DRAFT 03/03/2015

California Maritime Tsunami Response Playbook And Mitigation Guidance

Ventura Harbor – Ventura County

Maritime Tsunami Response Playbook (MTRP) No. 2014-Vent-01

DURING AN EMERGENCY, USE THE "QUICK REFERENCE" SHEET ON THE BACK PAGE (PAGE 22).

(For the expanded Playbook format, use directions on page 7)

California Maritime Tsunami Response Playbook No. 2014-Vent-01

California Geological Survey
California Governor's Office of Emergency Services
University of Southern California
Humboldt State University
National Oceanic and Atmospheric Administration

Funded by the Federal Emergency Management Agency and the National Tsunami Hazard Mitigation Program

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DURING AN EMERGENCY, USE THE "QUICK REFERENCE" ON PAGE 22 FOR GATHERING INFORMATION FOR RESPONSE ACTIVITIES.

PURPOSE: This Maritime Tsunami Response Playbook Guidance document will help members of the maritime community prepare, plan, and respond to strong currents and damage from future tsunamis. It has been developed with assistance from the maritime communities by the California Tsunami Program and principle funding from FEMA. **It is essential that harbor staff become familiar with this Playbook guidance document before use.** The information within the Playbook can also help the harbor develop and implement tsunami mitigation strategies through their Local Hazard Mitigation Plan, and receive potential mitigation funding if needed.

USE: This Playbook is primarily designed to help the maritime communities with tsunami response activities by providing detailed information about potential tsunami scenarios which can be used during an event.

First, it requires that the **harbor develop response plans for each of the scenarios in the Playbook;** this should be done when the Playbook is first received. The California Tsunami Program will work with the maritime communities to assist in develop these plans if requested.

When a tsunami is occurring, follow the steps outlined in either the Quick Reference guideline on the last page (Page 22) if the user is not as familiar with the Playbooks, or the Expanded Reference guideline on Page 7 if the user wants more detailed information. The harbor master or emergency response manager should **fill out information about the source earthquake and tsunami;** this information can be obtained from multiple sources, including the tsunami alert message from the National Tsunami Warning Center (NTWC) in Alaska, the city or county emergency manager, and/or the National Weather Service, Regional Weather Forecast Office. Keep in mind that this information can change during the first hour or two after the earthquake occurs.

Finally, **compare the tsunami forecast amplitude (wave height) to the maximum tsunami amplitude on the scenario table on Page 7 or 22**. Choose the scenario (Pages 8-17) which best matches the forecast information. Follow the instructions on the page for that scenario. Each scenario Playbook may be accompanied by a digital file indicating the response and evacuation plans; this can be shared during an emergency with emergency responders in the field.

MITIGATION PLANNING

In addition to using these Playbooks for tsunami response, the California Tsunami Program, FEMA, and its partners encourages maritime communities to utilize this information to help mitigate damages and loss of life from future tsunamis. These products and plans should be used by maritime communities to identify real-time response mitigation measures, determine where infrastructure enhancements should be initiated, and provide a mechanism for pre-disaster hazard mitigation funding through additions to their Local Hazard Mitigation Plans (see the list of potential mitigation measures below). Although these products, plans, and related mitigation efforts will not eliminate all casualties and damages from future tsunamis, they will provide a basis for greatly reducing future tsunami impacts on life-safety, infrastructure, and recovery in California maritime communities. Therefore, we recommend the following steps/actions:

1. **Review the maps within this Playbook guidance document to identify where strong currents could potentially damage docks, structures, and/or infrastructure, especially where aging or run-down facilities exist.**
2. **Review the Mitigation Measures below for both real-time response actions, or "soft" mitigation, or permanent measures, or "hard" mitigation.**
3. **Incorporate these measures/actions into the community Local Hazard Mitigation Plan, and work with the community, the state tsunami program, and/or FEMA to develop a strategy to request funding to implement these improvements.**

Mitigation Measures for Reducing Impacts in Maritime Communities

Real-time response mitigation measures	Permanent mitigation measures
Moving boats and ships out of harbors	Fortify and armor breakwaters
Repositioning ships within harbor	Increase size and stability of dock piles
Move large, deep keeled ships from harbor entrance	Strengthen cleats and single-point moorings
Remove small boats/assets from water	Improve floatation portions of docks
Shut down infrastructure before tsunami arrives	Increase flexibility of interconnected docks
Evacuate public/vehicles from water-front areas	Improve movement along dock/pile connections
Restrict boats from moving during tsunami	Increase height of piles to prevent overtopping
Prevent boats from entering harbor during event	Deepen/Dredge channels near high hazard zones
Secure boat/ship moorings	Move docks/assets away from high hazard zones
Personal flotation devices/vests for harbor staff	Widen size of harbor entrance to prevent jetting
Remove hazardous materials away from water	Reduce exposure of petroleum/chemical facilities
Remove buoyant assets away from water	Strengthen boat/ship moorings
Stage emergency equipment outside affected area	Construct flood gates
Activate Mutual Aid System as necessary	Prevent uplift of wharfs by stabilizing platform
Activate of Incident Command at evacuation sites	Debris deflection booms to protect docks
Alert key first responders at local level	Harbor control structures being tsunami resistant
Restrict traffic entering harbor; aid traffic evacuating	Construct breakwaters further away from harbor
Personnel to assist rescue, survey and salvage	Install Tsunami Warning Signs
Identify boat owners/live-aboards; establish phone tree, or other notification process	Equipment/assets (patrol/tug/fire boats, cranes, etc.) to assist response activities

There are a number of **TSUNAMI HAZARDS** that could directly affect boats/boaters:

- Sudden water-level fluctuations
  - Where boats and docks hit bottom (grounded) as water level drops
  - Docks and boats could overtop piles as water level rises
- Strong and unpredictable currents, especially where there are narrow openings/parts of harbor
- Tsunami bores and amplified waves resulting in swamping of boats and damage to docks
- Eddies/whirlpools causing boats to lose control
- Drag on large keeled boats causing damaging forces to boats tied to docks
- Collision with other boats, docks, and debris in the water
- Dangerous tsunami conditions can last tens of hours after first wave arrival, causing problems for inexperienced and unprepared boaters who take their boats offshore

Tsunami Alert Bulletins: During the typical tsunami alert, the Warning Center provides information about the tsunami in "bulletins" to the state and local jurisdictions. There are four levels of "alert" that can be sent by the NTWC (from least to greatest significance; http://ntwc.arh.noaa.gov/):

Tsunami Information Statement - Issued to inform and update emergency managers and the public that an earthquake has occurred, or that a tsunami Watch, Advisory or Warning has been issued elsewhere in the ocean.

Tsunami Watch - Issued to alert emergency managers and the public of an event which may later impact the Watch area. May be upgraded to an Advisory or Warning - or canceled - based on updated information and analysis.

Tsunami Advisory - Issued due to the threat of a tsunami which may produce strong currents or waves dangerous to those in or near the water; typically called when forecasted tsunami amplitudes are between 0.3m and 1m (1ft and 3ft) above existing tidal conditions are expected. Coastal communities are advised that beach and harbor areas could expect rapid, moderate tidal changes and strong currents.

Tsunami Warning - Issued when a tsunami with significant widespread inundation is imminent or expected; typically called when forecasted tsunami amplitudes are equal to or greater than 1m (3ft). Coastal communities are advised to evacuate people from low-lying areas identified as vulnerable to tsunamis.

ACTIONABLE TSUNAMI ALERT LEVELS

Tsunami Advisories and Warnings are the two actionable Alert levels for maritime communities.

Actions taken will depend on the Alert level and the forecasted tsunami wave height or amplitude for a particular harbor. For both Advisory and Warning level events, it is important that clear and consistent directions are provided to the entire boating community and waterfront businesses.

If there is not sufficient time to use the Playbooks, consider the following general actions for your maritime communities for either Advisory or Warning level events:

GENERAL "WARNING" LEVEL RECOMMENDATIONS

All activities below should be completed no later than one hour before forecasted tsunami arrival.

- Evacuate the public and harbor personnel from all structures and vessels in the water, as well as all land-ward areas identified in the mapped tsunami evacuation area (last page).
- Advise facility maintenance to shut off fuel to fuel docks, and all electrical and water services to all docks.
- Secure and strengthen all mooring lines throughout harbor, specifically areas near the entrance or narrow constrictions.
- Do not allow public to re-enter tsunami evacuation area until Warning is downgraded or cancelled.
- Follow instructions for an Advisory if Warning is downgraded to Advisory level.

GENERAL "ADVISORY" LEVEL RECOMMENDATIONS

All activities below should be completed no later than one hour before forecasted tsunami arrival.

- Evacuate the public from all structures and vessels in the water.
- Coordinate with local law enforcement to limit access of public along waterfront areas.
- All personnel working on or near the water should wear personal flotation devices.
- Advise facility maintenance to shut off fuel to fuel docks, and all electrical and water services to all docks.
- Secure and strengthen all mooring lines throughout harbor, specifically areas near the entrance or narrow constrictions.
- Do not allow public to re-enter structures and vessels in the water until Advisory is cancelled.

DIFFERENCE BETWEEN FORECAST TSUNAMI AMPLITUDE/WAVE HEIGHT AND FASTER TSUNAMI FLOOD HEIGHT

Forecast Tsunami Amplitude/Wave Height: Within the first couple hours after an earthquake and the generation of a tsunami, the National Tsunami Warning Center will provide an estimate, or forecast, of the potential amplitude/wave height of the tsunami for over 50 locations along the California coast. This amplitude is the height of the tsunami above existing ocean conditions and helps determine the official Tsunami Alert level for each region. **For the purposes of the Playbook, the forecast tsunami amplitude is used on the "Response Reference" page 7 or 22 to determine if piles will be overtopped and inundation of dry land will occur.**

FASTER Analytical Tool: To determine the full impact of tsunami inundation, other variables such as tidal and storm conditions must be considered. An analytical method has been created which incorporates important variables that will impact the ultimate tsunami flood level. The simplified components of the calculation are shown to the right. **The FASTER calculation, which will be provided by the local jurisdiction or the regional NOAA NWS Weather Forecast Office to the harbor during a tsunami event, is used on Page 7 to determine if piles will be overtopped and inundation of dry land will occur.**

Working example: Formula for determining playbook evacuation line to use (FA-S-T-E-R):

FA: **Forecasted Amplitude (Wave Height)** from Warning Center

+

S: **Storm** surge or existing ocean conditions

+

T: Maximum **tidal** height (first 5 hours of tsunami)

+

E: Forecast **error** potential (30%; analysis of 2010-11 events)

+

R: Site amplified **run-up** potential (from existing modeling, unique to each location; applied if inundation expected)

= Maximum tsunami run-up height

= Playbook elevation line

RELATIONSHIP BETWEEN TSUNAMI CURRENT SPEED AND HARBOR DAMAGE: Analysis of recent tsunami damage indicates a relationship between current speed and harbor damage. The Damage Index to the right has been used in the analysis to determine the following relationship (see color codes here and on maps):

CURRENTS = DAMAGE

0-3 knots = No Damage

3-6 knots = Minor/Moderate Damage

6-9 knots = Moderate/Major Damage

>9 knots = Major/Complete Damage

Damage Index:	Damage Type:
0	no damage
1	small buoys moved
2	1-2 docks/small boats damaged, large buoys moved
3	Moderate dock/boat damage, mid-sized vessels off moorings
4	Major dock/boat damage, large vessels off moorings
5	Complete destruction

Expanded Reference Information for Determining Real-Time Maritime Response Activities

NOTE: It is important to review all sections of this Playbook prior to using it during a tsunami emergency. When a tsunami alert is issued by the National Tsunami Warning Center, fill out the Expanded Reference page below under Step 1. The state/NOAA will provide information on recommended "Phase" evacuation and response plans to use based on the FASTER tsunami flood level value calculated for each community.

Step 1: Obtain information about earthquake and tsunami from National Tsunami Warning Center in Alaska, regional NOAA-Weather Forecast Office, and/or county and state emergency managers. (e.g. www.tsunami.gov)

Earthquake location _____
Earthquake magnitude _____
Tsunami Alert level (circle one) WATCH ADVISORY WARNING
Forecasted tsunami amplitude/wave height _____ (this will be compared with Peak Amplitude in Step 2)
Forecasted tsunami arrival time _____
Calculate/obtain FASTER tsunami run-up value in first 5 hours: _____
Calculate/obtain FASTER tsunami run-up value at highest tide _____
Height of shortest pilings above Mean Sea Level: _____
Elevation of lowest land above Mean Sea Level: _____
Compare FASTER value to pile heights and lowest land to determine if they will be overtopped.

Step 2:: Compare and match forecasted tsunami amplitude/wave height in Step 1 to "Peak Amplitude" in the table below (red box). Refer to associated Playbook page to determine actions for securing vessels and/or repositioning ships away from areas of expected damage to safe areas within the bay or offshore (Pg. 20).

Reference Pages for Details in Maritime Playbook	Scenario Playbook Plan Letter	Historical Events and Modeled Scenarios	Earthquake Magnitude and Source Location	Peak Amp. (in meters, above existing conditions)	Likely Tsunami Alert level	Tidal condition (during first 5hrs)	Peak Velocity from Modeling (in knots)	Damage Summary
	(No action)	2009	8.0 Samoa	~0.3	Advisory	High	-	Buoys moved
Page 8-9	A	Modeled Scenario	9.0 Cascadia	0.6	Advisory	High	4	-
Page 10-11	B	2010	8.8 Chile	0.8	Advisory	Low	7	$300-500k damage to docks in the Keys
Page 12-13	C	2011	9.0 Japan	0.9	Advisory	Low	8	$150k damage to docks/boats
Page 14-15	D	Modeled Scenario	9,4 Chile	1.5	Warning	High	10	-
Page 16-17	E	Modeled Scenario	9.2 Aleutians	3.2	Warning	High	>15	-

Playbook Plan A

(based on M9 Cascadia Scenario)

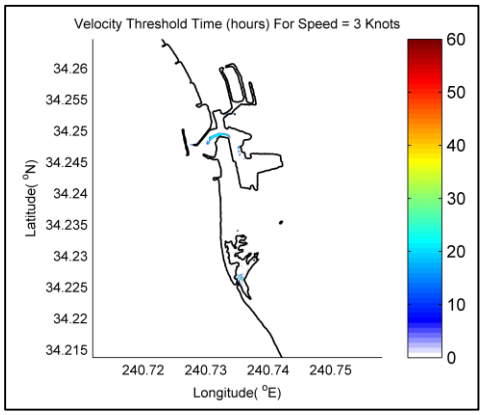
Background Information:
Alert level = Advisory
Peak Amplitude = 0.6 meters
Peak Velocity = 4 knots
Projected duration of strong currents (see location map below):
3-6 knots = 10 hrs; 6-9 knots = 0 hrs; >9 knots = 0 hrs

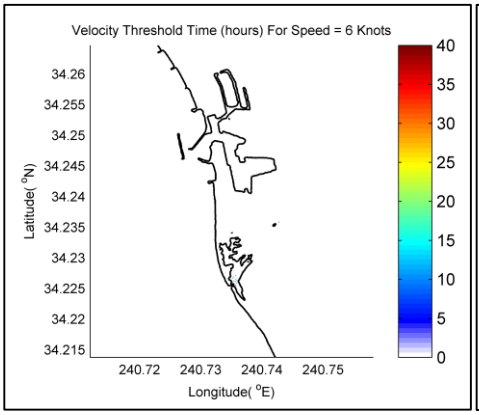
Specific Instructions:

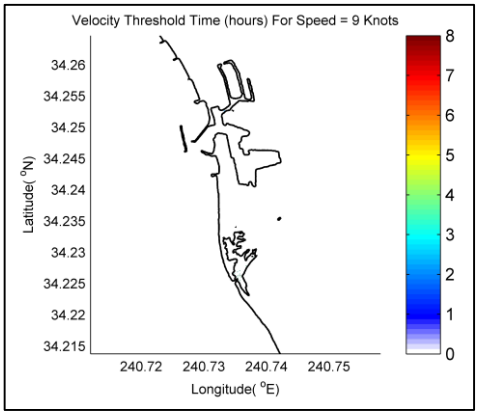
- Follow general guidance for Advisory-level tsunamis (Page 5)
- Strong currents and potential scour are expected in areas identified in blue on the map to the right. Consider relocating vessels located within 100 meters (300 feet) of these areas.
- Specific areas where vessels should be relocated and docks secured:
  - Vessels can be moved to non-blue areas the southern portion of the harbor.
  - …. (completed with maritime community input)

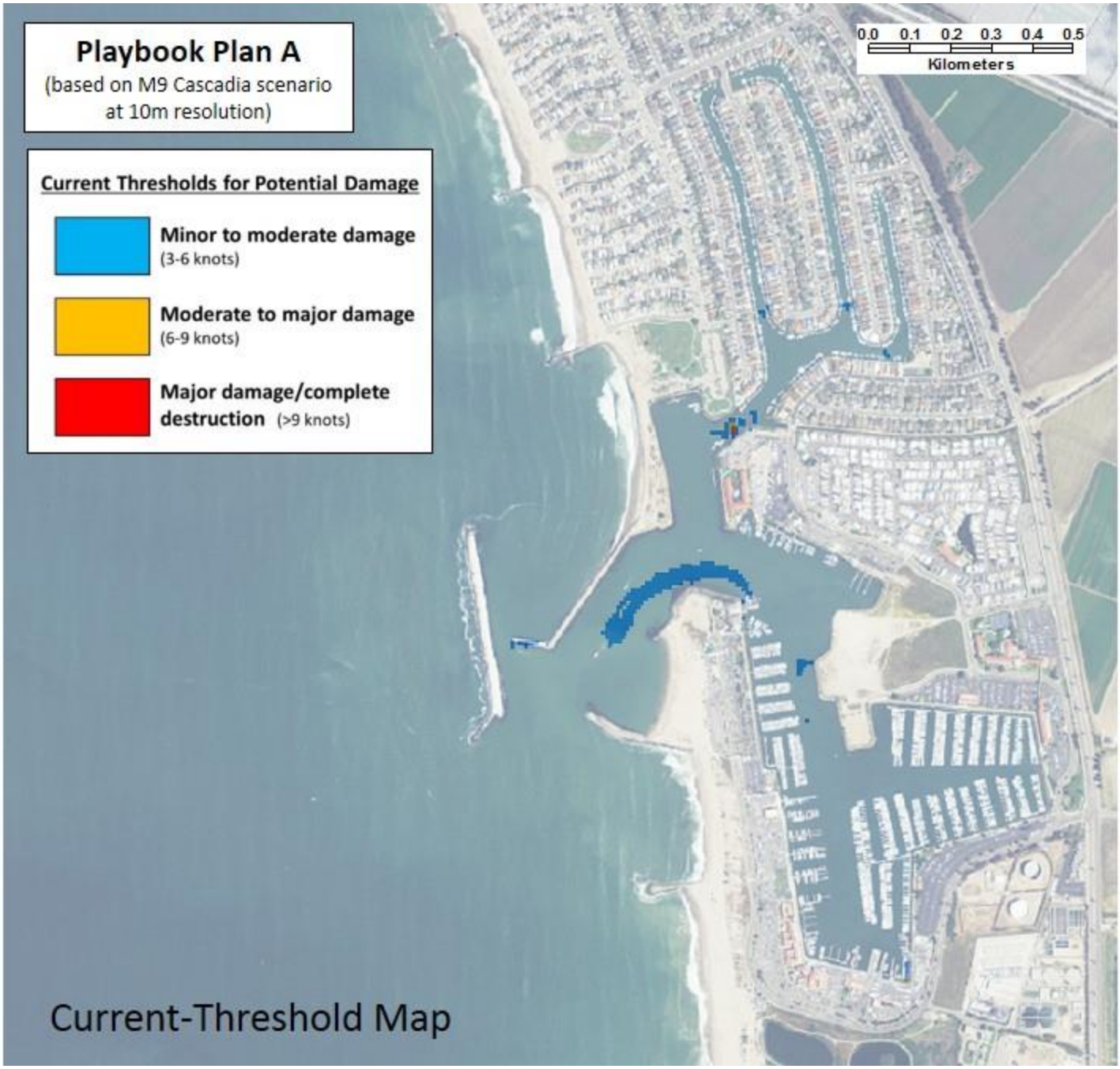
Safe areas for repositioning vessels within Ventura Harbor:
….. (completed with maritime community input)

Time thresholds for currents >3 knots……>6 knots……>9 knots
(Colors below represent HOURS of potential activity for blue, yellow, and red zones on opposite page)








Playbook Plan A
(based on M9 Cascadia scenario at 10m resolution)
Current Thresholds for Potential Damage
Minor to moderate damage
(3-6 knots)
Moderate to major damage
(6-9 knots)
Major damage/complete destruction (>9 knots)
0.0 0.1 0.2 0.3 0.4 0.5
Kilometers
Current-Threshold Map

Playbook Plan B

(based on 2010 M8.8 Chile Event)

Background Information:

Alert level = Advisory

Peak Amplitude =0.8 meters

Peak Velocity = 7 knots

Projected duration of strong currents (see location map below):

3 knots = 10 hrs; 6 knots = 3 hrs; 9 knots = 0 hrs

Specific Instructions:

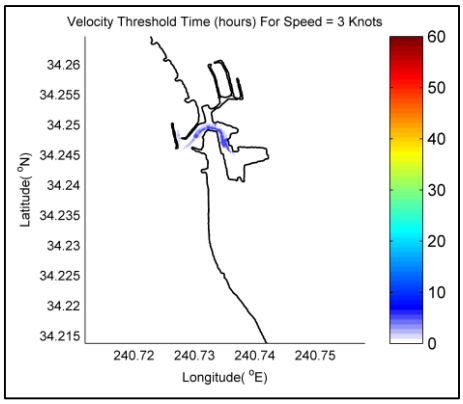
- Follow general guidance for Advisory-level tsunamis (Page 5)
- Strong currents and potential scour are expected in areas identified in blue on the map to the right. Consider relocating vessels located within 100 meters (300 feet) of these areas.
- Specific areas where vessels should be relocated and docks secured:
  - Vessels can be moved to non-blue areas the southern portion of the harbor.
  - ….. (completed with maritime community input)

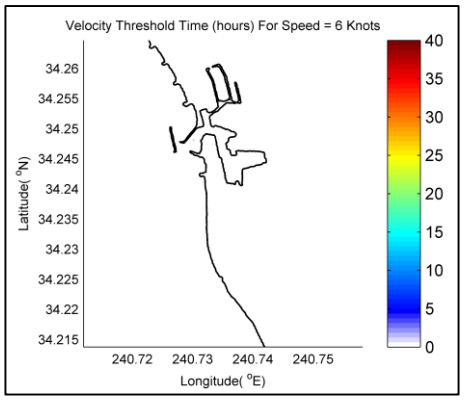
Safe areas for repositioning vessels within Ventura Harbor:

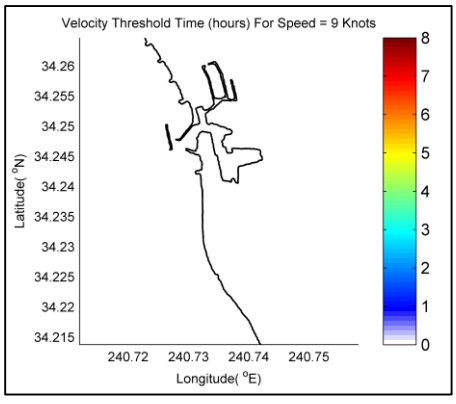
….. (completed with maritime community input)

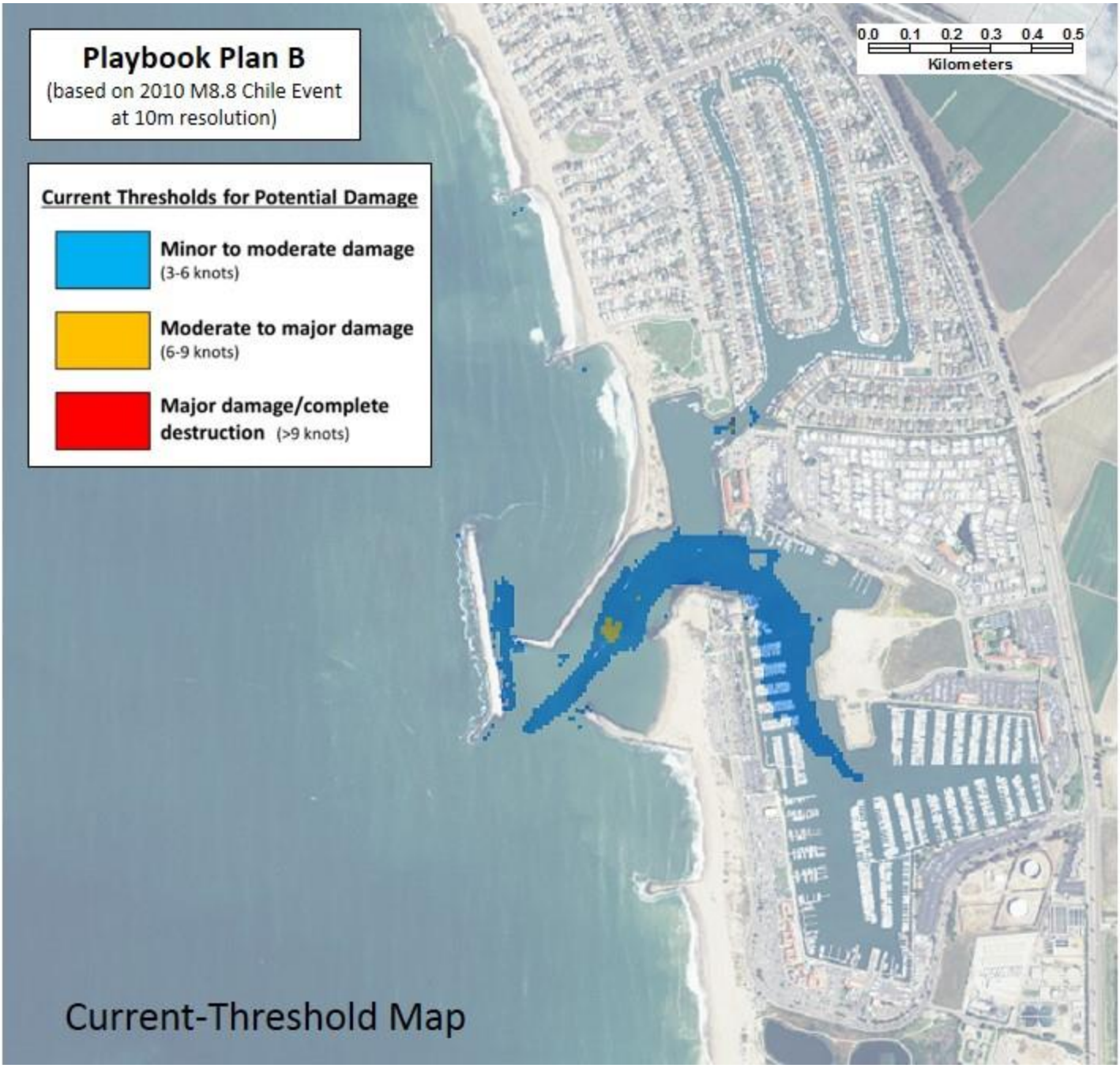
Time thresholds for currents >3 knots……>6 knots……>9 knots

(Colors below represent HOURS of potential activity for blue, yellow, and red zones on opposite page)








Playbook Plan B
(based on 2010 M8.8 Chile Event at 10m resolution)
Current Thresholds for Potential Damage
Minor to moderate damage
(3-6 knots)
Moderate to major damage
(6-9 knots)
Major damage/complete destruction (>9 knots)
0.0 0.1 0.2 0.3 0.4 0.5
Kilometers
Current-Threshold Map

Playbook Plan C

(based on 2011 M9 Japan Event)

Background Information:

Alert level = Advisory

Peak Amplitude = 0.9 meters

Peak Velocity = 7 knots

Projected duration of strong currents (see location map below):

3-6 knots = 30 hrs; 6-9 knots = 10 hrs; >9 knots = 0 hrs

Specific Instructions:

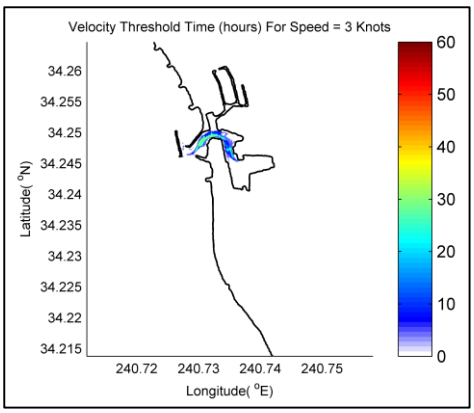
- Follow general guidance for Advisory-level tsunamis (Page 5)
- Strong currents and potential scour are expected in areas identified in blue and gold on the map to the right. Consider relocating vessels located within 100 meters (300 feet) of these areas.
- Specific areas where vessels should be relocated from and docks secured:
  - Vessels can be moved to non-blue areas the southern portion of the harbor.
  - …… (completed with maritime community input)

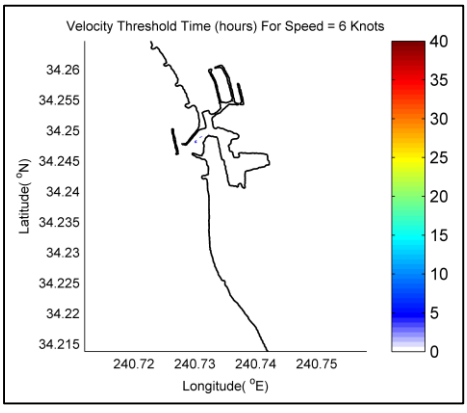
Safe areas for repositioning vessels within Ventura Harbor:

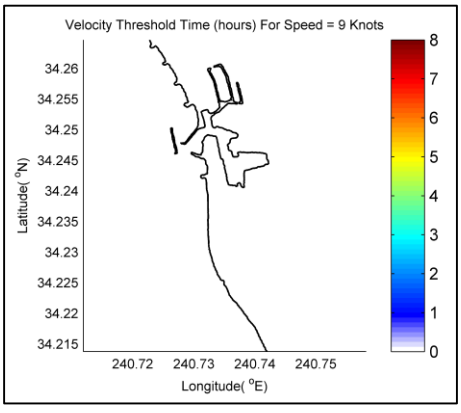
…..(completed with maritime community input)

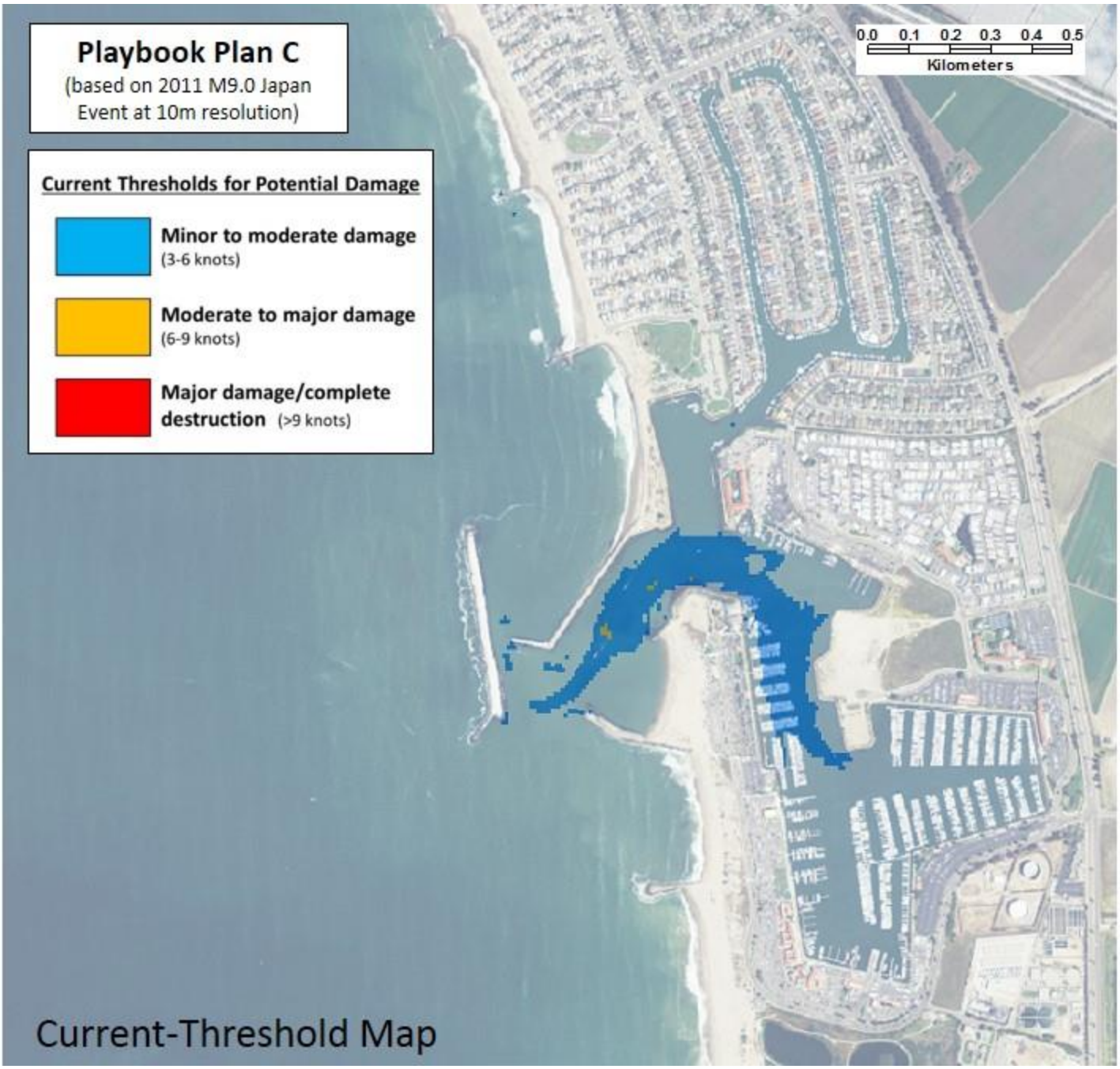
Time thresholds for currents >3 knots……>6 knots……>9 knots

(Colors below represent HOURS of potential activity for blue, yellow, and red zones on opposite page)








Playbook Plan C
(based on 2011 M9.0 Japan Event at 10m resolution)
Current Thresholds for Potential Damage
Minor to moderate damage (3-6 knots)
Moderate to major damage (6-9 knots)
Major damage/complete destruction (>9 knots)
0.0 0.1 0.2 0.3 0.4 0.5
Kilometers
Current-Threshold Map

Playbook Plan D

(based on M9.4 Chile North Scenario)

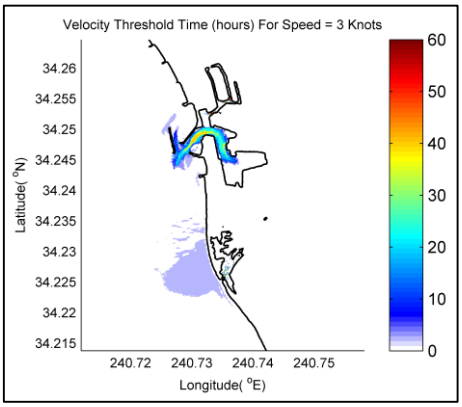
Background Information:
Alert level = Warning
Peak Amplitude = 1.5 meters
Peak Velocity = 10 knots
Projected duration of strong currents (see location map below):
3-6 knots = 40 hrs; 6-9 knots = 15 hrs; >9 knots = 3 hrs

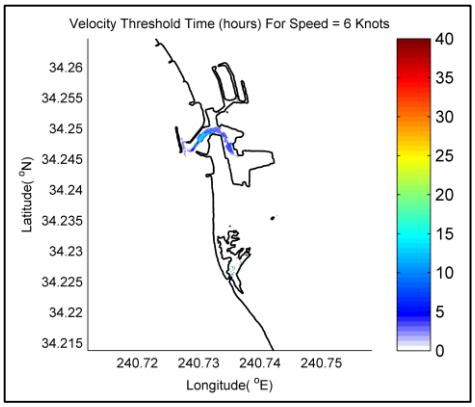
Specific Instructions:

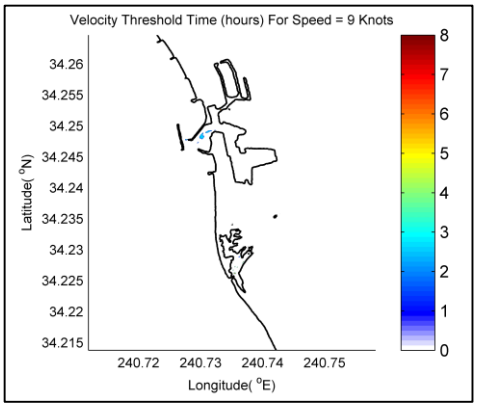
- Follow general guidance for Warning-level tsunamis (Page 5)
- **Inundation of dry land could occur in this scenario**
- Strong currents and potential scour are expected in areas identified in blue and gold on the map to the right. Consider relocating vessels located within 100 meters (300 feet) of these areas.
- Specific areas where vessels should be relocated from and docks secured:
  - Vessels can be moved to non-blue areas the southern portion of the harbor.
  - …… (completed with maritime community input)

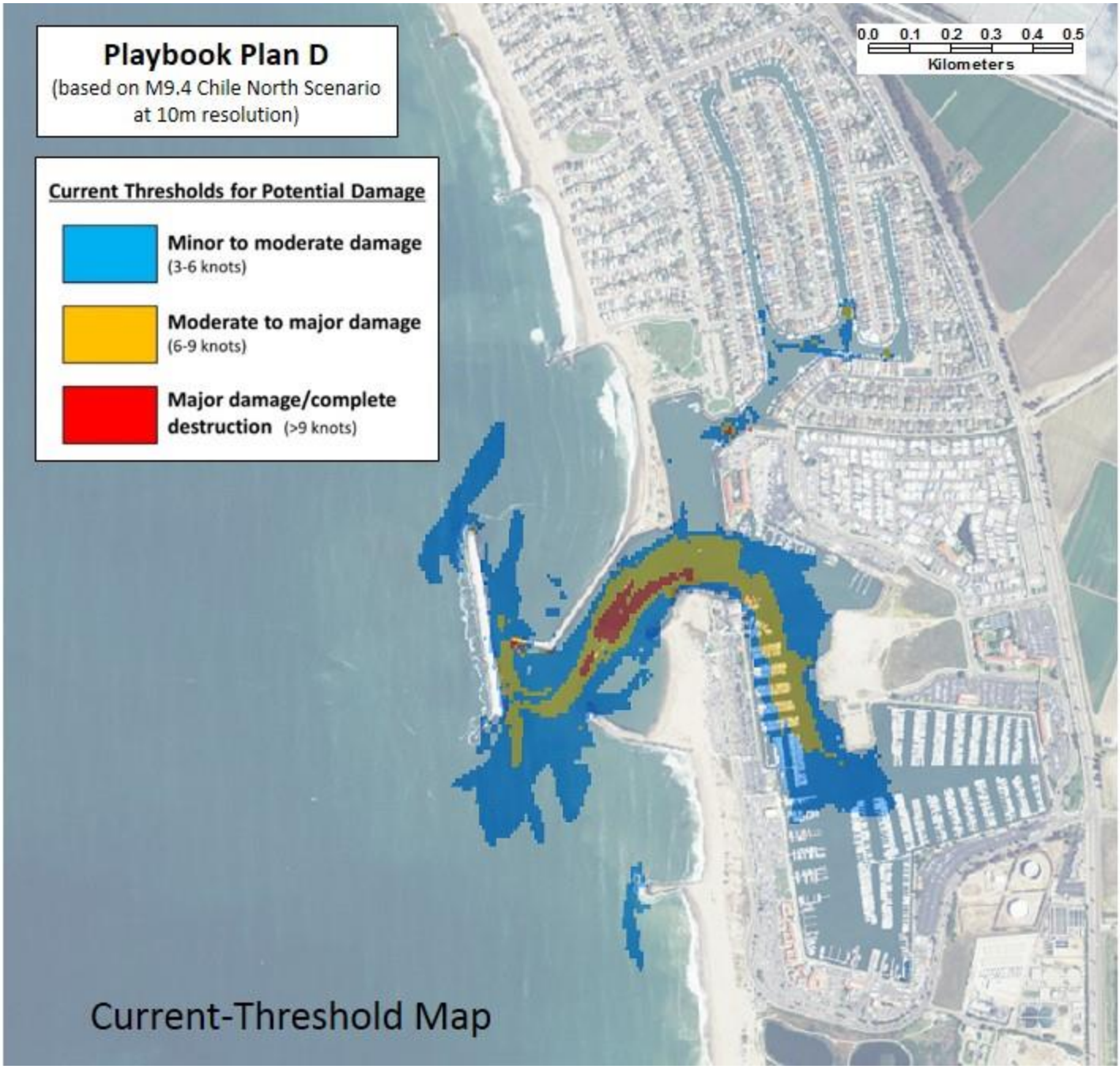
Safe areas for repositioning vessels within Ventura Harbor:
…..(completed with maritime community input)

Time thresholds for currents >3 knots……>6 knots……>9 knots
(Colors below represent HOURS of potential activity for blue, yellow, and red zones on opposite page)








Playbook Plan D
(based on M9.4 Chile North Scenario at 10m resolution)
Current Thresholds for Potential Damage
Minor to moderate damage
(3-6 knots)
Moderate to major damage
(6-9 knots)
Major damage/complete destruction (>9 knots)
0.0 0.1 0.2 0.3 0.4 0.5
Kilometers
Current-Threshold Map

Playbook Plan E

(based on M9.2 Eastern Aleutian-Alaska Scenario)

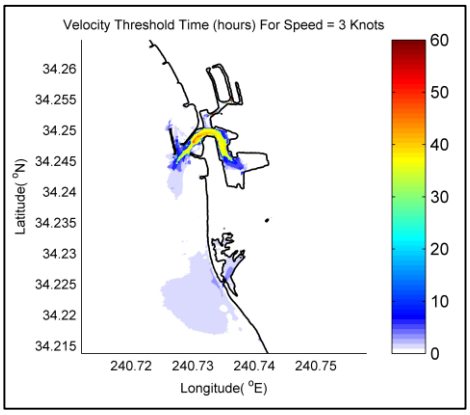
Background Information:
Alert level = Warning
Peak Amplitude = 3.2 meters
Peak Velocity = 15+ knots
Projected duration of strong currents (see location maps below):
3-6 knots = 50 hrs; 6-9 knots = 20 hrs; >9 knots = 5 hrs

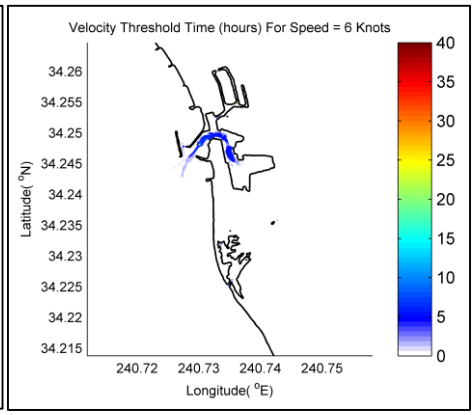
Specific Instructions:

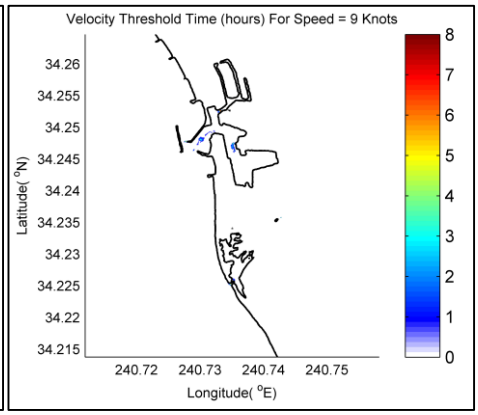
- Follow general guidance for Warning-level tsunamis (Page 5)
- **Inundation of dry land will likely occur in this scenario**
- Strong currents and potential scour are expected in areas identified in blue – yellow-red on the map to the right. Consider relocating vessels located within 100 meters (300 feet) of these areas.
- Specific areas where vessels should be relocated from and docks secured:
  - NONE (completed with maritime community input)

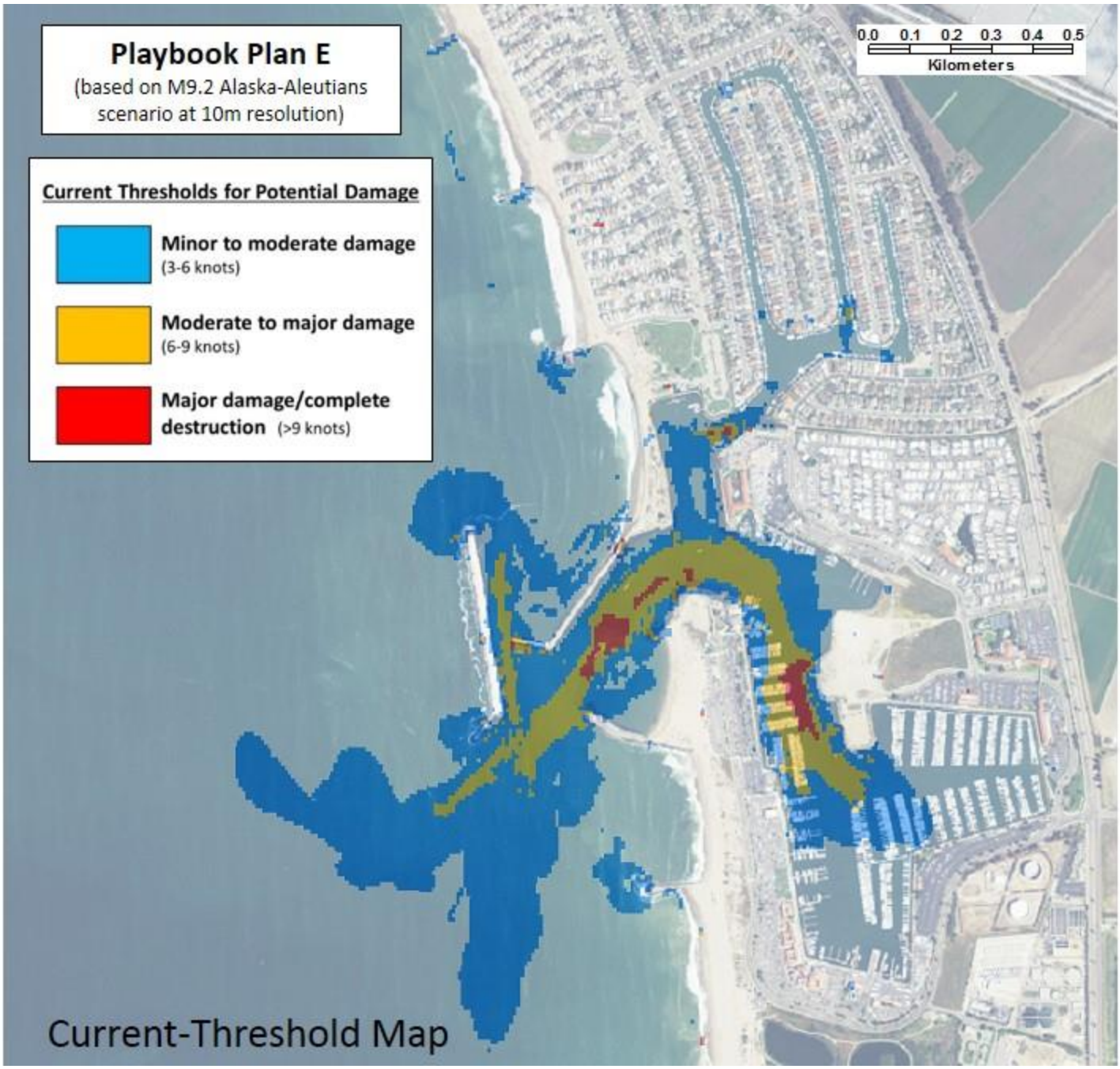
Safe areas for repositioning vessels within Ventura Harbor: NONE
(completed with maritime community input)

Time thresholds for currents >3 knots……>6 knots……>9 knots
(Colors below represent HOURS of potential activity for blue, yellow, and red zones on opposite page)








Playbook Plan E
(based on M9.2 Alaska-Aleutians scenario at 10m resolution)
Current Thresholds for Potential Damage
Minor to moderate damage (3-6 knots)
Moderate to major damage (6-9 knots)
Major damage/complete destruction (>9 knots)
0.0 0.1 0.2 0.3 0.4 0.5
Kilometers
Current-Threshold Map

Notable Historical Tsunamis: The following table provides very basic information about historical tsunami events; not all tsunamis are represented, especially minor or small tsunamis. Note that the largest, most damaging tsunamis in Ventura County history have come from large earthquakes in the Alaska-Aleutian Islands and Chile regions as distant tsunami sources and a potential submarine landslide as a local source. Although the potential for local tsunamis exists, they are much less frequent than distant source tsunamis.

Notable Historical Tsunamis in Ventura County

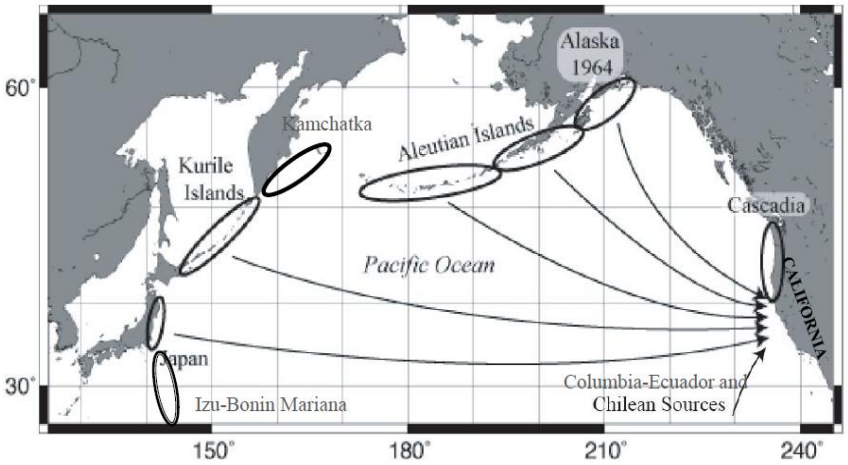
Run-up amplitude, in feet, above normal tide conditions

OBS = observed tsunami activity
NR = No damage or severe conditions reported

- Distant Source - Tsunamis without felt earthquakes

- Local Source - Earthquake and tsunami together

Date	Magnitude-Source area	Tsunami location	Run-Up/Amp	Remarks
12/21/1812	Local M7 earthquake triggered potential submarine landslide	Ventura	7 ft	Tsunami damage to San Miguelito Chapel
4/1/1946	M8.8 – Aleutian Islands	Ventura	OBS	Single wave to the high-water mark
		Port Hueneme	3 ft	Minor berthing problem for ship
		Ormond Beach	5ft	Sand swept over railroad tracks near beach
11/4/1952	M9.0 - Kamchatka	Port Hueneme	2 ft	NR
3/9/1957	M8.6 - Aleutian Islands	Port Hueneme	2 ft	High run-up occurred 6 hours after first wave
3/28/1964	M9.2 Alaska	Ventura	OBS	Tide dropped eight feet
		Oxnard	OBS	Large swells reported
9/29/2009	M8.0 – Samoa	Ventura	OBS	Several buoys moved near mouth of harbor
2/27/2010	M8.8 – Chile	Ventura	3 ft	Over 20 docks damaged ($300-500k)
		Oxnard	3 ft	Damage to docks from large boat wake
		Port Hueneme	4 ft	NR
3/11/2011	M9.0 - Japan	Ventura	4 ft	Damage to dock and several boats ($150k)
		Oxnard	4 ft	Minor damage to docks
		Port Hueneme	5 ft	NR

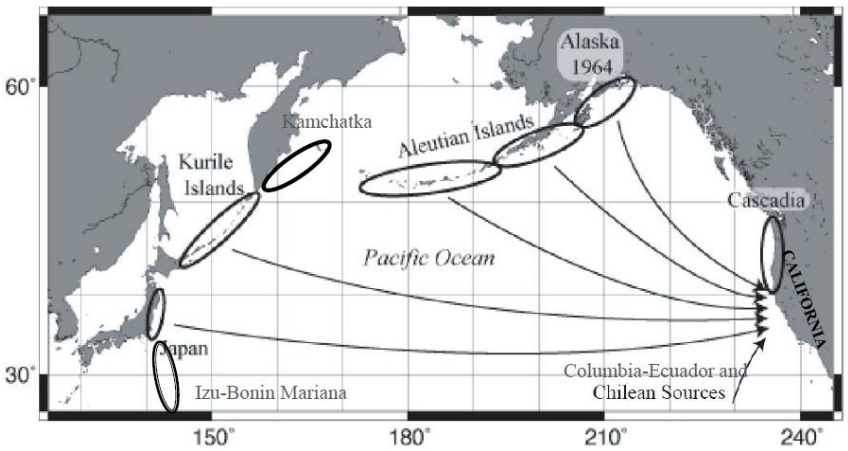


Modeled Tsunami Scenarios: Because very large tsunamis are infrequent and the likelihood that the largest potential tsunamis have not yet occurred in Ventura County, the state tsunami program developed a suite of maximum credible tsunami scenarios as part of their tsunami inundation mapping project for local evacuation planning. The general tsunami wave height for key locations from these scenarios are provided below. As identified in the historical tsunami table, the largest tsunamis could occur from large earthquakes in the Alaska-Aleutian Islands or Chile regions, or from a large submarine landslide offshore.

Tsunami Source Scenario Model Results for Ventura County

Near shore tsunami heights (flow depths) for both local and distant sources scenarios, in feet above Mean Sea Level

	TSUNAMI SOURCES	Approximate Travel Time	Punta	Pitas Point	Dulah	Ventura River	Pierpoint	Ventura Harbor	Oxnard Mandalay	Ox Hbr Entrance	Ox Hbr Channel	Port Hueneme	Oxnard Pier	Point Mugu	Solromar
Local Sources	M7.2 Anacapa-Dume Fault	10-15min		3	4	4	3	4	4		2				
	M7.5 Channel Isl. Thrust Ft	10-15min	8	7	8	6	7	7	6	6	3	4	5	3	5
	M7.1 Santa Monica Fault	15-20min		2	3	3	3	2	3		2				
	M7.7 Catalina Fault	20-30min							2	2	2	3	3	3	5
	Goleta 1 Landslide	10-15min	12	22	6	12	10	5	7		2				
	Goleta 2 Landslide	10-15min	16	9	8	12	11	8	12		2				
Distant Sources	M9 Cascadia-full rupture	1hr		4	4	4	4	5	4		2				
	M9.2 Alaska 1964 EQ	5hr	7	7	7	7	7	8	6	5	5	5	5	4	5
	M8.9 Central Aleutians I	5hr	5	5	5	5	5	5	6	5	8	4	4	3	3
	M8.9 Central Aleutians II	5hr		4	4	4	4	4	3		2				
	M9.2 Central Aleutians III	5hr	10	9	10	9	10	10	10	9	10	7	7	5	6
	M9 Kamchatka 1952 EQ	9hr							3	5	5	3	3	3	3
	M8.8 Kuril Islands II	9hr		3	3	3	3	3	2		2				
	M8.8 Kuril Islands III	9hr		3	3	3	3	3	3		2				
	M8.8 Kuril Islands IV	9hr		3	3	3	3	3	3		2				
	Japan II	10hr		3	3	3	4	4	3		2				
	Chile 1960 EQ	13hr		4	4	4	4	4	4		2				
	Chile North	13hr	7	6	8	6	6	7	7	7	2	5	5	4	4
	Maximum Runup - Local Source		**16**	**22**	**8**	**12**	**11**	**8**	**12**	**6**	**3**	**4**	**5**	**3**	**5**
	Maximum Runup - Distant Source		**10**	**9**	**10**	**9**	**10**	**10**	**10**	**9**	**10**	**7**	**7**	**5**	**6**

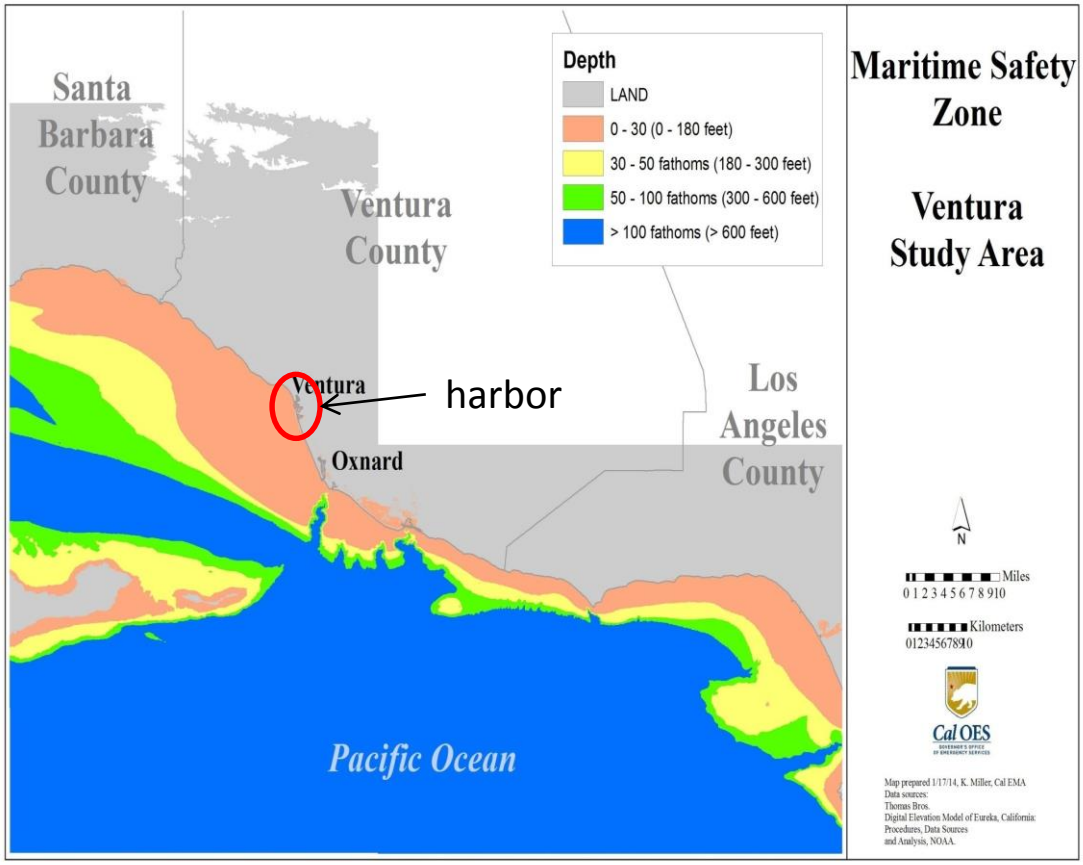


PLAN FOR OFFSHORE EVACUATION OF BOATS

NOTE: The safety of the boating public should outweigh the benefit of saving boats and harbor property during a tsunami.

- For most harbors in California, it is safer to keep boats docked during a tsunami because most tsunamis are relatively small.
- On the rare occasion when a large, damaging tsunami and associated strong currents are expected and there are no safe areas within the harbor, the boat owner may be considering taking their boat offshore.
- There are a number of factors that should be considered prior to recommending boats evacuate offshore prior to the arrival of the tsunamis, including:
  (1) the SIZE of the tsunami;
  (2) is there sufficient TIME to get to the 30 fathom depth (180 feet), which has been evaluated as safe depth for boats during distant source tsunamis (map below);
  (3) the PREPAREDNESS of the boat and its captain to stay at sea over 24 hours;
  (4) the WEATHER at sea could be as dangerous as the tsunami itself; and,
  (5) if significant damage occurs within the harbor, boaters should have enough fuel and supplies to travel to a non-damaged harbor.

Note for trailer boat owners: Expect congested boat ramps and remember that you have to get your boat to the trailer, out of the water, and out of the tsunami zone before the tsunami arrives.



TSUNAMI EVACUATION ZONE MAP FOR VENTURA HARBOR AREA

This tsunami evacuation map was prepared to assist cities and counties in identifying their tsunami hazard. It is intended for local jurisdictional, coastal evacuation planning uses. The red area represents the maximum considered tsunami inundation from a number of extreme, yet realistic, tsunami sources. In other words, people within the red-colored zones could get wet; people uphill or inland from these areas should be safe during any tsunami. **This map, or the local tsunami evacuation map/plan, should be used for evacuation from a Warning-level tsunami event unless otherwise directed by local emergency management officials.**

For digital copies of tsunami inundation maps for other portions of California, visit **http://www.tsunami.ca.gov**

APPENDIX
Quick Reference Page for Determining Real-Time Maritime Tsunami Response Activities

Step 1: Obtain basic information about the earthquake and tsunami from National Tsunami Warning Center in Alaska, regional National Weather Service office, and/or county emergency manager. **NOTE: Tsunami Alert Level may change in first couple hours after the earthquake; WATCH may be upgraded to ADVISORY or WARNING.**

Earthquake location _____

Earthquake magnitude _____

Tsunami Alert level (circle one) WATCH ADVISORY WARNING

Closest forecasted tsunami amplitude/wave height _____

Forecasted tsunami arrival time _____

Step 2: Tsunami evacuation and response will depend on the amount of time before the tsunami arrival. Four (4) hours is considered the threshold time needed for evacuation. As a quick reference, we offer the following guidance:

1) **If less than four hours before tsunami arrival, we recommend the following:**
   - ADVISORY – evacuate beaches, harbor docks, and piers
   - WARNING – evacuate entire maximum on-land evacuation zone, or follow guidance provided by local emergency manager

2) **If greater than four hours before tsunami arrival**, and your harbor has fully developed its tsunami response Playbook plans, the harbor can utilize the FORECAST AMPLITUDE from Step 1 on the table on the right to identify the appropriate response plan to use.

Reference Pages for Details in Maritime Playbook	Scenario Playbook Plan Letter	Peak Amplitude/ wave height (in meters)
	(No action)	~0.3
Page 8-9	A	0.6
Page 10-11	B	0.8
Page 12-13	C	0.9
Page 14-15	D	1.5
Page 16-17	E	3.5