

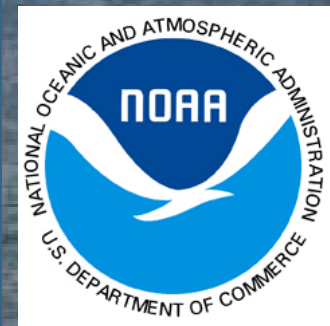
# SEA-LEVEL RISE COASTAL INUNDATION RISK AND VULNERABILITY ASSESSMENT FOR HONOLULU, HAWAII.

**Dolan Eversole-University of Hawaii Sea Grant College Program**

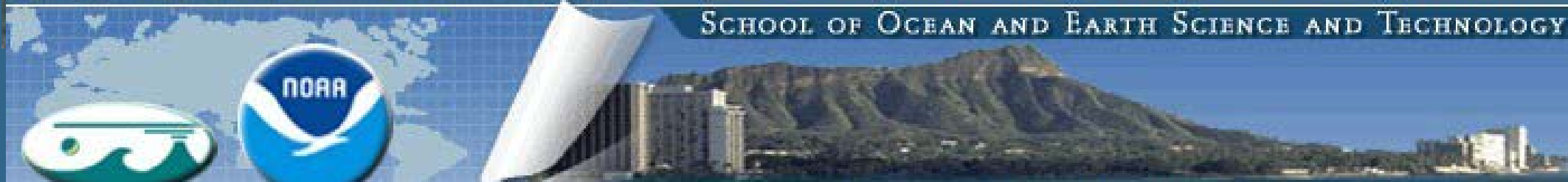
**Cheung, K. F., University of Hawaii, USA**

**Fletcher, C., University of Hawaii, USA**

**Kim, K., University of Hawaii, USA**



UNIVERSITY OF HAWAI'I SEA GRANT COLLEGE PROGRAM  
SCHOOL OF OCEAN AND EARTH SCIENCE AND TECHNOLOGY





# Honolulu SLR Inundation Study

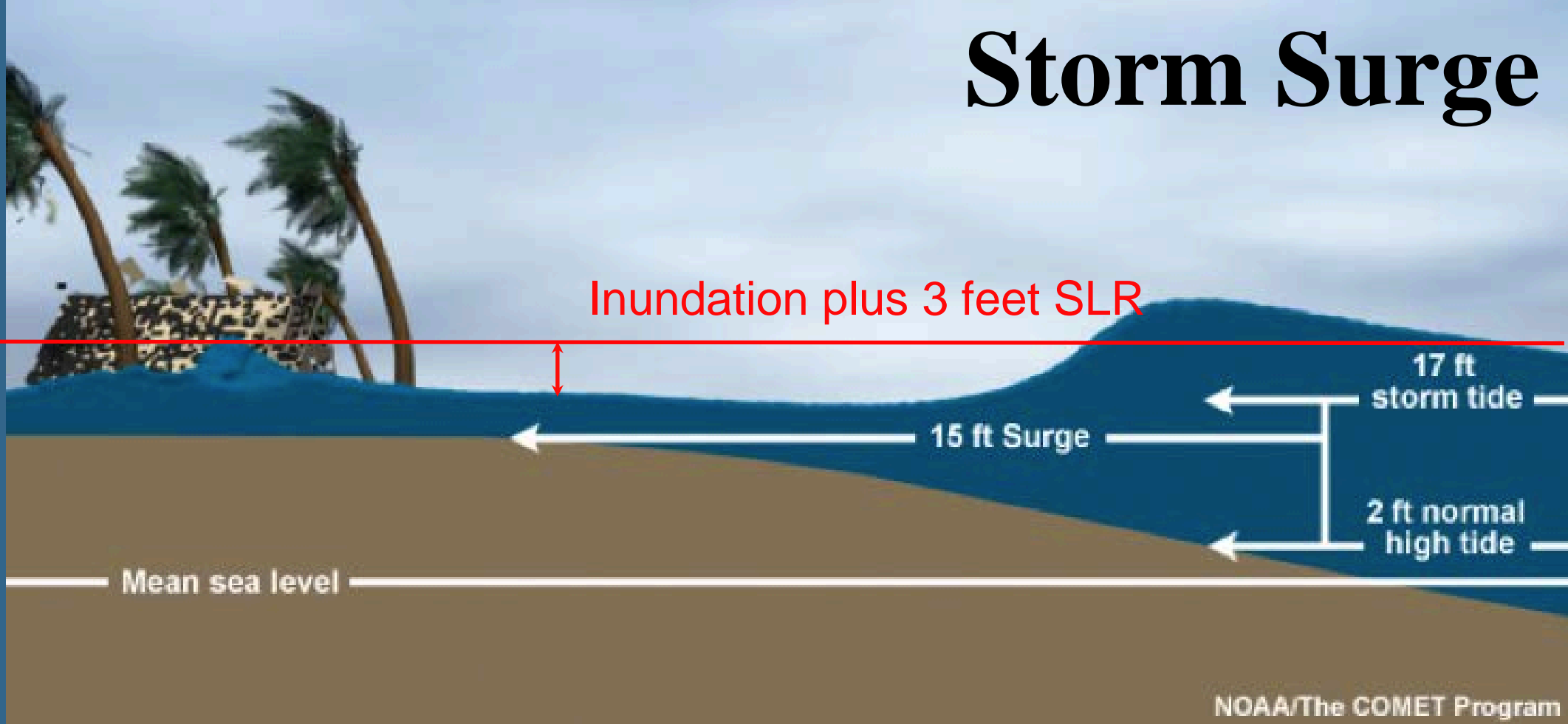
## SCOPE OF WORK:

### Mapping:

1. SLR scenarios mapped at 1 meter (3.2 ft).
2. Map and identify critical infrastructure located in these hazard zones.



## Storm Surge





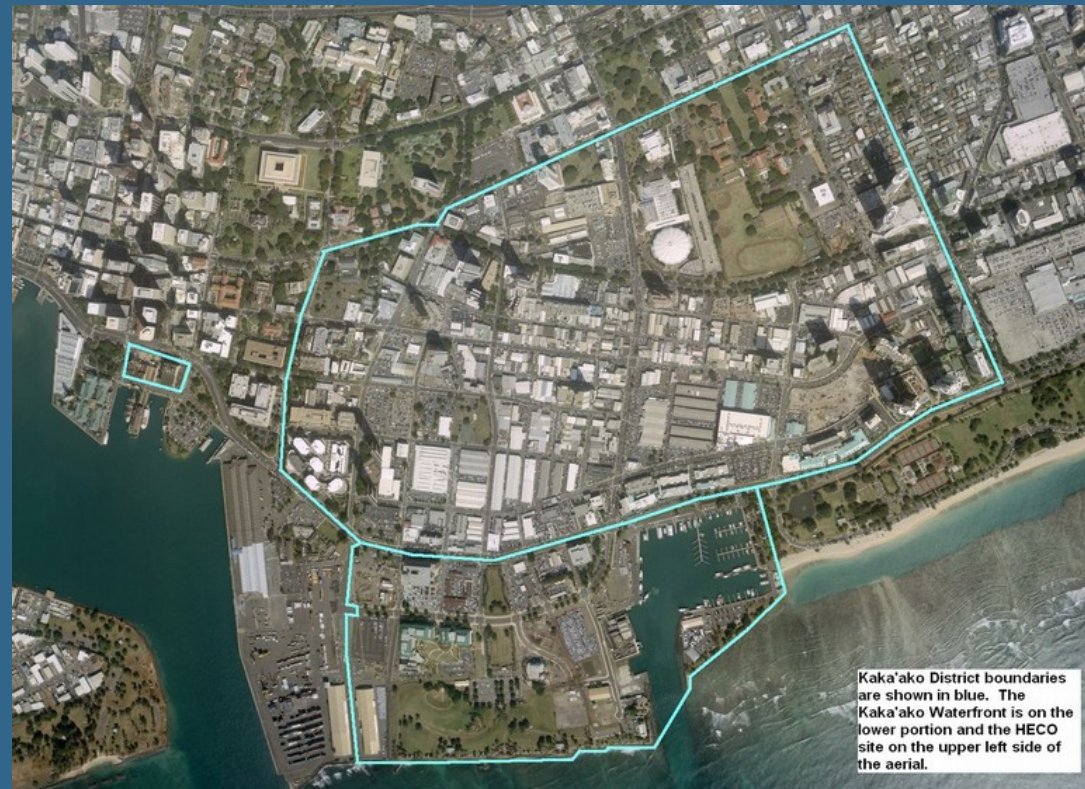
# Honolulu SLR Inundation Study

## *Critical Facilities Inventory and Socio-Economic Impact Assessment*

- GIS overlay maps of **economic impacts of inundation of critical infrastructure** in the inundation zone for hazard zone overlay.
- Combined risk assessment for Honolulu;**  
(socio-economic, infrastructure, and transportation assets).

The study follows a 7 step formula described by the the NOAA Coastal Services Center (CSC):

- 1) Hazard Identification,
- 2) Hazard Analysis Mapping,
- 3) Critical Facilities Vulnerability Analysis,
- 4) Societal Vulnerability Analysis,
- 5) Economic Vulnerability Analysis,
- 6) Environmental Vulnerability Analysis, and
- 7) Mitigation Opportunities Analysis.



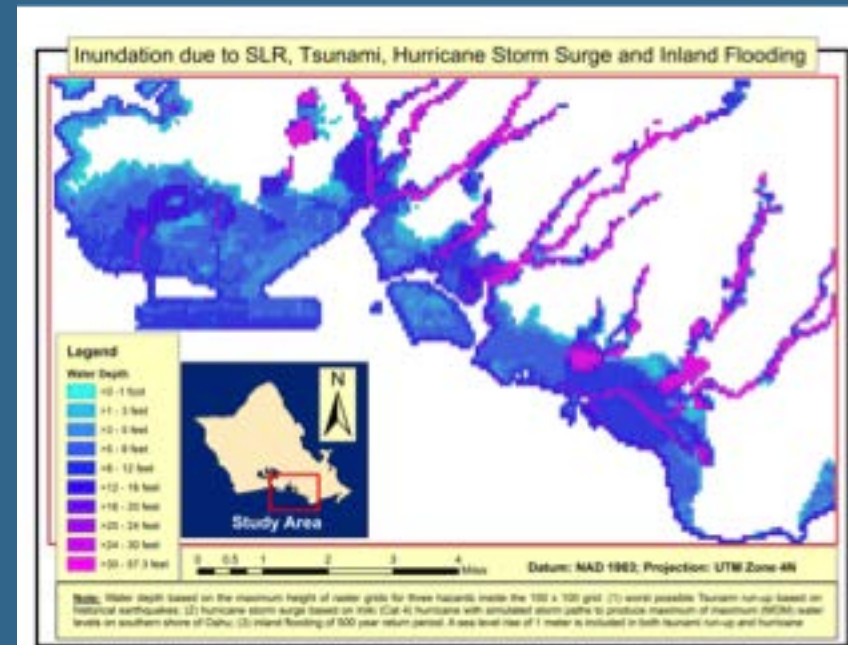
Kaka'ako District boundaries are shown in blue. The Kaka'ako Waterfront is on the lower portion and the HECO site on the upper left side of the aerial.



# Multi-hazard Perspective

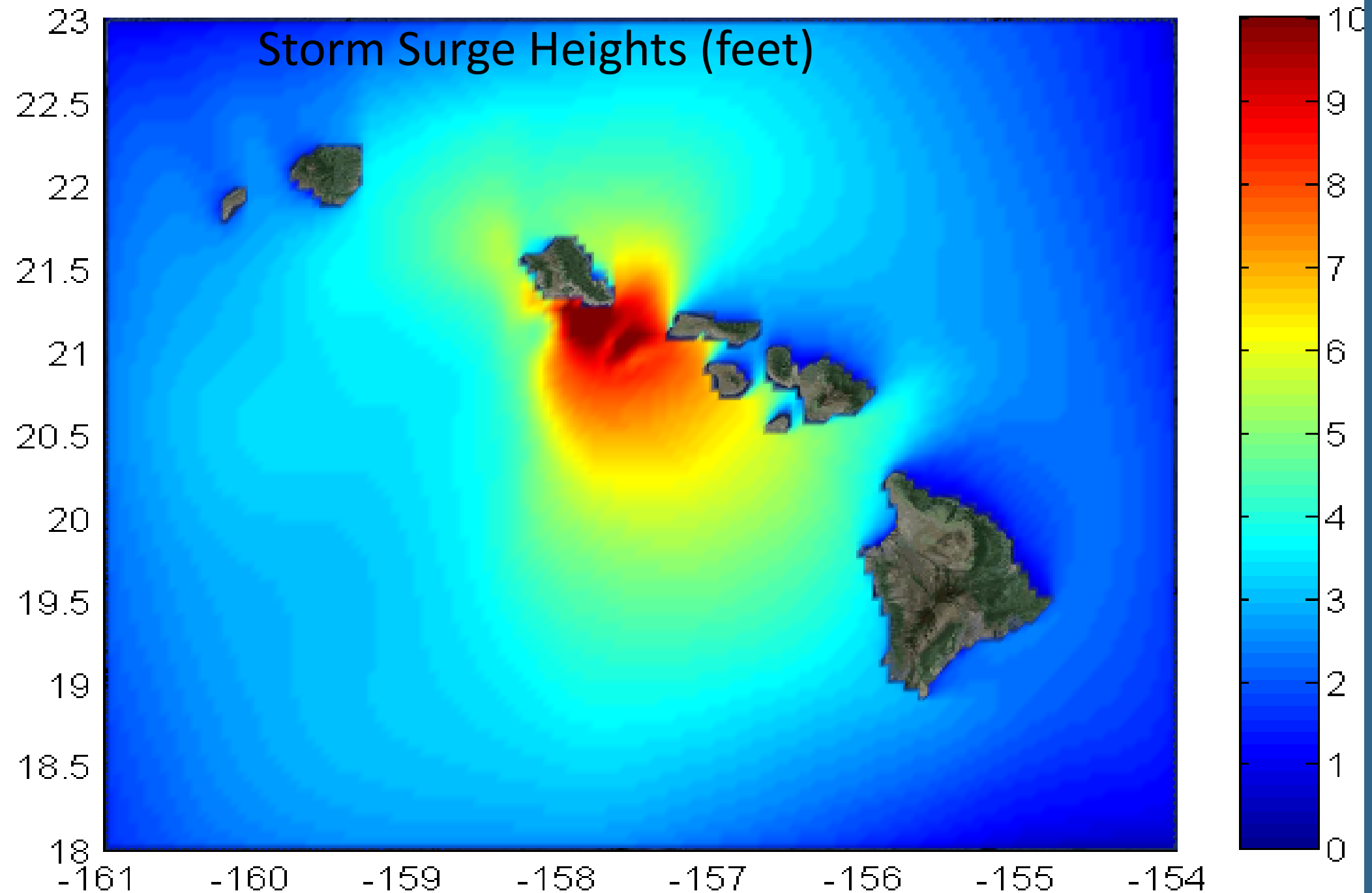
Combined output from four inundation models:  
SLR+ Tsunami + Hurricane + Flooding

1. Sea Level Rise of 1 meter
  2. Storm surge due to simulated Category 4 storm
  3. Simulated maximum inundation based on five major historical tsunamis in Hawaii.
  4. 500 Year return period for inland riverine flooding
- GIS – composite hazard map





# Methodology

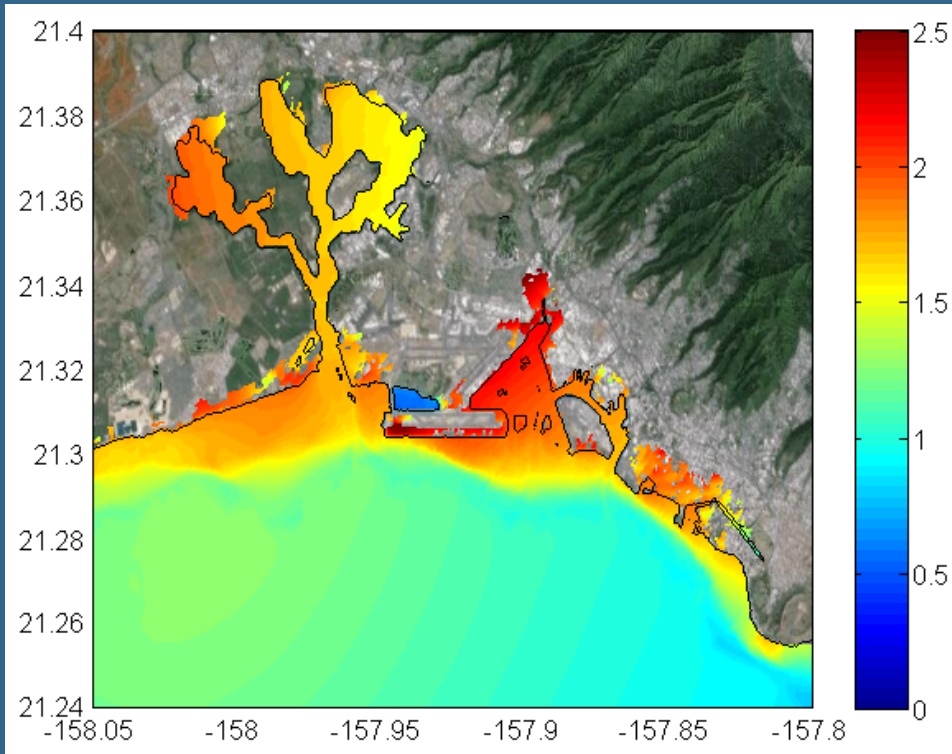




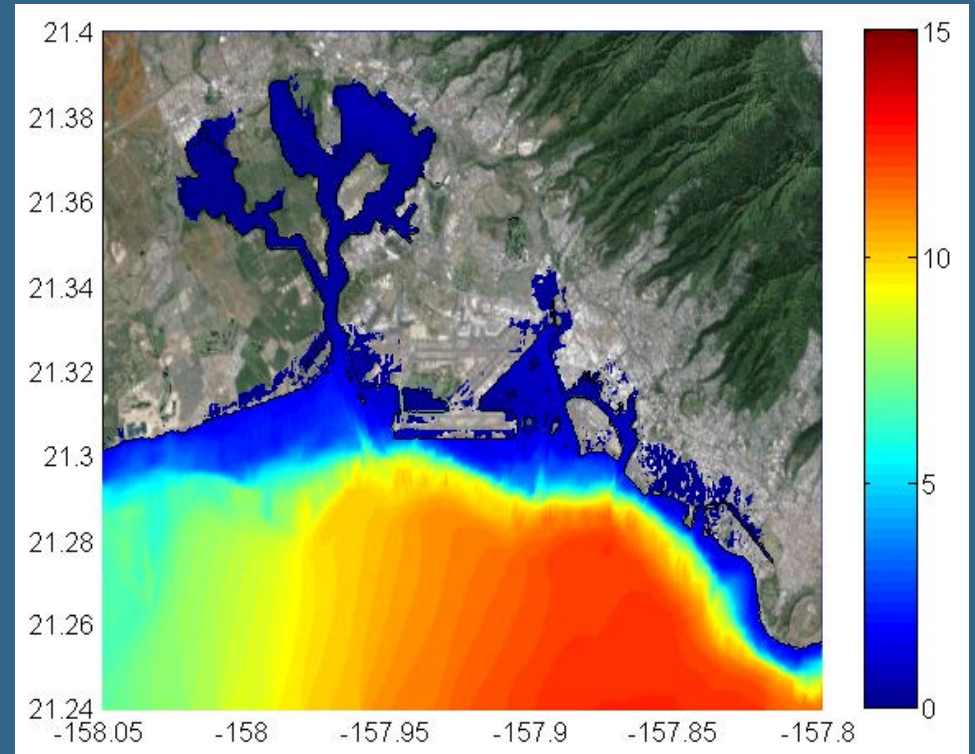
# Results

## 1992 Hurricane Iniki approach into Honolulu

### Storm Surge



### Significant Wave Height





# Results

1992 Hurricane Iniki approach into Honolulu

Snapshots of simulated surge and waves for hurricane landfall in Honolulu.

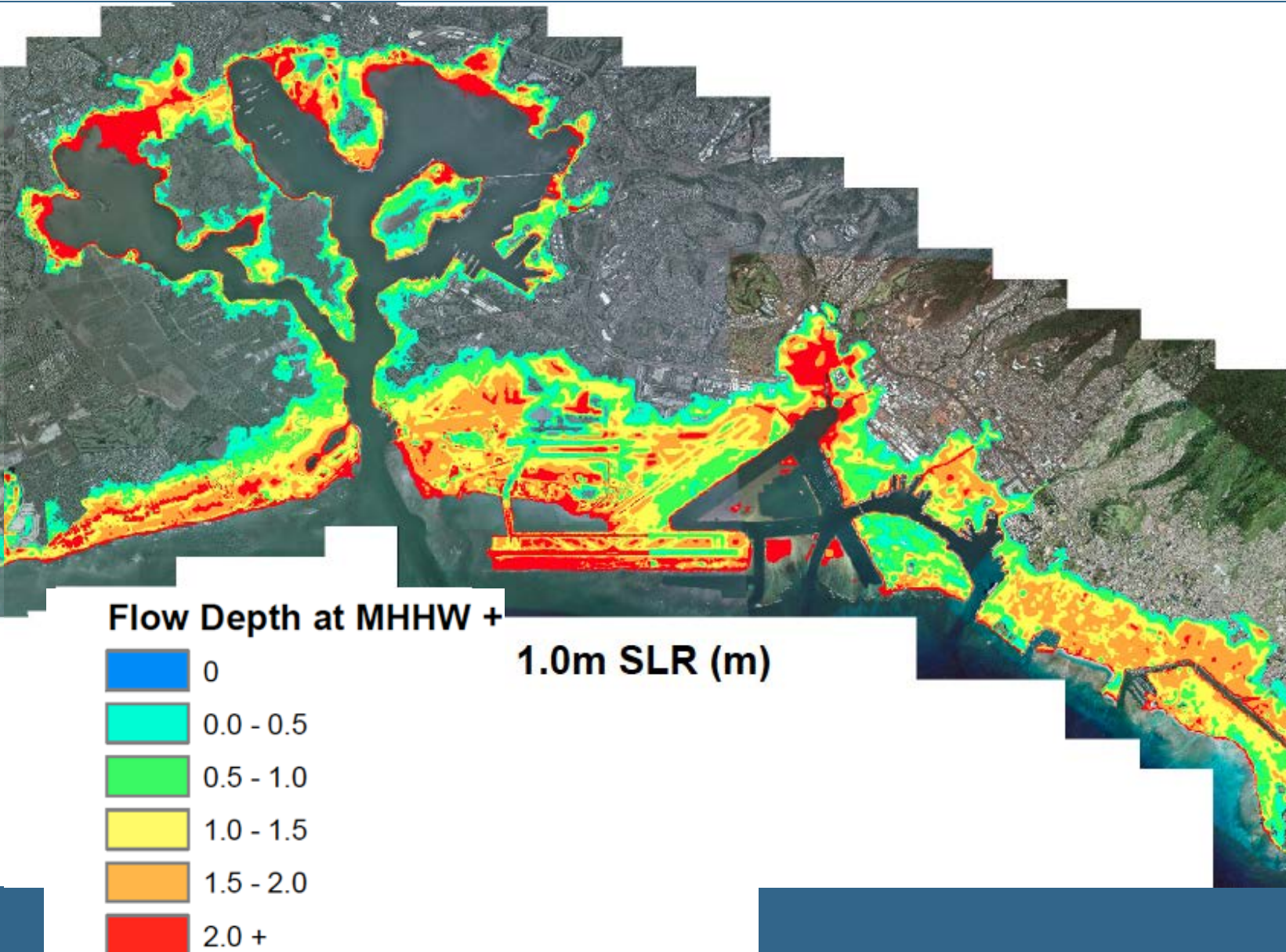
+1m MSL





# Honolulu SLR Inundation Study

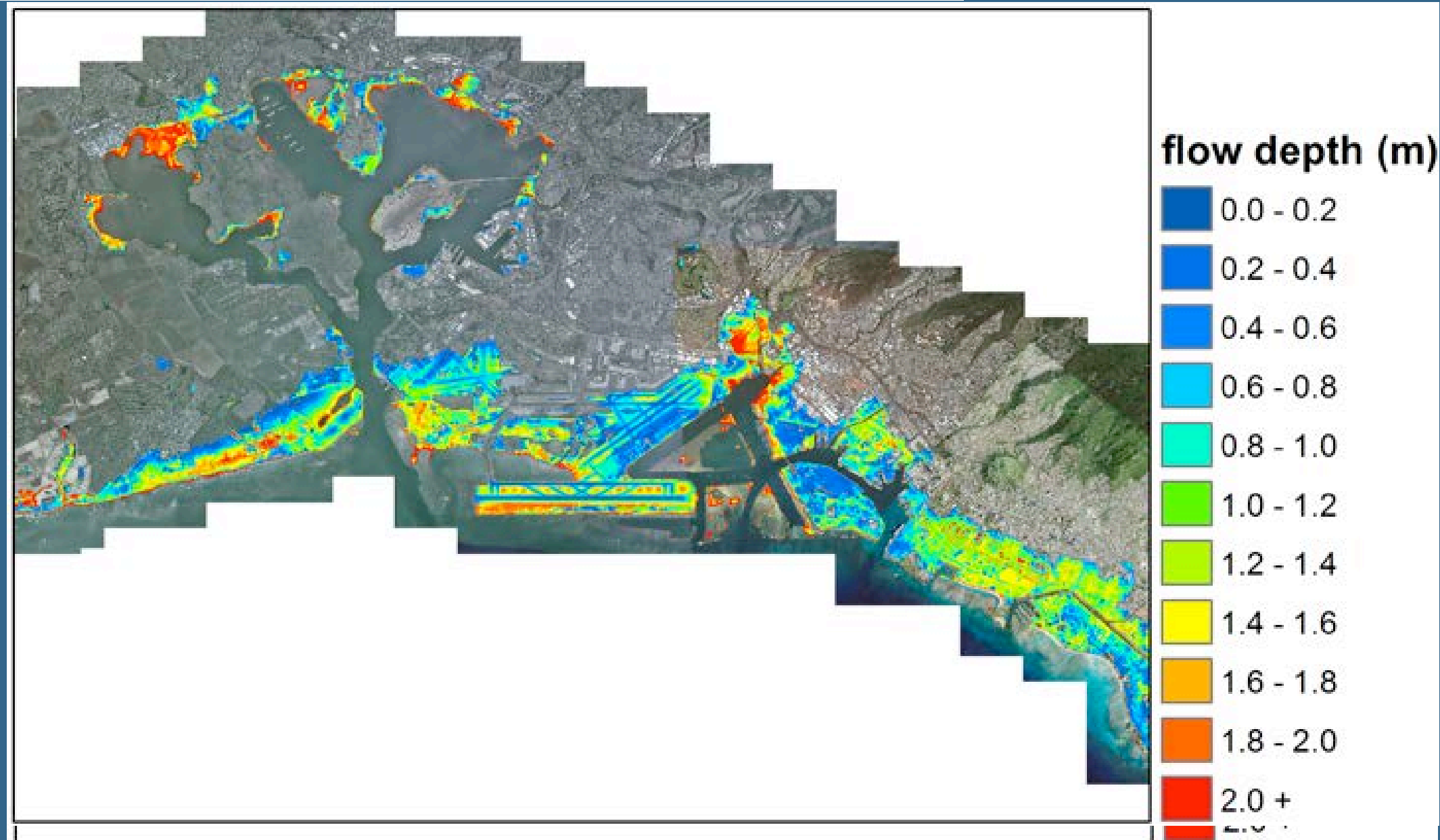
***HURRICANE*** Storm Surge Current Conditions (+3 ft SLR)





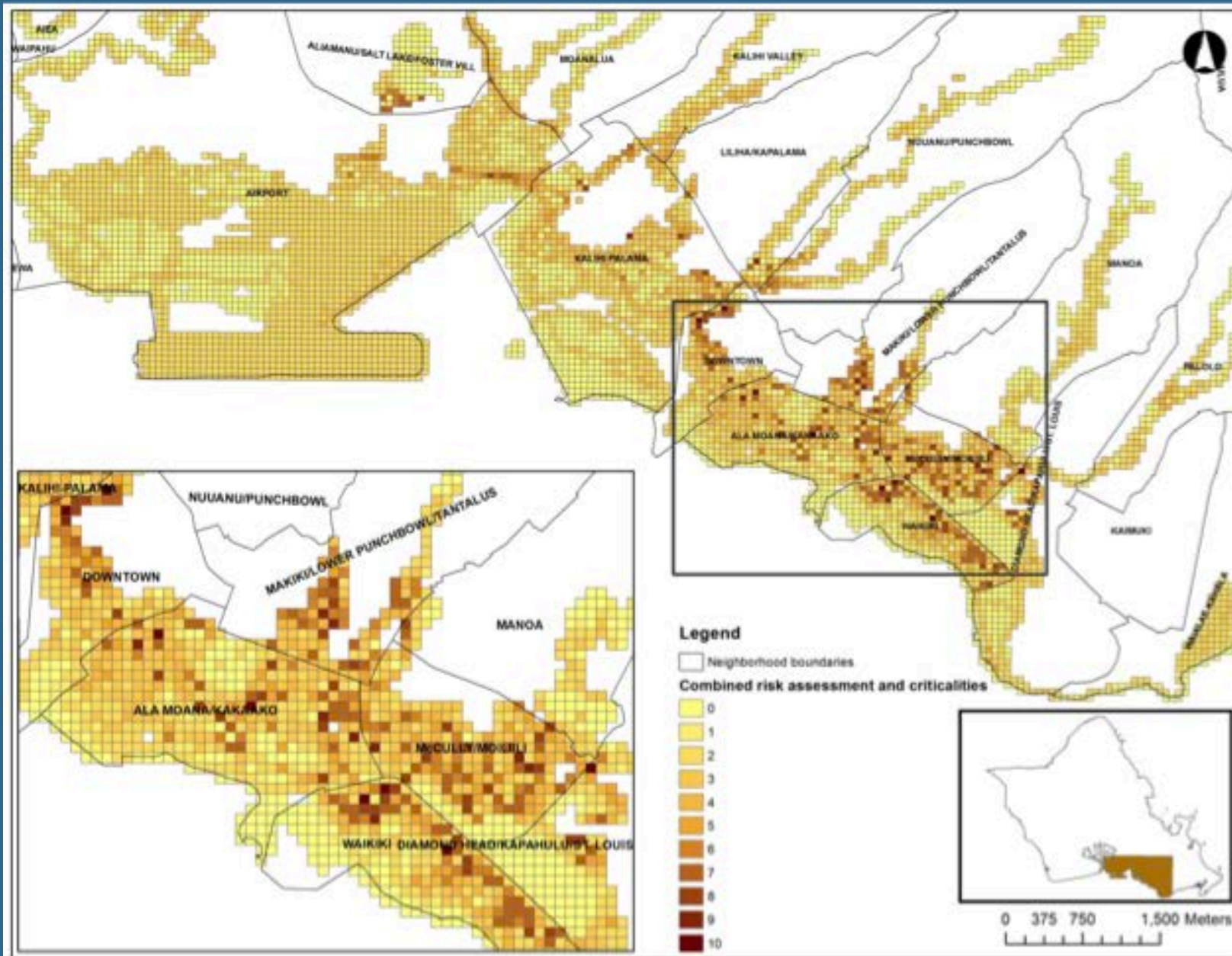
# Honolulu SLR Inundation Study

**TSUNAMI** Current Conditions (+3 ft SLR)





# Honolulu SLR Inundation Study Combined Risk Assessment



*ic Impacts*

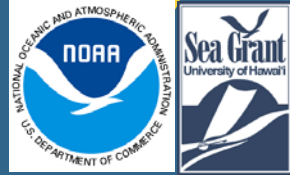
of SLR to critical  
play.



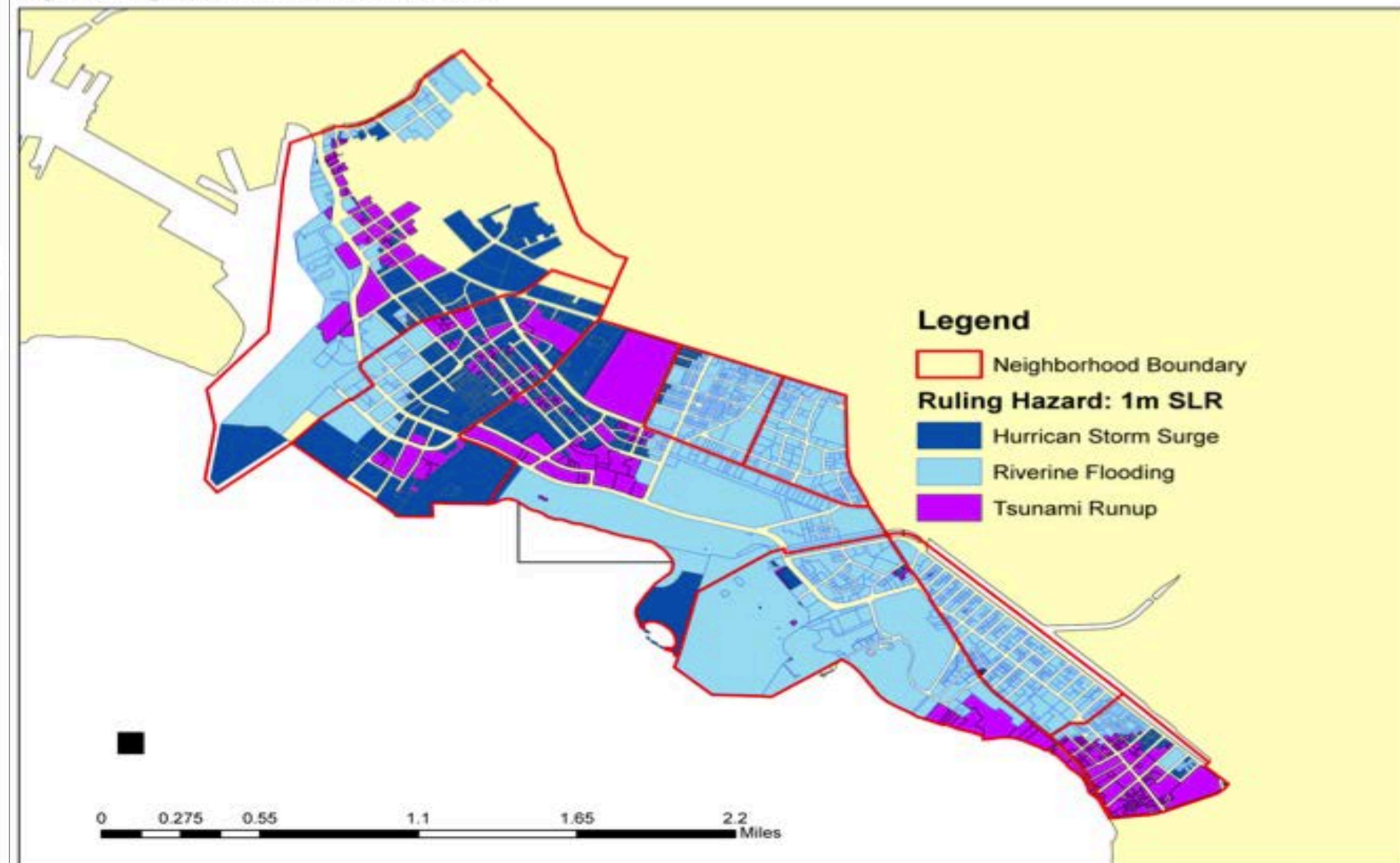
# Honolulu SLR Inundation Study

## Predominant Hazard

*Critical Facilities Inventory and Socio-Economic Impacts*



Map 8: Ruling Hazard with 1m Sea Level Rise





# Honolulu SLR Inundation Study

## Summary Conclusions

### Economics

- \$34.8 Billion or 80% of the study area economy is exposed to the modeled combined hazard.
- 87% of the tourism sector economy (\$2.8 billion) is subject to some flooding.
- Flood risk by parcel for land use development is most significant between 1ft and 5ft of flood depth.
- The exposure rate decreases after 8 feet for all sectors of the economy.
- Largest cumulative flooding impact (~20%) occurs between .3m and 1.0 m (1 ft to 3.2ft).
- Less than 5% of grid cells are flooded beyond 2.5 m (~8ft) of flooding.

### Transportation

- The length of local streets exposed to flooding is 221.20 miles
- By percentage, arterial roads are significantly more exposed compared to other road types.
- Freeway 18.68 miles, Arterial roads 17.73, highway 14.24 miles

### Population

- 45% of the total project population percentage is exposed to some inundation.





# *Aloha and Mahalo!*



Photo courtesy of Hawaii Tourists Authority (HITAT) Ron Gamble



**NOAA  
COASTAL STORMS PROGRAM**





# Coastal Inundation Mapping- So now what?

## Opportunities and Outcomes:

- Kakaako Master Plan and opportunity to integrate Smart growth, hazard mitigation and climate adaptation simultaneously.

- ICAP-CREST SLR policy planning study- Great interest in pilot study in Kaakako and/or Waikiki.

- **Outcomes – Strengths and weaknesses**

**Strengths-** Science-based with robust and highly accurate validated computer models.

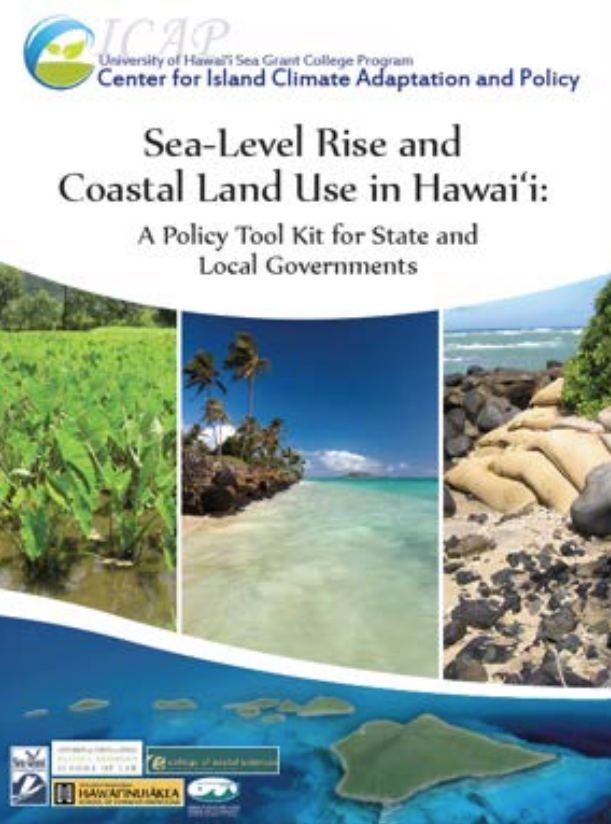
**Weakness-** outcomes and actions based on maps. Economic component will provide justification and motivation for implementation of strategies.

**Application-**Working with U.S.ACE on drainage assessment and alternative adaption measures.

Storm-water drainage.

Subsurface utilities and structures

Need better understanding of ground-water





# Kakaako- Looking *For* Ward



Thursday, October 11, 2012

## 22 towers dot plan for Ward Centers

Howard Hughes Corp. envisions redeveloping nearly the whole Ward Centers area with 22 residential towers and twice as much retail, restaurants and entertainment venues.

The new plan, dubbed Ward Village, would double the amount of retail, dining and entertainment venues on their property. It also **calls for 22 skinnier towers that preserve more public views of the mountains and ocean** compared with General Growth's plan for 20 towers.

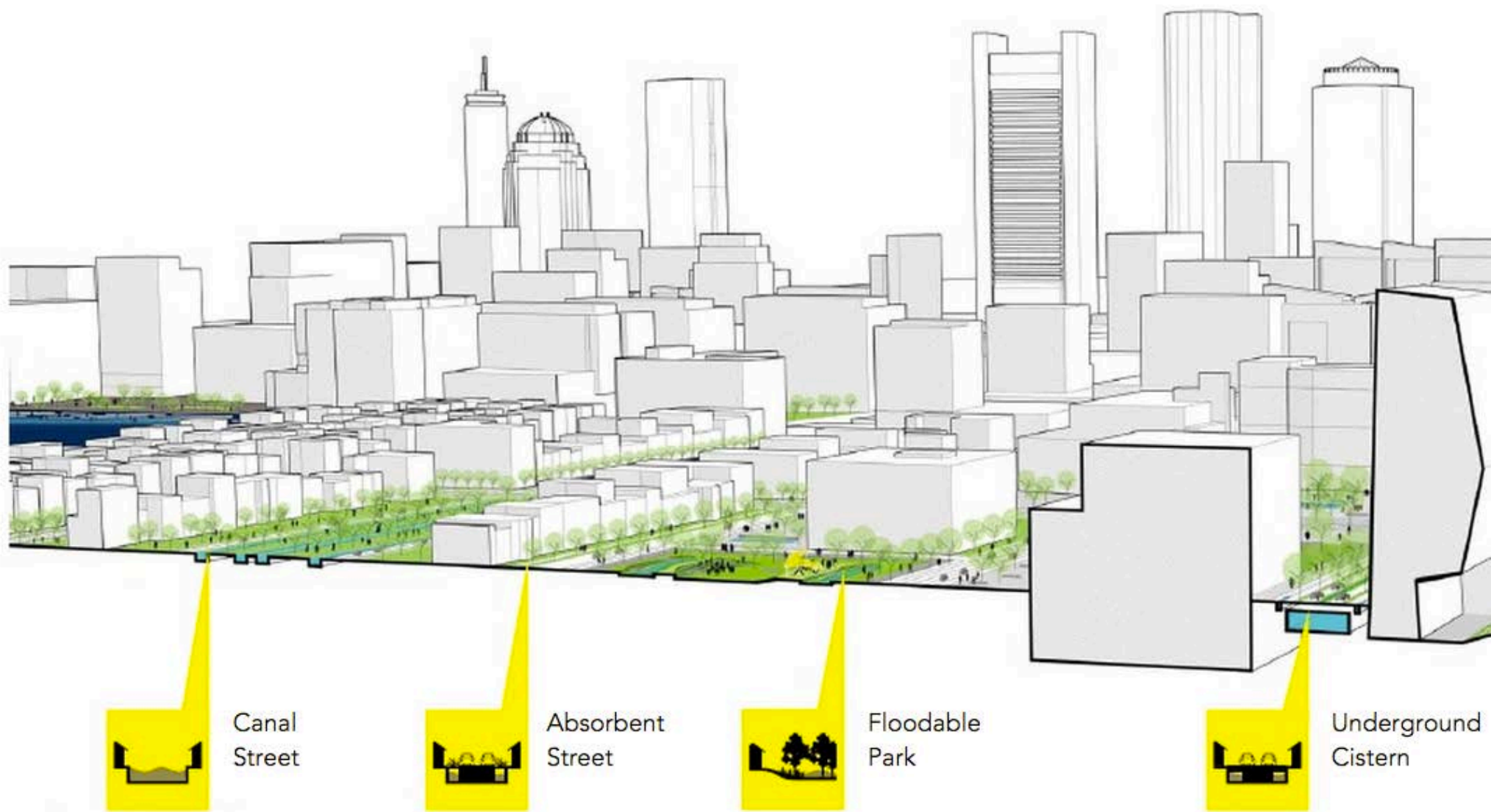
Another major plan revision is the intention by Hughes Corp. to orient the long side of nearly all its towers on a mauka-makai axis to further maximize public mountain and ocean views between buildings.

Eight towers still would front Ala Moana Boulevard, but they would be set back 60 to 70 feet from the street instead of 15 feet, according to Nick Vanderboom, Hughes Corp. vice president of development.





# MAKING ROOM FOR WATER IN THE CITY



Canal Street



Absorbent Street



Floodable Park



Underground Cistern

