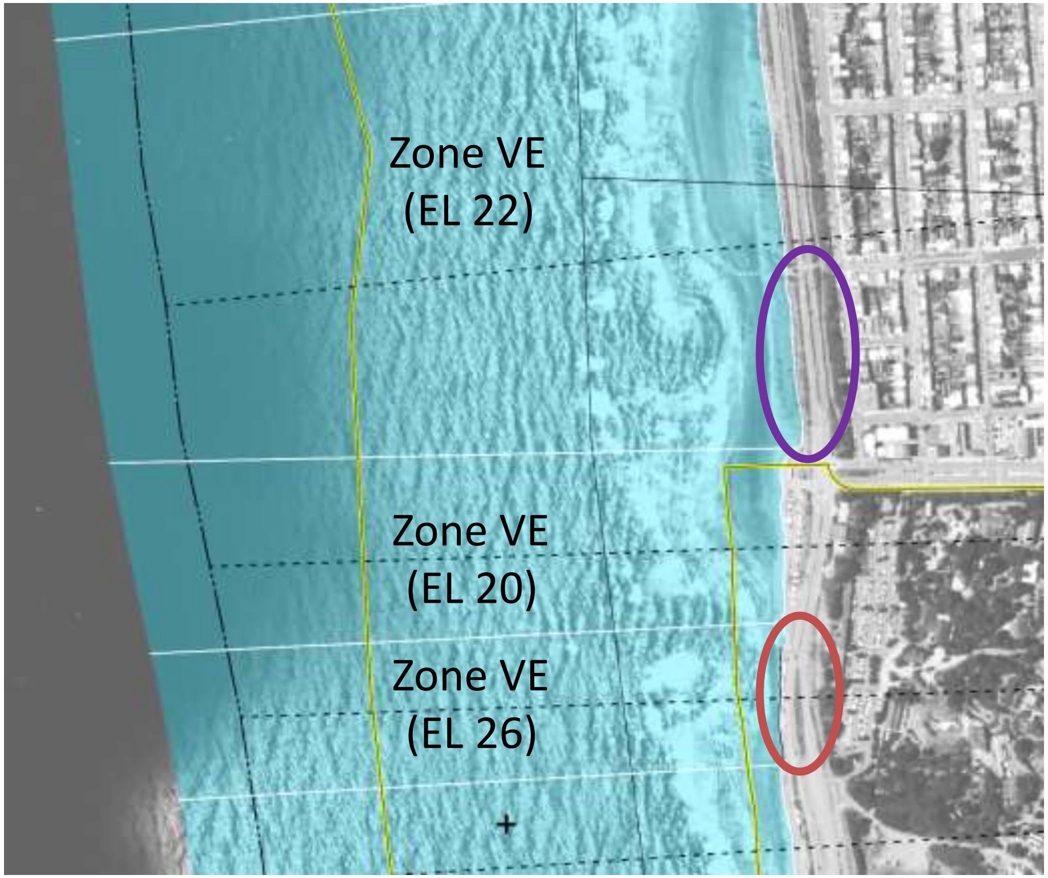
F(Morph) = 1.0 to 4.0

Method 2a – Add SLR

Vertical

$$TWL_f = TWL_c + SLR * F(Morph)$$

SLR = 3 ft



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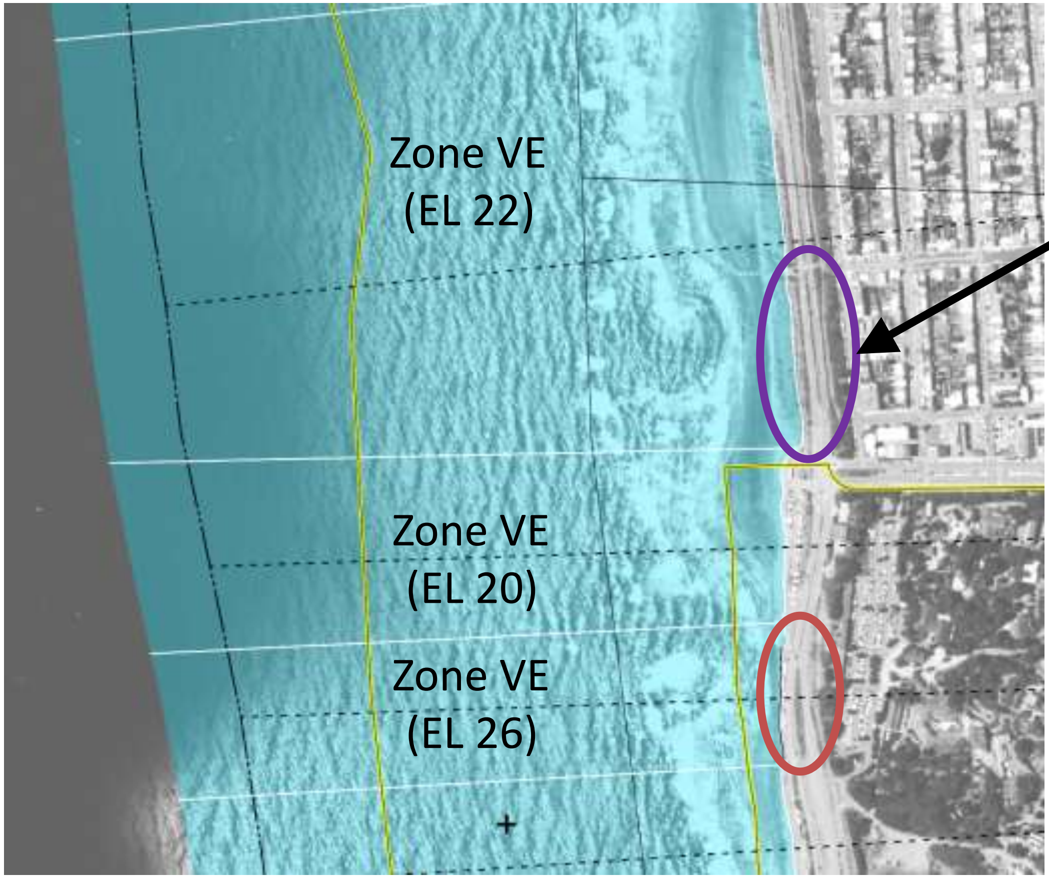


F(Morph) = 1.0

$TWL_c = 22.0\ ft$

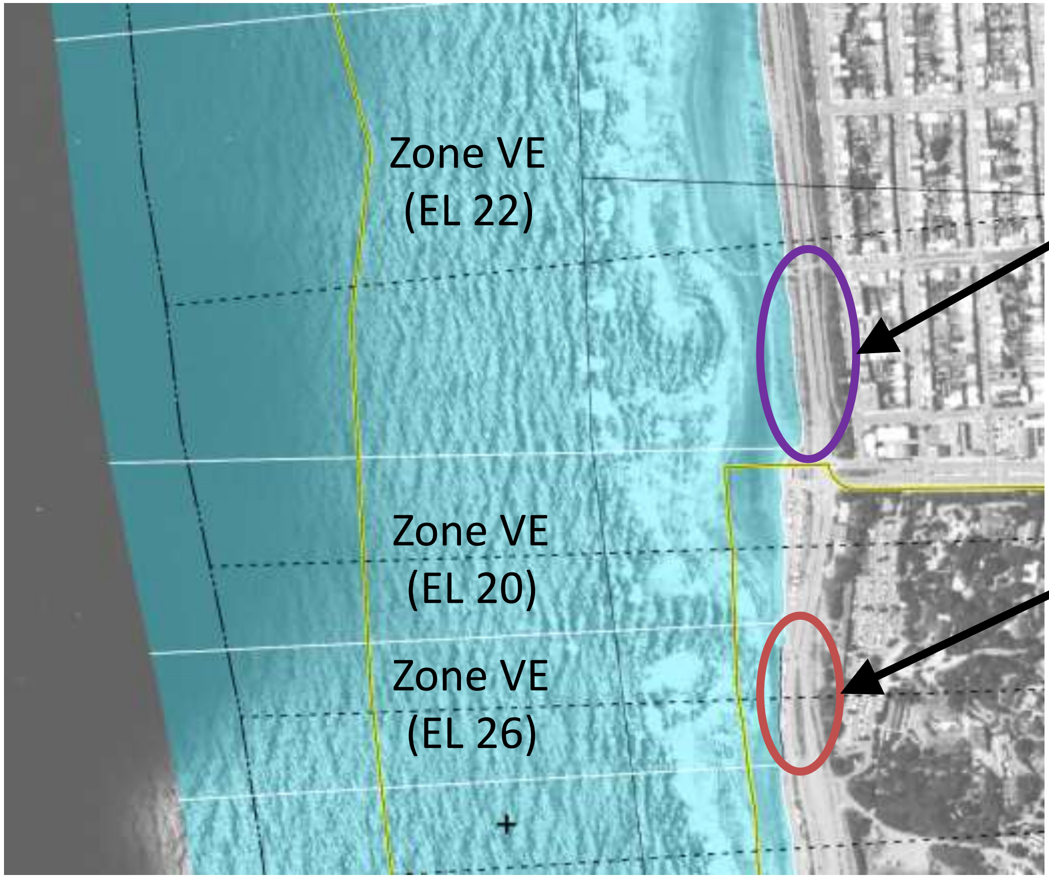
$TWL_f = 22 + 3\ * 1 = 25.0\ ft$

Method 2a – Add SLR

Vertical

$$TWL_f = TWL_c + SLR * F(Morph)$$

SLR = 3 ft



F(Morph) = 1.0

$TWL_c = 22.0\ ft$

$TWL_f = 22 + 3 \ * 1 = 25.0\ ft$

F(Morph) = 2.0

$TWL_c = 26.0\ ft$

$TWL_f = 26 + 3 \ * 2 = 32.0\ ft$

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Method 2a – Add SLR

Horizontal

Erodible and free to transgress

Shore recession based on slope

Armored and rigid

Bore propagation based on freeboard

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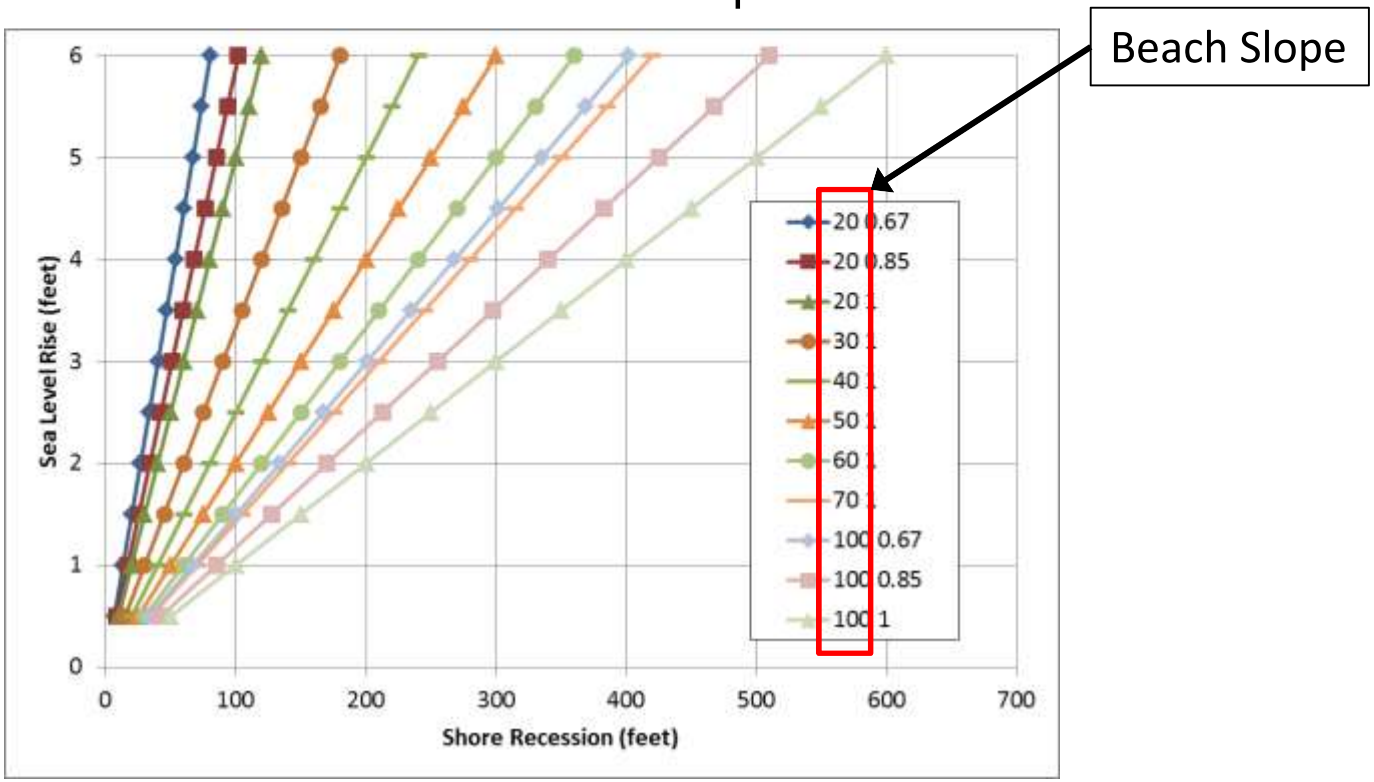
Method 2a – Add SLR

Horizontal

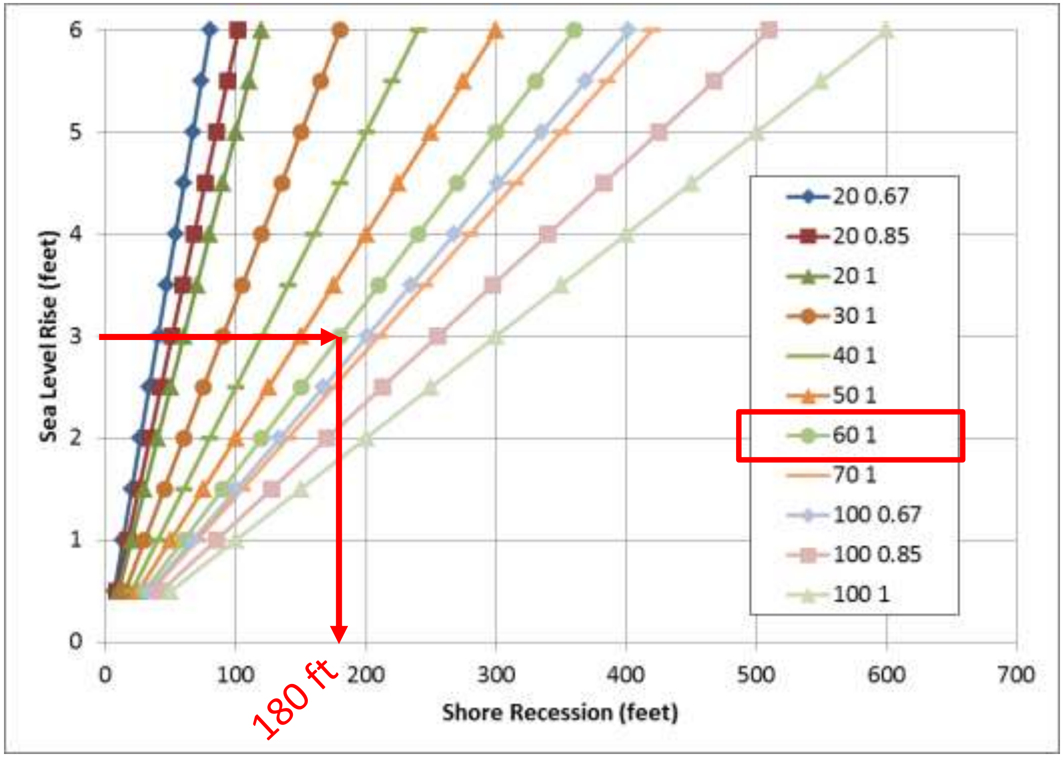
Shore recession based on slope

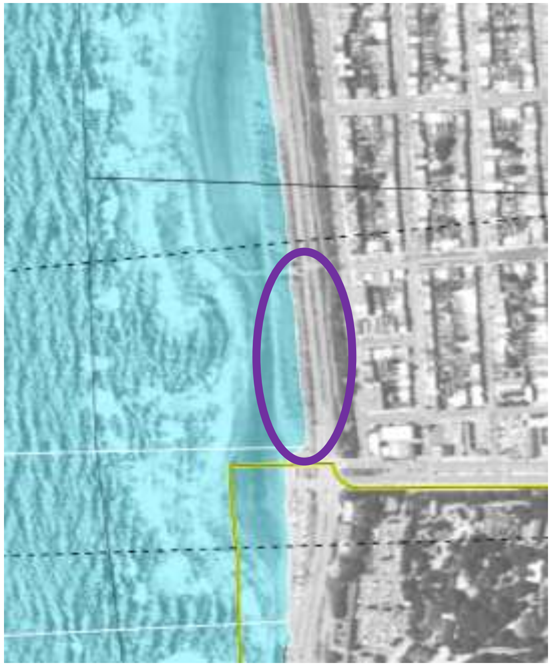


Method 2a – Add SLR

Horizontal

Shore recession based on slope





Beach Slope 1V : 60H

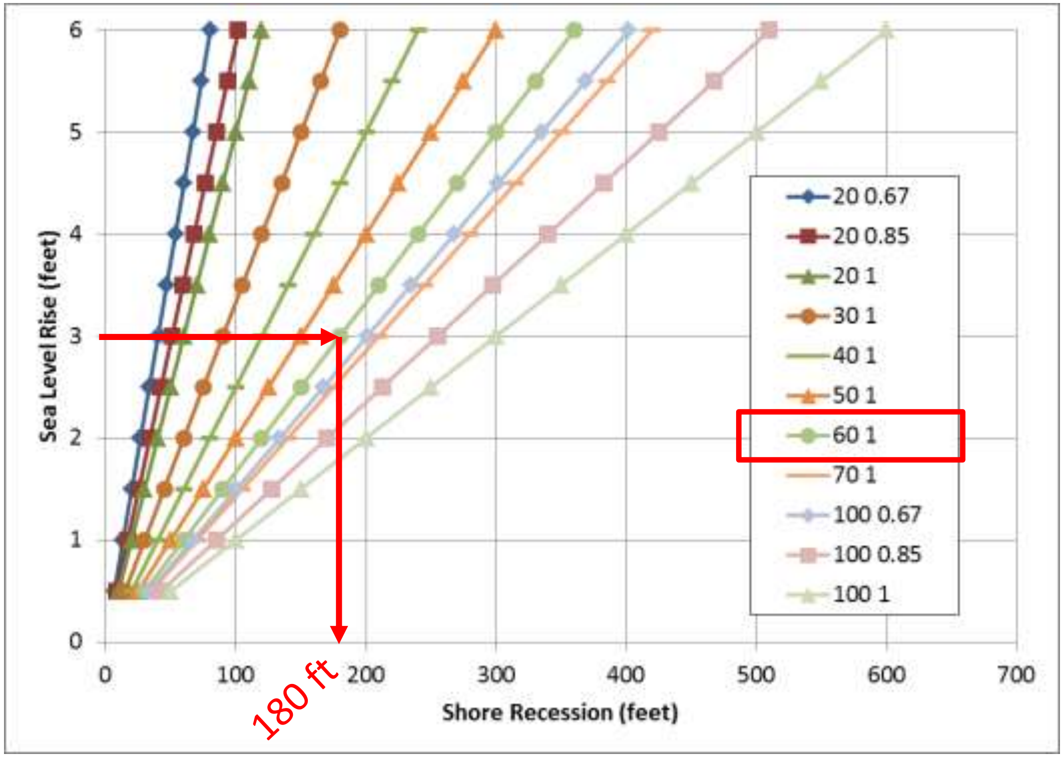
SLR = 3 ft

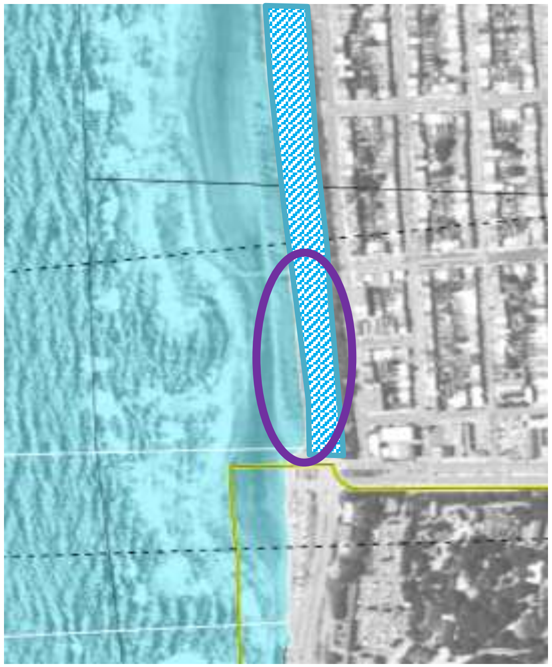
Transgression = 180 ft

Method 2a – Add SLR

Horizontal

Shore recession based on slope





Beach Slope 1V : 60H

SLR = 3 ft

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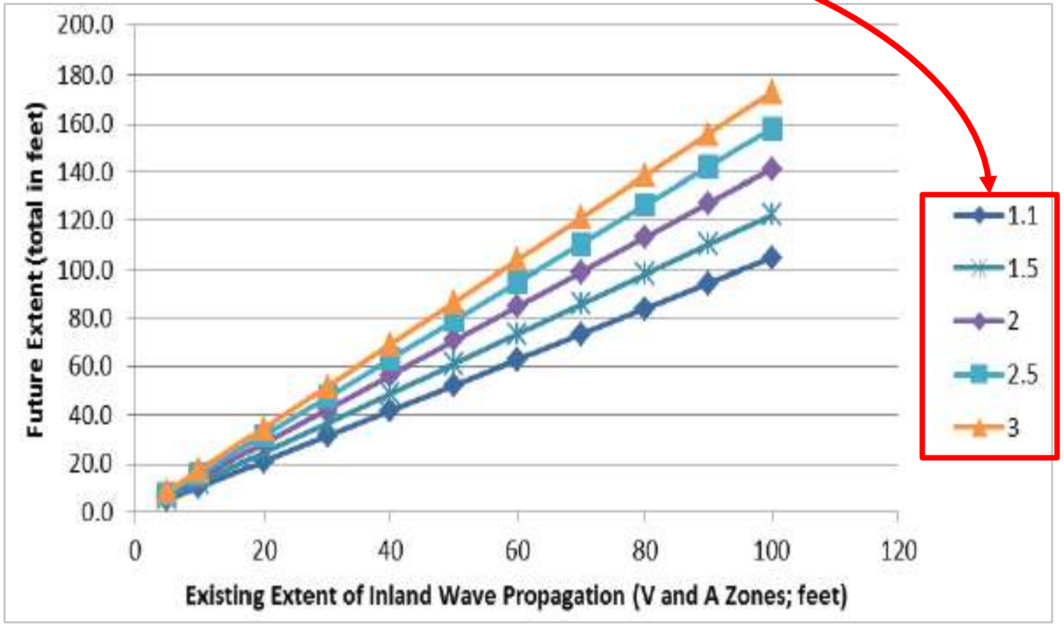
Method 2a – Add SLR

Horizontal

Bore propagation based on freeboard

$$Y_{future} = \left(FB_{future}/FB_{current}\right)^{0.5} \cdot Y_{current}$$



Y = Inland Extent **FB** = Negative Freeboard

Method 2a – Add SLR

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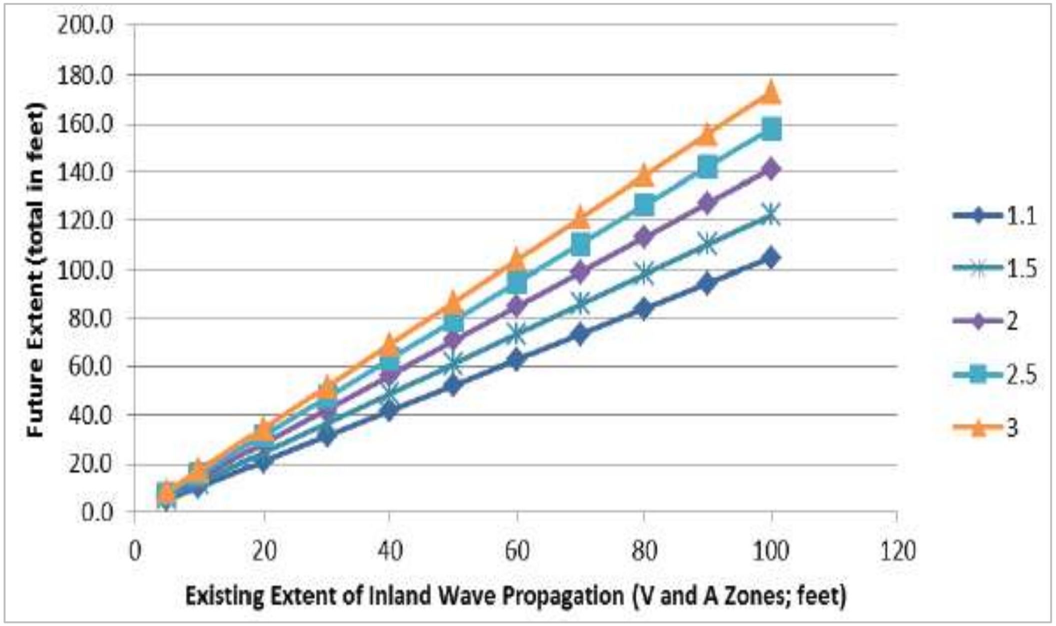

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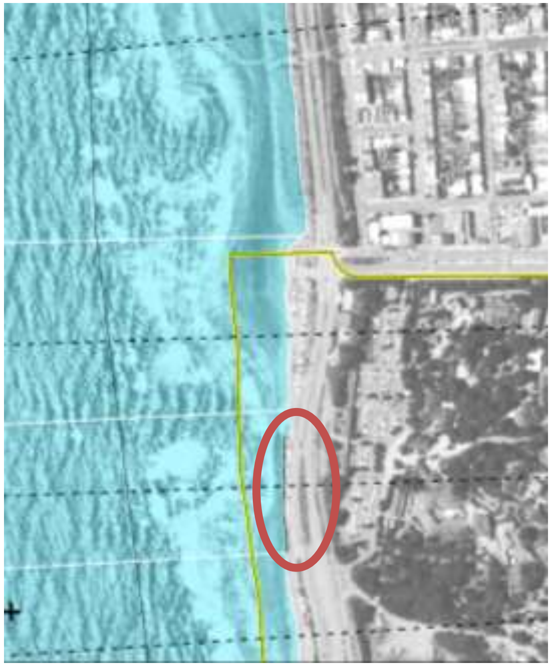

Structure Crest = 25 ft

Current Inland Extent = 20 ft

Current TWL → FB = 26 ft → 1 ft

Future TWL → FB = 32 ft → 7 ft

Future Inland Extent = 53 ft

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Method 2a – Add SLR

Horizontal

Bore propagation based on freeboard

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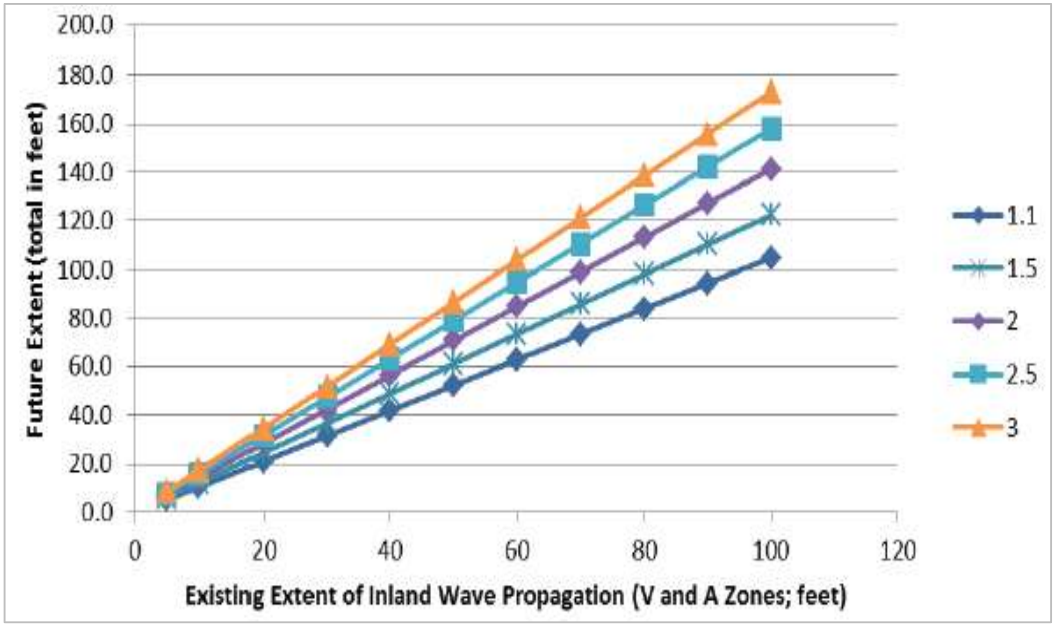

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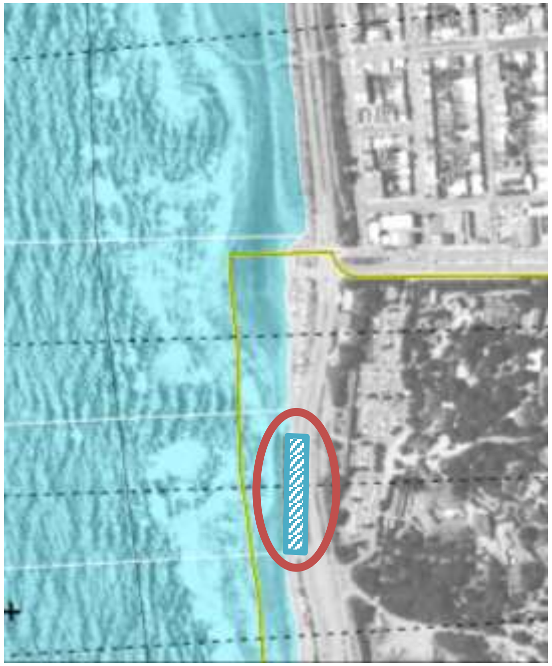

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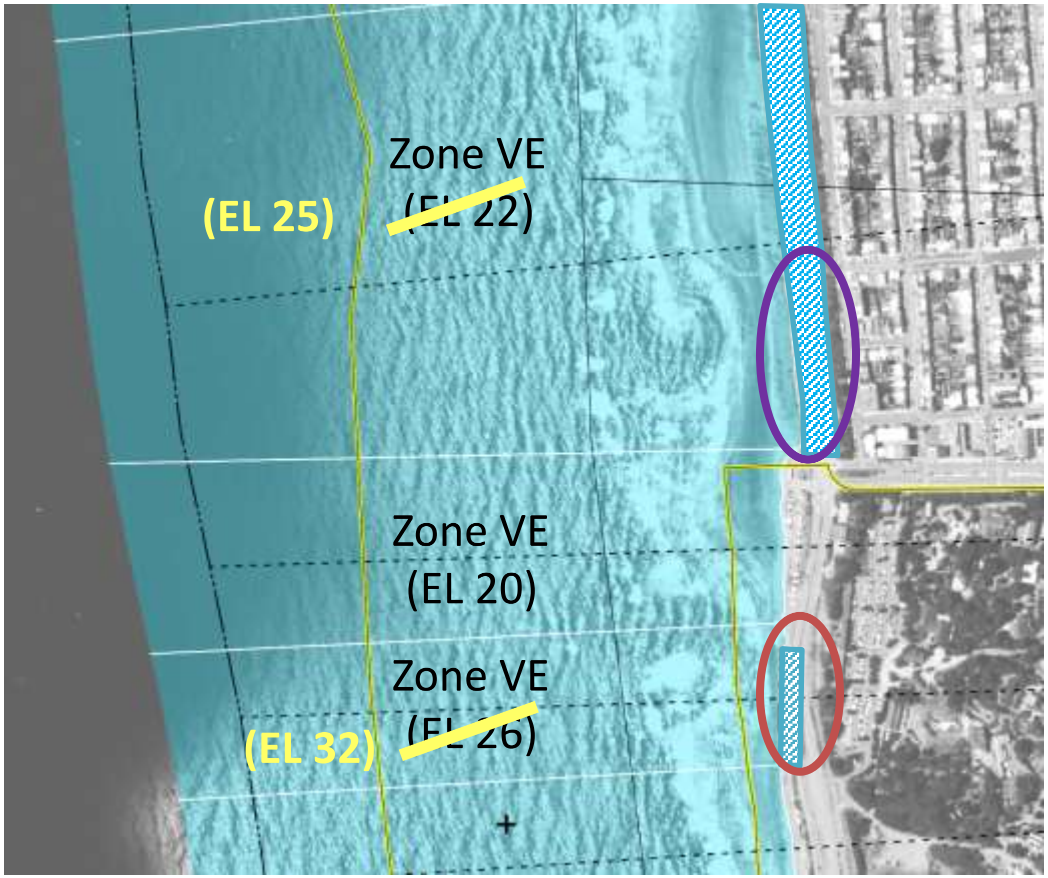

Other Methods from the TMM

- Level 1 – Compare to Local/Regional Studies
  - Check a local study, if you have one
- Level 2 – Adjust V-Zones
  - (2a) Add Sea Level Rise
    - Revise from BFE
  - (2b) Prorate Components
    - Revise components (RWL and Runup)
- Level 3 – Account for Geomorphic Change
  - In addition, account for changing erosion rates/patterns
- Level 4 – Repeat FEMA Analysis with Future Conditions Modeling
  - Do the big analysis

Conclusions

- FEMA maps can be a **useful tool for future conditions**
- We **cannot just add** SLR to FEMA maps
- **Backshore morphology** is a driver
- For background, details, and guidance, **read the manual**

Acknowledgements

Bob Battalio, PE
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Scripps Inst. of Oceanography

Louis White, PE
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Battalio, R., P. Bromirski, D. Cayan, L. White. 2016. *Relating Future Coastal Hazards to Existing FEMA Flood Hazard Maps: Technical Methods Manual*. Prepared for CA Dept. of Water Resources and CA Ocean Science Trust. Prepared by Env. Sci. Associates.

Questions?

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