

APPENDIX 11
(SOUTH CAROLINA TSUNAMI RESPONSE PLAN)
TO THE SOUTH CAROLINA EMERGENCY OPERATIONS PLAN

I. INTRODUCTION

- A. Tsunamis are ocean waves produced by earthquakes or underwater landslides and may occur at any time, day, or night.
- B. Tsunamis are often incorrectly referred to as tidal waves. A tsunami is actually a series of waves that can travel at speeds averaging 450 (and up to 600) miles per hour in the open ocean.
- C. There are two sources of tsunamis for coastal waters - a distant source and a local source.
 - 1. Distant Source: The source of the tsunami is more than 620 miles (1,000 km) away from the Tsunami Warning Center's Area of Responsibility (AOR).
 - 2. Local/Regional Source: Source of the tsunami is within 620 miles of the AOR. A local or near-field tsunami has a very short travel time (30 minutes or less), and mid-field or regional tsunami waves have travel times on the order of 30 minutes to 2 hours.
- D. Locally generated tsunamis generally cause more loss of life than distant tsunamis. Tsunamis generated from local sources are generally larger and arrive much sooner after the causative source event than tsunamis from distant sources. Though the impact is high, the probability for such an event is extremely low.
- E. Though seldom, tsunamis have been recorded along the U.S Atlantic Coast as far back as 1755 and as recent as 1929. Landslides on the outer continental shelf and slope along the Mid-Atlantic coast have the potential to trigger tsunamis that may affect populated coastal areas.
- F. Withdrawal of the sea is not always a precursor to arrival of the wave. The first wave may not be the largest. The largest wave usually occurs among the first three waves.

II. PURPOSE

- A. Plan and coordinate the operational procedures South Carolina will use in the event of a tsunami.
- B. Provide resources to assist local governments in preventing and minimizing injury or death to people resulting from a tsunami.

III. ASSUMPTIONS

- A. Communications and critical infrastructure services will be disrupted or destroyed.

- B. The maximum possible tourist and workforce populations will be present in affected areas.
- C. Damage will be widespread and will vary widely (i.e., concentrations of significant damage in some areas with slight damage in others).
- D. Access to damaged areas will be restricted and some low-lying areas will be inundated.
- E. The Statewide Mutual Aid Agreement will be implemented.

IV. SITUATION

- A. Though the potential impact is high, the tsunami threat for South Carolina is extremely low, and any tsunamis would likely be small and inundate mostly the beaches.
- B. The tsunami threat in South Carolina will result from a distant seismic source and provide at least 2-4 hours lead time.
- C. A Tsunami Watch, Warning, or Advisory will be transmitted by National Weather Service (NWS) offices for all tsunamis forecasted to impact South Carolina.
- D. The National Tsunami Warning System was developed and implemented to help reduce the loss of life and property from a tsunami event.
 - 1. The National Oceanic and Atmospheric Administration (NOAA) monitors for earthquakes and subsequent tsunami events in both the Pacific and Atlantic Oceans.
 - 2. The Tsunami Warning Centers issue Tsunami Warnings, Watches, and Advisories in addition to Tsunami Information Bulletins for both the U.S. West and East Coasts.
- E. NOAA's NWS Offices promote the TsunamiReady Program.
 - 1. The TsunamiReady Program is designed to help states, counties, municipalities, universities and other population centers in coastal areas reduce the potential for deadly tsunami-related consequences.
 - 2. The program helps community leaders and emergency managers strengthen their local operations. TsunamiReady communities are better prepared to save lives through improved planning, education, and awareness.
 - 3. Communities have fewer fatalities and property damage if they effectively plan before a tsunami arrives. No community is tsunami proof, but the TsunamiReady Program can help minimize loss to vulnerable communities.

4. SC Tsunami Ready Counties and Communities:
<https://www.weather.gov/tsunamiready/sc-tr>

Counties	Communities
• Charleston	• Myrtle Beach
• Georgetown	• North Myrtle Beach
• Horry	• Surfside Beach
	• Debordieu Colony

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V. CONCEPT OF OPERATIONS

A. Warning System

1. NOAA operates the Tsunami Warning System with the goal of protecting life and property from the tsunami hazard by providing timely, accurate, reliable, and effective tsunami warning to coastal populations and emergency management organizations within the AOR as well as by advancing other aspects of tsunami hazard mitigation.
2. The primary operational objectives of a Tsunami Warning System are to rapidly locate, assess magnitude and extent, and otherwise characterize major earthquakes to determine their tsunami potential, predict tsunami arrival times, predict coastal run-up when possible, and disseminate appropriate warning and informational products based on this information.
3. National Tsunami Warning Center
 - a. The National Tsunami Warning Center at Palmer, Alaska is responsible for the preparation and dissemination of Tsunami Warning, Watch, Advisory, and Information products for the coastal regions of Canada and all States except Hawaii. These regions are defined as the National Tsunami Warning Center’s AOR.
 - b. The National Tsunami Warning Center has the primary responsibility for the detection and parameterization of potentially tsunamigenic earthquakes occurring within or immediately adjacent to its AOR and events within the Atlantic Basin north of the Tropic of Cancer.
4. Deep-ocean Assessment and Reporting of Tsunamis Buoys.
 - a. The Tsunami Warning Center uses earthquake information, tide gauges, and DART (Deep-ocean Assessment and Reporting of Tsunamis) buoys.

- b. DART buoys are located in the Atlantic Ocean, the Gulf of Mexico, and the Caribbean Sea.
 - c. The DARTs (or tsunameters) are strategically deployed near regions to ensure accurate measurement of the waves as they propagate towards threatened U.S. coastal communities.
 - d. The data captured by DART buoys is critical to monitoring tsunami waves and predicting the timing and magnitude of the waves as they approach and impact the coast of South Carolina.
5. The following products are issued by NOAA’s Tsunami Warning Centers. Each had a distinct meaning relating to local emergency response.

Product	Likely Wave Action	Recommended Actions
Information Statement	Minor waves at most	No action suggested
Watch	Danger level not yet known	Stay alert for more info
Advisory	Strong currents likely	Stay away from the shore
Warning	Inundating wave possible	Full evacuation suggested

a. Tsunami Information Statement

- (1) A Tsunami Information Statement is issued to inform emergency management officials and the public an earthquake has occurred, or a tsunami warning, watch or advisory has been issued for another section of the ocean.
- (2) In most cases, Information Statements are issued to indicate there is no threat of a destructive tsunami and to prevent unnecessary evacuations as the earthquake may have been felt in coastal areas.
- (3) An Information Statement may, in appropriate situations, caution about the possibility of destructive local tsunamis.
- (4) Information Statements may be re-issued with additional information, though normally these messages are not updated. However, a watch, advisory or warning may be issued for the area, if necessary, after analysis and/or updated information becomes available.

b. Tsunami Watch

- (1) A Tsunami Watch is issued to alert emergency management officials and the public of an event which may later impact the watch area.
- (2) The Watch area may be upgraded to a warning or advisory or canceled based on updated information and analysis.
- (3) Watches are normally issued based on seismic information without confirmation that a destructive tsunami is underway.
- (4) Citizens should use a NOAA Weather Radio or stay tuned to a local radio or television station for updated emergency information.

c. Tsunami Advisory

- (1) A Tsunami Advisory is issued due to the threat of a potential tsunami which may produce strong currents or waves dangerous to those in or near the water.
- (2) The threat may continue for several hours after the arrival of the initial wave, but significant widespread inundation is not expected for areas under an advisory.
- (3) Appropriate actions to be taken by local officials may include closing and/or evacuating beaches, evacuating harbors and marinas, and repositioning ships to deep waters when there is time to do so. Local tsunami plans should be referenced for more information.
- (4) Advisories are normally updated to continue the Advisory, expand/contract affected areas, upgrade to a warning, or cancel the Advisory.

d. Tsunami Warning

- (1) A Tsunami Warning is issued when a potential tsunami with significant widespread inundation is imminent or expected.
- (2) Warnings alert the public that widespread, dangerous coastal flooding accompanied by powerful currents is possible and may continue for several hours after arrival of the initial wave.
- (3) Warnings also alert emergency management officials to take action for the entire tsunami hazard zone. Appropriate actions to be taken by local officials may include the evacuation of low-lying coastal areas, and the repositioning

of ships to deep waters when there is time to safely do so. Reference local tsunami plans for more information.

- (4) Warnings may be updated, adjusted geographically, downgraded, or canceled. To provide the earliest possible alert, initial Warnings are normally based only on seismic information.
- 6. The geographic extent of a tsunami product is based on the size of the earthquake, the tsunami travel times throughout the AOR, and expected impact zones.
- 7. Tsunami products are generally issued within 10 minutes after earthquake occurrence.
- 8. Below is the U.S. East Coast criterion:

Magnitude	Area	Product
4.0-4.9	Within 50 km (31 miles) of coast	Tsunami Seismic Information Statement
5.0-5.9	Within 500 km (310 miles) of coast	Tsunami Seismic Information Statement
6.0-6.75	Within 500 km (310 miles) of coast	Tsunami Information Statement
6.0+	Inland	Tsunami Information Statement
6.8-7.5	Atlantic Coast	Tsunami warning (350km) (217 miles)
7.6-7.8	Atlantic Coast	Tsunami warning (1000km) (620 miles)
>7.8	Atlantic Coast	3 hour watch/3 hour warning

B. Notification

- 1. In the event of a Tsunami Warning, Watch, Advisory, or Information Statement, the National Tsunami Warning Center issues the tsunami message to the NWS offices in the affected states. The local NWS forecast offices have the primary responsibility to process the information and rebroadcast the tsunami message or product through the civil emergency system which activates Emergency Alert System (EAS).
- 2. EAS
 - a. The decision to activate EAS for a tsunami product is the sole responsibility of the local NWS Forecast Offices.

- b. The issuance of a Tsunami Warning or Watch may prompt NWS to activate EAS. The issuance of a Tsunami Advisory and Information Statement will not prompt EAS activation.
 - c. If NWS activates EAS, state and local officials can follow-up with another activation of EAS to warn the public and/or issue safety messages.
 - d. Tsunamis with minimal impacts (rough surf and currents) may not result in EAS activation.
3. Upon receipt of a Tsunami Warning, Watch, Advisory, or Information Statement. The State Warning Point (SWP) will confirm receipt of the tsunami message with the National Tsunami Warning Center and relay to coastal counties. For redundancy, the SWP has several communications systems to receive tsunami messages when issued by NOAA:
 - SC Law Enforcement Division (SLED) teletype system
 - Internet
 - NOAA All Hazards Weather Radio
 - iNWS text/email notification
 - NWS Chat
4. During business hours a copy of the tsunami message is given to SC Emergency Management Division (SCEMD) officials by the SWP and forwarded to the coastal emergency management offices. The SWP will call to confirm receipt of the message.
5. After business hours, it is forwarded to coastal emergency management warning centers which notify the county emergency management director. The SWP will also confirm the receipt of the message telephonically with the warning centers and forward the message to the Duty Officer, Director, Chief of Staff, and the SCEMD Chiefs.
6. The SWP participates monthly in a tsunami message test drill. The procedures for notification of a tsunami message are exercised during this monthly test drill.
7. The coastal county warning centers also receive Tsunami Warning and/or Watch information independent of the SWP through NOAA All Hazards Weather Radio and other systems that receive NOAA Weather warnings.
8. Upon receipt of any of the tsunami products, the SCEMD Director (or his designee) will confer with the NWS State Liaison (and if not available, a

coastal NWS Forecast representative) to confirm threat and discuss potential consequences.

9. In the event a Tsunami Warning is issued for South Carolina coast by the National Tsunami Warning Center (NTWC), the State Emergency Operations Center (SEOC) will activate at OPGON 1 and staff accordingly.
10. In the event a Watch or Advisory is issued for the South Carolina coast by the National Tsunami Warning Center, the SEOC will activate at OPGON 3 and staffed accordingly.

C. Evacuation

1. High-speed communications systems are used by the Tsunami Warning Centers, and distant tsunamis can often be announced by the Warning Centers with lead time to evacuate. A tsunami produced from a distant-source may allow three or four hours to evacuate.
2. Current tsunami inundation modeling is still in its infancy for the U.S. East Coast. There is some modeling work being done by NOAA. Until tsunami inundation maps are developed for coastal South Carolina, the State's Tsunami Evacuation Zone will use the recommended NWS Forecast Zone which is the evacuation one (1) mile inland away from river or approximately the third floor of a high rise building in the event of a Tsunami Warning.
3. Inland evacuation is the preferred method to evacuate low-lying coastal areas in advance of the initial tsunami wave. However, if lead time is insufficient to effect an inland mass evacuation, citizens should evacuate to high rise buildings to the highest floor to implement vertical evacuation procedures. Vertical evacuation is a last resort. Vertical evacuation is the act of moving to the highest floor in a multiple-story building in order to avoid the tsunami wave
4. SCEMD will request the Governor activate the SC Emergency Operations Plan (SCEOP) and may declare a mandatory evacuation of specific coastal areas. Upon receipt of a Tsunami Warning, local government officials will communicate, if applicable, the Governor's evacuation order to the threatened area. See Attachment A for a Sample Evacuation Order.
5. The evacuation message will be broadcast to television and radio stations through the activation of EAS and other communications systems.
6. SCEMD and the local emergency manager will maintain communication with the NWS State Liaison and the local NWS Forecast Offices on all notification and evacuation decisions. Telephone numbers of the NWS Forecast offices are maintained in SCEMD and the county emergency managers' telephone directories.

7. An evacuation order for a Tsunami Watch will be dependent upon the situation. The recommendation to evacuate will be made by representatives of the State Emergency Response Team (SERT), NWS forecast officials, and affected local emergency management officials.
8. After the arrival of the first wave, additional waves may continue at varying intervals for several hours.
9. Assembly areas for those without transportation may be designated in the tsunami risk areas by county emergency managers.
10. Shelters for persons needing accommodations will be identified outside the tsunami risk areas.
11. If required or requested, Traffic Control Points (TCP) will be identified for the areas and implemented by local law enforcement with assistance by ESF-16 (Emergency Traffic Management) if necessary. Access control after the event is essential.
12. Identifying evacuation routes are not necessary due to the limited inundation area; however, if the need arises to implement evacuation routes, the routes currently identified for hurricane evacuation will be implemented along with traffic management operations. Local officials will be responsible for coordinating local evacuation efforts and requesting implementation of the hurricane traffic management plan.
13. The following actions will occur following an evacuation order:
 - a. Advise jurisdictions to maintain full evacuation until the evacuation order has been rescinded. The evacuation order being rescinded will be based upon an “ALL CLEAR” signal from Tsunami Warning Center and in consultation with local officials.
 - b. An “ALL CLEAR” determination is the responsibility of local officials in consultation with NWS Forecast Offices and SERT officials. An “ALL CLEAR” message will be issued no earlier than after the last damaging wave. Before the “ALL CLEAR” determination is made, officials must be able to observe the waves from a safe distance/height
 - c. No persons are to enter evacuated areas until the evacuation order has been rescinded. Re-entry is the responsibility of local officials.
 - d. Consider requesting a disaster declaration based on incurred damage.
 - e. Disseminate public information about the event.

- f. Resource allocation and coordination preceding the tsunami wave will take into consideration the following areas of special concern:
 - (1) Evacuation of education and childcare facilities and nursing homes located within the impacted area.
 - (2) Evacuation of disabled persons and those needing special medical assistance within the impacted area.
- g. Request jurisdictions to initiate preparation for damage assessments to compile information and report information to the SEOC.
- h. Request health inspections to begin preparation of damaged areas to ensure they are safe for residents to return.

14. See Attachments B, C & D for Tsunami Checklists.

D. Public Information

1. See Annex 15 (Public Information) of the SCEOP.
2. The NWS Forecast Offices have the authority and responsibility to warn of a tsunami. The NWS Forecast Offices activate EAS and other systems. State and local officials may follow with a rebroadcast of the initial EAS message.
3. A Tsunami Warning will be disseminated to cover the affected areas by one or all of the following systems:
 - EAS
 - NOAA All Hazards Weather Radio
 - Local Warning System (e.g., Reverse 911, Code Red, Everbridge etc)
 - Local TV Stations
 - Local Radio Stations
 - Loud speakers (if available)
 - Route Alerting
 - Social Media
 - County apps (if available)
4. See Attachment G for a Sample EAS Statement and Attachment H for a Sample News Release.

E. Recovery

1. SCEMD will implement the SC Initial Recovery Plan to facilitate recovery in the disaster area after the evacuation order has been rescinded and the “ALL CLEAR” signal has been given.
2. A focus will be placed on health inspections to prevent the spreading of communicable diseases, and the contamination of food and water supplies.

VI. RESPONSIBILITIES

A. South Carolina Emergency Management Division.

1. Update and review annually this Annex and coordinate plan review with applicable state agencies, local NWS Weather Forecast Offices, and county emergency management offices.
2. Provide assistance to county emergency management offices in support of tsunami planning and TsunamiReady Program. See Attachment I – Map of TsunamiReady Counties and Communities.
3. Coordinate with local emergency management offices and local NWS Weather Forecast Offices to review procedures for disseminating tsunami products to local jurisdictions.
4. Coordinate and implement procedures to relay and/or verify receipt of tsunami products notifications to affected counties.
5. Coordinate with NOAA and local emergency management offices to determine tsunami inundation areas within the State and develop tsunami inundation maps.
6. In conjunction with county emergency management offices and local NWS Forecast Offices develop public education tools for tsunami public education program.
7. Coordinate with local NWS Weather Forecast Offices to prepare EAS tsunami messages to include “ALL CLEAR” messages.
8. Coordinate with local NWS State Liaison Office to participate in the monthly EAS test and provide information to coastal counties.

B. Coastal County Emergency Management Offices.

1. Participate in TsunamiReady Program and tsunami planning.
2. In conjunction with SCEMD and NOAA, assist in the development of tsunami inundation maps. Incorporate available information into emergency action plans.

3. Develop plans to receive and disseminate tsunami products as needed in emergency action plans.
 4. In conjunction with SCEMD, local NWS Forecast Offices, SC Department of Public Safety (SCDPS), SC Department of Transportation (SCDOT), and local law enforcement offices, assist in the development and coordination of traffic management plans to ensure effective evacuation to include establishing local traffic control points/road blocks and implementing of the hurricane traffic management planning if necessary.
 5. Review and identify the best methods to evacuate threatened areas. For vertical evacuations, local planning for use of multi-story, high capacity, structurally sound buildings is needed. Additionally, identification of and routing to/from these structures must be considered.
 6. In coordination with SC Department of Health and Environmental Control (SCDHEC) identify licensed health care facilities requiring transportation assistance.
 7. In conjunction with the American Red Cross and SC Department of Social Services (SCDSS), identify shelters to support displaced tourists and county population. Shelters identification should be outside the tsunami risk area.
 8. In conjunction with local NWS Forecast Offices develop public education tools for tsunami public education and information program. Utilize materials from TsunamiReady Program.
 9. Identify assembly areas for those without transportation to take to shelters.
 10. In coordination with SCEMD and local NWS Forecast Offices develop plans to issue “ALL CLEAR” signal and initiate re-entry policies.
- C. South Carolina Department of Transportation.
1. Review plans and procedures be prepared to implement plans to transport evacuated persons from tsunami threatened areas to designated shelters.
 2. In coordination with the South Carolina Department of Education (Transportation), identify school buses for evacuation of coastal communities.
 3. In coordination with the South Carolina National Guard, identify bus drivers for evacuation missions.
 4. Contact the Air Boss to activate the Air Operations Branch.
 5. Identify roadways requiring post-impact debris removal.

6. Inspect tsunami-impacted roadways and bridges.
- D. South Carolina Department of Administration (Division of Technology Operations).
1. Issue pre-planned radio/cell phone equipment in support of SCDPS transportation management and evacuation operations (Note: May be insufficient time to distribute equipment per plan; prioritized distribution scheme may be employed).
 2. As required, coordinate alternate communication systems to augment damaged or inoperative systems.
 3. Gather post-impact communication damage assessment information (including telephone/cellular, broadcast and commercial radio stations, and cyber related outages) for integration into recovery plans.
- E. South Carolina Department of Labor, Licensing, and Regulation. Posture Search and Rescue teams as close as possible to anticipated impact areas in preparation for operations.
- F. South Carolina Department of Social Services.
1. In coordination with the American Red Cross and local emergency managers, identify shelters to support evacuations from tsunami risk areas. Shelter identification should be outside the tsunami risk areas.
 2. In coordination with The Salvation Army (TSA) and the American Red Cross, be prepared to feed evacuated persons from tsunami threatened areas.
- G. American Red Cross.
1. In coordination with local emergency managers and SCDSS, identify shelters to support evacuations from tsunami risk areas. Shelters should be located outside tsunami risk areas.
 2. In coordination with SCDSS, TSA, and local emergency managers, be prepared to feed evacuated persons from tsunami threatened areas to include special needs populations (nursing homes, health care facilities, foster care group homes, vulnerable adult population groups).
 3. Red Cross and/or other organizations may open general population mass care shelters. Red Cross shelter operations, however, are managed by Red Cross-trained volunteers and staff while SCDSS provides augmentation to support Red Cross and local/county incident commanders that need additional shelter support.
 4. Support local government TsunamiReady Programs.

- H. The Salvation Army. In coordination with DSS and the American Red Cross, be prepared to feed evacuated persons from tsunami threatened areas to include special needs populations (nursing homes, health care facilities, foster care group homes, vulnerable adult population groups).
- I. South Carolina Lieutenant Governor's Office on Aging. Coordinate and implement procedures to relay Tsunami Warning and Watch notifications to Area Agencies on Aging serving senior population groups in inundation areas.
- J. South Carolina Department of Health and Environmental Control.
 - 1. Review health concerns that may affect the public following a tsunami and develop procedures to prevent spread of communicable diseases and contamination of food and water supplies.
 - 2. Open, manage and operate Special Medical Needs Shelters as required.
 - 3. In coordination with county emergency managers, identify licensed health care facilities requiring transportation assistance.
 - 4. Provide information and monitor hazardous material storage facilities to minimize hazardous material spills.
- K. South Carolina Department of Natural Resources. In coordination with SCDOT and SCDPS, develop plans and procedures to evacuate persons using boats and other water craft and respond to other requests for assistance.
- L. South Carolina Department of Public Safety.
 - 1. In conjunction with county law enforcement authorities, develop and coordinate traffic management plans to assist with evacuation of affected areas to include establishing local traffic control points/road blocks and implementation of the hurricane traffic management planning if necessary.
 - 2. Support local government tsunami planning.
- M. Clemson University Livestock-Poultry Health.
 - 1. Consult with SC Association of Veterinarians and SCDHEC concerning animal diseases and public health concerns related to a tsunami hazard, and assist with dissemination of related information to the public.
 - 2. In coordination with local emergency managers and other ESF-17 (Animal/Agriculture Emergency Response) support agencies, identify emergency animal shelters located outside tsunami risk areas.
- N. South Carolina Department of Commerce.

1. Assess business impacts in affected communities as a result of the disaster.
2. Coordinate with the South Carolina Department of Insurance in monitoring the post-impact deployment/activities of insurance claims adjusters.

VII. FEDERAL ASSISTANCE

- A. NOAA assists through its subordinate agencies to include the NWS Weather Forecast Offices, the NOAA Center for Tsunami Research (NCTR), and the National Geophysical Data Center (NGDC).
- B. The Department of Homeland Security and the Federal Emergency Management Agency (FEMA) will implement the National Response Framework (NRF) to provide assistance.
- C. The United States Geological Survey (USGS) provides earthquake monitoring and analysis support.
- D. Other Federal agencies have collateral or coordinating responsibilities as identified in the SCEOP.

VIII. ATTACHMENTS

Annex A	Sample Evacuation Order
Annex B	Tsunami Warning Checklist
Annex C	Tsunami Watch Checklist
Annex D	Tsunami “ALL CLEAR” Checklist
Annex E	Sample Emergency Alert System (EAS) Messages for Tsunami Hazard
Annex F	Sample News Release
Annex G	TsunamiReady Map