



National Flood Insurance Program
Community Rating System

CRS Credit for Mitigation of Tsunami Hazards

2006



FEMA

A community interested in more information on obtaining flood insurance premium credits through the Community Rating System (CRS) should have the *CRS Application*. This and other publications on the CRS are available at no cost from

Flood Publications
NFIP/CRS
P.O. Box 501016
Indianapolis, IN 46250-1016
(317) 848-2898
Fax: (317) 848-3578
NFIPCRS@iso.com

They can also be viewed and downloaded from FEMA's CRS website,
<http://training.fema.gov/emiweb/CRS/index.htm>

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INTRODUCTION

The Community Rating System (CRS) rewards communities that are doing more than meeting the minimum requirements of the National Flood Insurance Program (NFIP) to help their citizens prevent or reduce flood losses. The CRS also provides an incentive for communities to initiate new flood protection activities. The goal of the CRS is to encourage, by the use of flood insurance premium adjustments, community and state activities beyond those required by the NFIP to

- Reduce flood losses, i.e.,
 - protect public health and safety,
 - reduce damage to buildings and contents,
 - prevent increases in flood damage from new construction,
 - reduce the risk of erosion damage, and
 - protect natural and beneficial floodplain functions.
- Facilitate accurate insurance rating, and
- Promote the awareness of flood insurance.

The CRS includes 18 creditable activities, organized under four categories:

300—Public Information

400—Mapping and Regulations

500—Flood Damage Reduction

600—Flood Preparedness.

Credit points are based on the extent to which an activity advances the three goals of the CRS. Communities are invited to propose alternative approaches to these activities in their applications.

The Federal Emergency Management Agency (FEMA) and many communities in the United States have long recognized that the mapping and regulatory standards of the NFIP do not adequately address all of the flood problems in the country. In particular, a number of “special” flood hazards deserve attention. They include

- Ice jam flooding,
- Flooding adjacent to closed basin lakes,
- Mudflow hazards,
- Flooding affected by land subsidence,
- Uncertain flow path flood hazards,
- Coastal erosion, and
- Tsunamis.

This publication discusses the credits provided by the CRS for mapping and management of tsunami hazards. The other hazards are addressed in the publications *Special Hazards Supplement to the CRS Coordinator's Manual* and *CRS Credit for Management of Coastal Erosion Hazards*. All are supplements to the *CRS Coordinator's Manual*, and include additional Schedule sections and Commentary.

BACKGROUND ON TSUNAMI HAZARDS

A tsunami is a series of long waves generated by a sudden displacement of a large volume of water. Tsunamis are triggered by submarine earthquakes, submarine volcanic eruptions, underwater landslides or slumps of large volumes of earth, meteor impacts, and even onshore slope failures that fall into the ocean or a bay.



Source: NOAA News Photo.

Tsunamis are typically classified as either local or distant. Locally generated tsunamis have minimal warning times and may be accompanied by damage resulting from the triggering earthquake such as ground shaking, surface faulting, liquefaction, or landslides. This leaves few options except to run to high ground. Distant tsunamis may travel for hours before striking a coastline giving the community a chance to implement evacuation plans.

In the open ocean, a tsunami may be only a few inches or feet high but can travel with speeds approaching 1000 kilometers (about 600 miles) per hour. As a tsunami enters the shoaling waters near a coastline, its speed diminishes, its wavelength decreases, and its height increases greatly. However, the first wave usually is not the largest. Several larger and more destructive waves often follow the first one.

The configuration of the coastline, the shape of the ocean floor, and the characteristics of advancing waves play important roles in the destructiveness of the waves. Offshore canyons can focus tsunami wave energy and islands can filter the energy. The orientation of the coastline determines whether the waves strike head-on or are refracted from other parts of the coastline.

A wave may be small at one point on a coast and much larger at other points. Bays, sounds, inlets, rivers, streams, offshore canyons, islands, and flood control channels may cause various effects that result in greater damage than many people would expect. It has been estimated, for example, that a tsunami wave entering a southern California flood control channel could reach a mile or more inland, especially if it enters at high tide.

The first visible indication of an approaching tsunami may be recession of water (draw down) caused by the trough preceding the advancing, large inbound wave crest. Rapid draw down can create strong currents in harbor inlets and channels that can severely damage coastal structures due to erosive scour around piers and pilings. As the water's surface drops, piers can be damaged by boats or ships straining at or breaking their mooring lines. The vessels can overturn or sink due to strong currents, collisions with other objects, or impact with the harbor bottom.

Conversely, a rise in water level may be the first indication of a tsunami. The advancing tsunami may initially resemble a strong surge increasing the sea level like the rising tide, but the tsunami surge rises faster and does not stop at the shoreline. Even if the wave height appears to be small, three to six feet for example, the strength of the accompanying surge can be deadly. Waist-high surges can cause strong currents that float cars, small structures, and other debris. Boats and debris are often carried inland by the surge and left stranded when the water recedes.

Outflow following inundation also creates strong currents, which rip at structures and pound them with debris, and erode beaches and damage coastal structures. As tsunamis reach the shoreline, they may take the form of a fast-rising tide, a cresting wave, or a bore. The bore phenomenon resembles a step-like change in the water level that advances rapidly (from 10 to 60 miles per hour).

The force and destructive effects of tsunamis should not be underestimated. At some locations, the advancing turbulent wave front will be the most destructive part of the wave. In other situations, the greatest damage will be caused by the outflow of water back to the sea between crests, sweeping all before it and undermining roads, buildings, bulkheads, and other structures.

This outflow action can carry enormous amounts of highly damaging debris with it, resulting in further destruction. Ships and boats, unless moved away from shore, may be dashed against breakwaters, wharves, and other craft, or be washed ashore and left grounded after the withdrawal of the seawater.



Damage from the 1960 tsunami in the Waiakea area of Hilo, Hawaii. The force of the debris-filled waves bent parking meters. (National Tsunami Hazard Mitigation Program, 2001, p. 13; Photo from U.S. Navy.)

Source Areas

The earth's surface is made up of a number of plates that contain large sections of the continents and ocean basins. These plates may pull apart, slide past, override, or underide (i.e., "subduct") one another. Plate boundaries coincide with faults that produce earthquakes as stress accumulated from the relative movement of the plates is relieved. The earthquakes, in turn, may produce displacements of the sea floor that can set the overlying column of water in motion, initiating a tsunami. However, all submarine earthquakes do not produce tsunamis. It depends on the magnitude of the earthquake and type of faulting that has occurred.

The National Oceanographic and Atmospheric Administration (NOAA) issues warnings of a possible tsunami when an earthquake is located very near or under the sea and its magnitudes exceeds a certain threshold (currently 6.8 for earthquakes in Hawaii, 7.0 for Alaska, British Columbia, Washington, Oregon, and California, and 7.5 for elsewhere in the Pacific).

The most active plate boundaries rim the Pacific Ocean and the Caribbean Sea. Consequently, this is where most tsunami activity might be expected. This is indeed the case. Most tsunamis originate in the Pacific “Ring of Fire,” which is the most active seismic feature on earth.

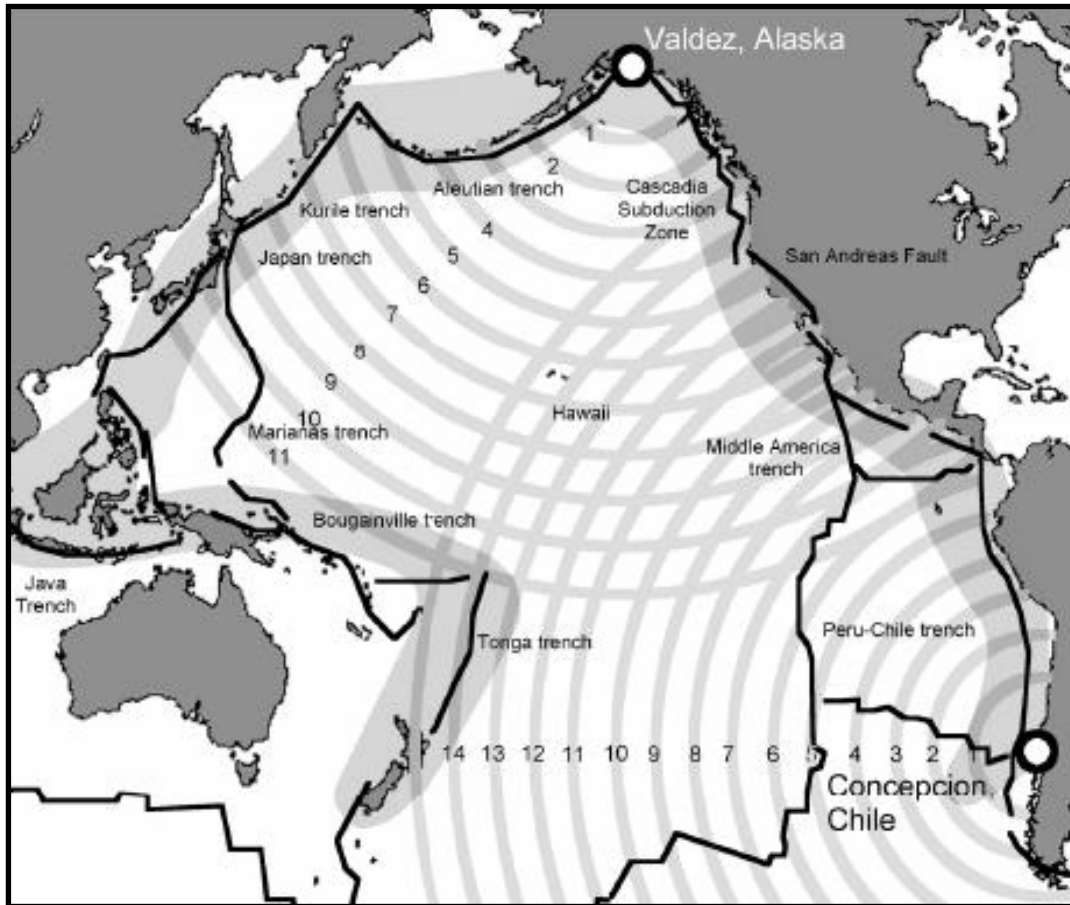
An estimated 489 cities within the Pacific states of Alaska, California, Hawaii, Oregon, and Washington are susceptible to tsunamis. As many as 900,000 residents of these cities would be inundated by a 50-foot tsunami.

Potential Destructiveness of Tsunamis in the Five Pacific States (Wallace, 2000, p. 5)		
State	Cities susceptible to tsunamis	Population endangered by a 50-foot tsunami
Alaska	52	47,000
California	152	589,500
Hawaii	123	131,000
Oregon	60	31,500
Washington	102	96,000
Total	489	895,000

Pacific Northwest

History has demonstrated that most tsunamis affecting the Pacific Northwest (N. California, Oregon, and Washington) have originated in the Gulf of Alaska (Aleutian Subduction Zone). There is also geological evidence of significant impacts from tsunamis originating along the Cascadia Subduction Zone. The Cascadia Subduction Zone extends from Cape Mendocino in California to the Queen Charlotte Islands, British Columbia, and its surface trace is but a short distance off the coast.

Historically, the Washington and Oregon coasts have received comparatively minor damage from Alaskan tsunamis. However, Crescent City, in northern California, has experienced damaging tsunamis from Alaska and noticeable effects from a tsunami originating near Chile. A tsunami generated along the near-by Cascadia Subduction Zone would probably also be very damaging to that community.



The Pacific “Ring of Fire” is the most active seismic feature on earth. Tsunami waves triggered by seismic activity can travel across the Pacific Ocean at up to 500 miles per hour, striking distant coastal areas in a matter of hours. The figure shows the estimated number of hours for tsunami-generated waves to travel across the Pacific Ocean from Alaska and Chile, respectively (National Tsunami Hazard Mitigation Program, 2001, p. 6).

Many geo-scientists and emergency managers are concerned about the possibility of an earthquake along the Cascadia Subduction Zone. Much of the concern is based on the proximity of the zone to populated coastal areas and the belief that another earthquake may be due. The average recurrence interval (Glossary) for a Cascadia Subduction Zone event is approximately 500 years with time between events as little as 200 years and as much as 1000 years. The last event has been placed about the year 1700.

An examination of sediments along the Pacific Northwest coasts supports the theory that tsunamis accompanied previous Cascadia Subduction Zone events. At the June 2000 Penrose Conference consensus was reached by the scientific community. This evidence has been used in support of some tsunami inundation maps.

Central and Southern California

Communities located on the central and southern California coasts should primarily be concerned with tsunamis originating from local faulting and submarine landslides. However, the area has experienced tele-tsunamis from a number of locations including:

- Alaska peninsula
- Aleutian Islands (several locations)
- Chile (several locations)
- Hawaii
- Japan (several locations)
- Kamchatka/Kuril Islands

The San Francisco Bay Area suffered over \$1 million in damage from the 1964 tsunami. However, the relative absence of damage tends to minimize tsunami hazard mitigation activities in Bay Area communities.

Alaska

Alaskan communities are located in a region known to generate or experience very destructive tsunamis. The region is highly seismic (Aleutian-Alaskan trench) and is also subject to tele-tsunamis originating in the vicinity of Kamchatka and the Kuril Islands. Local tsunamis have been produced through faulting, submarine landslides, and surface landslides into constricted bodies of water (e.g., bays). Twelve destructive tsunamis have been recorded in Alaska. At least three of these caused significant damage in the Pacific basin. Hawaii is particularly vulnerable to tsunamis generated in Alaska. Significant tele-tsunamis have also been recorded from Japan and South America.

Hawaii

Hawaii has a history of being adversely impacted by many tsunamis, generated both locally and from around the Pacific rim. They are generated locally primarily through earthquakes and landslides associated with Hawaii's active volcanoes. However, relatively few tsunamis are generated locally and destruction from local tsunamis has historically been confined to one island. Widespread destruction from tele-tsunamis occurs more frequently – a few times each century. The position of the islands makes them vulnerable to all the known tele-tsunami sources along the Pacific margin including all of South America, Alaska and the Aleutian Islands, Kamchatka and the Kuril Islands, and northern Japan.

It is noteworthy that run-up heights differ throughout the islands. This is to be expected because of reef protection and the behavior of tsunamis entering confined bodies of water (e.g., bays and lagoons). Run-ups may be somewhat higher on the side of the island facing the source zone, but tsunami waves can efficiently wrap around islands and be destructive on all shores.

South Pacific

Like Hawaii, the three NFIP communities of Guam, American Samoa (Manua and Tutuila), and the Northern Marianas (Saipan), are vulnerable to local tsunamis and tele-tsunamis originating along the Pacific margin. However, unlike Hawaii, the islands are very near two extremely seismic areas. Guam and Saipan are just west of the Mariana Trench and American Samoa is adjacent to the Tonga Trench. These two trenches are active subduction zones and consequently generate earthquakes and tsunamis.

The three island communities have experienced destructive tsunamis dating back to the mid-1800s (when records commenced). Some of the tsunamis are associated with local volcanic activity. However, despite their proximity to volcanic areas and subduction zones, most tsunamis there have originated along the Pacific margin. Places of origin include Alaska, Mexico, the west coast of South America, Indonesia, and the North Pacific (e.g., Kuril Islands).

Pago Pago, on the Samoan island of Tutuila, can be singled out as being especially vulnerable to tsunamis. This is because of its coastal configuration, a V-shaped bay. Pago Pago has experienced over 40 tsunamis dating back to 1837.

Atlantic Seaboard

Forty tsunamis or tsunami-like waves have occurred in the eastern United States since 1600. Tsunamis were generated by such events as the 1755 Queen Anne's earthquake, the Grand Banks event of 1929, the Charleston earthquake of 1886 and the New Madrid earthquakes of 1811-1812. Tsunami and tsunami-like waves along the East Coast appear in most cases to be the result of slumping or landsliding associated with local earthquakes or wave action associated with strong storms. Other sources of tsunamis or tsunami like waves include volcanic debris falls or catastrophic failure of volcanic slopes and explosive decompression of underwater methane deposits.

Caribbean Sea

The Caribbean tsunami hazard is partly reflected in the compilation of events over the last 150 years, where tsunami-related fatalities may have been greater than that in Alaska, Hawaii, and the U.S. West Coast combined. Practically all known causes of tsunamis are present in the Caribbean. These include local earthquakes, volcanic activity, submarine landslides and tele-tsunamis. Puerto Rico and the U.S. Virgin Islands are situated near a boundary of the Caribbean Plate, a tectonically active region which will generate tsunamis in the future.

According to Caribbean Tsunami Awareness, a Spanish-French-English outreach publication, the Lesser Antilles (e.g., the Leeward Islands southeast of Puerto Rico) is the most likely source of a Caribbean-wide tsunami disaster. The dome of the active volcano at Montserrat is growing, which suggests a possible landslide-generated tsunami hazard. In addition, the submarine volcano, "Kick'em Jenny", poses a threat to all of the islands in the eastern Caribbean. This volcano lies about 8 kilometers off the north coast of Grenada.

CRS CREDIT

The hazards associated with tsunamis must be dealt with at the community level using all of the tools used in conventional floodplain management. Under the CRS, these tools are organized under four general series of credited activities:

- Informing the public and specific populations, about the hazards (300 series)
- Mapping and regulation of the hazard areas with recognition of the unique problems associated with the hazards (400 series)
- Special structural and nonstructural efforts to solve existing problems (500 series) and
- Special emergency preparedness efforts that recognize the particular problems associated with these hazards (600 series).

This section reviews the proven mitigation measures for tsunami hazards addressed in this publication. In some cases, CRS credit is provided for an activity in the CRS Coordinator's Manual. In other cases, particularly in the 400 series, special credit is provided in this publication. For those credits, this document is a supplement to the schedule and commentary in the CRS Coordinator's Manual and the same formatting is used. The special hazard credit points calculated under this publication are added to the regular credit points in the CRS Coordinator's Manual.

A community's tsunami hazard management program may include activities that are not eligible for CRS credit. For example, post-disaster recovery and mitigation policies might require damaged areas to be redeveloped with new street patterns to accommodate the clustering of structures away from the high hazard area.

300 Public Information Activities

People living on the coast usually do not start worrying about tsunamis until their property or home is visibly threatened. At that point, their choices are more limited than they would have been if the tsunami hazard had been considered before the building was located on the site.

Because the flood hazards associated with special hazards are different from "normal" flood hazards, there are special needs for public education. Property owners and developers must be made aware of the hazards and the methods needed to mitigate them.

A sustained public outreach program is needed to inform coastal populations and to institutionalize tsunami preparedness and mitigation. Such a program should encourage consistent information between local government and the community at risk. Innovative approaches should be encouraged at many different levels.

There are several ways to provide this information, including

- Newsletter and newspaper articles,
- Signs posted in the hazardous areas,
- Brochures and booklets on the hazards and what can be done,
- Evacuation maps,
- Booths at shopping malls,
- Presentations to civic associations or neighborhood groups,
- Providing information on the location and severity of the hazard areas to inquirers,
- Putting references on the hazard and protection measures in the public library and on websites, and
- Providing technical assistance to property owners.

Communities can use brochures, single-page instructions, periodic warning system tests, electronic and print media information, signs, and emergency response exercises to maintain awareness and instill effective response behavior. Some of this information should be directed towards special institutions, such as schools, hospitals, and convalescent-care facilities, and non-English speaking community members. Because of seasonal tourism in many coastal communities, some provide information especially for tourists.

310 Elevation Certificates

FEMA elevation certificates, which are required for the purchase of NFIP flood insurance, and which must be maintained by CRS communities, must be based upon the current FIRM for the community, and they must be completed using the flood information from the FIRM and the corresponding Flood Insurance Study. There is no requirement to maintain elevation certificates outside the Special Flood Hazard Area (SFHA).

This means that if a community has mapped areas with tsunami hazards, and it is regulating areas outside the SFHA, and/or its regulatory flood elevation is higher than that shown on the FIRM, everyone must still use the data from the FIRM for the purpose of filling out the elevation certificate.

320 Map Information

Many communities provide inquirers with flood information from their Flood Insurance Study and FIRM. Some use this opportunity to explain local regulations, including their tsunami hazards and tsunami management requirements. This provides the inquirers with a more complete picture of their coastal hazard and the importance of regulations as property protection measures. Notifying people that they are in flood and tsunami hazard areas can also motivate them to purchase flood insurance and/or undertake property protection measures.

Providing information from the community’s Flood Insurance Rate Map (FIRM) provides many benefits to residents, businesses, real estate and insurance agents, lenders and those interested in purchasing, developing or repairing property. CRS credit is provided for advertising this service and for providing information as described in the CRS Coordinator’s Manual under Activity 320.

If the community is receiving CRS credit for mapping and regulating its tsunami hazard, the map information service must include telling inquirers if the property in question is mapped as a tsunami hazard area. The community must also disclose any tsunami hazard regulatory requirements for developing the property. This can help property owners and potential buyers better understand the natural hazards risks of a particular location. Understanding these risks can help property owners and builders identify and evaluate potential property protection measures.

330 Outreach Projects

This activity provides credit for newsletters, mailings, presentations, booths, brochures and a host of other means of getting the word out to the public or target audiences, such as builders or school children. Credit for some of the elements is based on covering topics such as “flood hazard,” “flood hazard map,” “flood safety” and “property protection.” These topics should include information on the tsunami hazards, in addition to the flood hazard mapped on the Flood Insurance Rate Map.



A magnet card designed to foster family preparedness for tsunamis.

One of the elements in Activity 330 provides 100 points for developing and implementing a public information program strategy. The community identifies its most important public information needs and identifies the best way to meet those needs. The strategy could focus on tsunamis, if the strategy team determines that that is as important as or even more important than “normal” flooding. The full credit of 100 points would still be provided.

340 Flood Hazard Disclosure

The CRS provides credit when real estate agents disclose information on a property's flood hazard to prospective buyers. More credit is provided if the disclosure includes other hazards, such as tsunami hazards. State or local mandates for sellers, landlords or developers to disclose these hazards can receive credit. If real estate agents don't actually disclose a property's hazards, but provide a handout advising potential property buyers about what to look for and what questions to ask, additional points are provided.

350 Flood Protection Information

Under Activity 350, communities receive credit for putting flood protection information in their public libraries and on their websites. These materials should cover all known flood related hazards, including tsunami hazards and property protection measures. Additional credit points are specifically provided if the library has references on tsunami hazards provided they are present in the community. This CRS supplement can be cataloged in the library to receive that credit.

The community or the librarian should also review the references at the end of this supplement to identify additional documents that would be helpful locally. Some of the websites mentioned in this publication could also be good links for the community's website coverage of its tsunami hazards and ways people can protect themselves and their property.

360 Flood Protection Assistance

The other activities in this series advise people to learn more about flood insurance and flood protection. The objective of this activity is to provide interested property owners with technical information on the tsunami and flood hazards at their property, with advice on tsunami and flood protection measures, and information on qualified contractors.

Floodplain residents are more likely to undertake activities to reduce flood and tsunami hazards to their property if reliable assistance is available locally. The CRS provides credit if a local government provides technical advice to interested property owners and publicizes that this service is available.

400 Mapping and Regulatory Activities

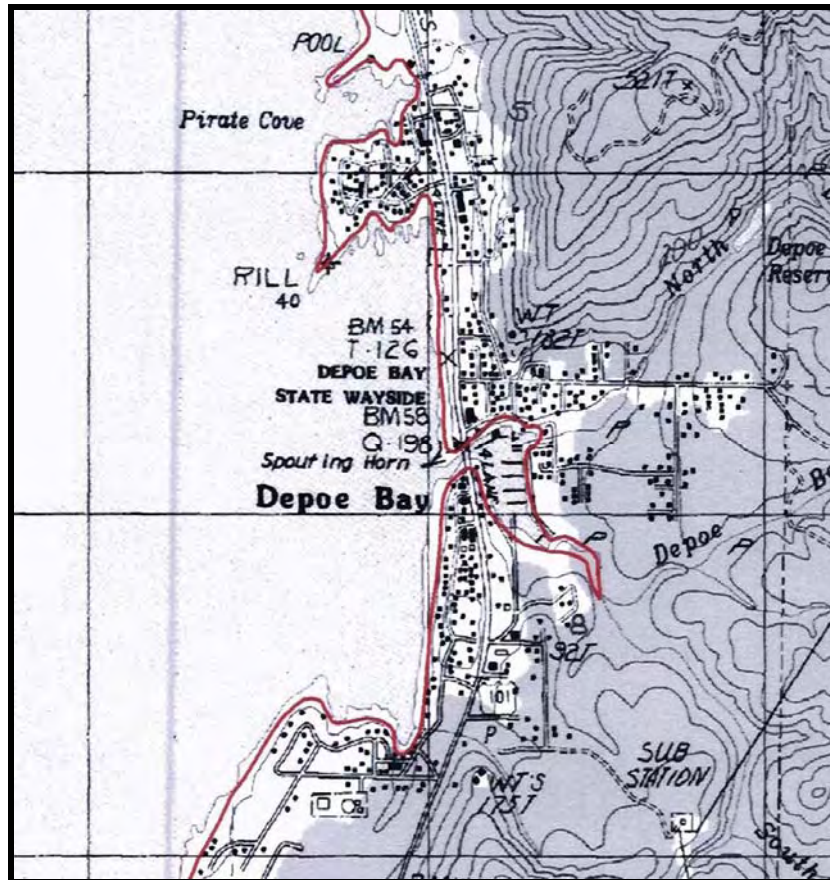
FEMA and many communities in the United States have long recognized that the national mapping and/or minimum regulatory standards of the NFIP do not adequately address the problems of special hazards. Since these special hazards have the potential for extraordinary flood damage, it is important that communities deal with these hazards in ways that go beyond the minimum NFIP standards.

Tsunami Hazard Mapping in Oregon

The five Pacific states have undertaken tsunami mapping projects. The Oregon project was undertaken to help implement Senate Bill 379 passed in 1995. The statute limits construction of new essential facilities and special occupancy structures in tsunami flooding zones. A line marking inundation from the highest run-up, which was also most consistent with the prehistoric tsunami data, was adopted to implement the statute.

The entire Oregon coast is now mapped and selected areas have been and will be mapped in greater detail. The inundation maps were produced by modeling the deformation from an earthquake, numerically simulating the resulting tsunami waves, and mapping the maximum inland flooding limit. The first two steps were done by computer methods. The third step was accomplished chiefly by inference using professional judgment and available topographic data.

The mapping project addresses the simultaneous uplift and subsidence of the sea floor accompanying undersea earthquakes along the Cascadia Subduction Zone fault system. Numerically simulated run-up elevations for scenarios with the highest and lowest tsunami run-up were used to infer inundation on 1:24,000-scale topographic base maps.



The State of Oregon, Department of Geology and Mineral Industries, prepared maps of the state's tsunami hazards (Priest, 1995).

In order for a community to protect new development in areas subject to special hazards, they must have maps that adequately define the hazards and ordinance language that deals with the specific hazards in those areas.

410TS Additional Flood Data for Tsunami Hazard Areas

Local decision makers need to understand their risk in order to make informed planning decisions. Tsunami waves generated from near-source or near-shore earthquakes, or underwater landslides, may vary in impact from those generated by distant subduction zone earthquakes. Since the inundation projections are intended for emergency and evacuation planning, in order to avoid the conflict over tsunami origin, inundation projections are based on worst-case scenarios.

Inundation maps save lives by providing information ahead of time about the potential for tsunami impact in certain areas. They enable communities to better plan safe egress routes. The maps may also serve as a catalyst for thought about placing future development, especially critical facilities, in projected inundation areas.

Credit for mapping tsunami hazard areas for management purposes is provided under this activity. Credit for the regulation of new development in mapped tsunami areas is provided in Section 430TS. Areas for which tsunami hazards regulation credit is requested may be within the SFHA or outside of it.

411TS Credit Points

Mapping tsunami-prone areas (MTS) (Maximum credit: 50 points)

a. Prerequisites for mapping credit:

1. The area mapped must be subject to tsunami-related development regulations that receive at least 20 points (after the impact adjustment) under Section 420TS and/or Section 430TS.
2. The map was prepared based on a scientific study to determine the level of tsunami flooding. The FEMA Regional Office must state, in writing, that the study is acceptable for CRS credit.

b. MTS = Up to 50 points for mapping the tsunami runup area. Credit for mapping the tsunami hazard area is:

1. 50 points for mapping areas outside of the SFHA,
2. 50 points for mapping areas in the SFHA where the tsunami regulatory elevation is higher than the BFE on the FIRM, or
3. 20 points for mapping areas in the SFHA where the tsunami regulatory elevation is lower than the BFE on the FIRM.

Areas subject to tsunami hazards for which credit is requested may be within the Special Flood Hazard Area (SFHA) or outside of it. There is no mapping credit without relevant regulations.

413TS Credit Calculation

Tsunami Hazard (Maximum Credit: 50 points)

c410TS = MTS

414TS Credit Documentation

The community must provide the following:

- a. A map that shows the areas subject to tsunami hazards and the other floodplains (including the SFHA) in the community. If only a small area of the community is mapped for special hazards, only the SFHA in that area need be shown on the map.
- b. A description of the method used for the mapping that shows that it reasonably delineates areas subject to tsunami hazards and documentation that the method is acceptable to the FEMA Region.
- c. Credit for 410TS is only provided if the mapping is used for land use regulation to prevent damage from the special hazard. The documentation required for Activity 420TS (open space preservation based on regulations) or Activity 430TS will suffice for this prerequisite.

420TS Open Space Preservation in Tsunami Hazard Areas

NOTE: This section is a supplement to Activity 420 (Open Space Preservation) in the CRS Coordinator's Manual. Much of the discussion in this section relies on Activity 420. Please read that section before proceeding.

This activity provides credit for having floodprone property within a designated special hazard area preserved as publicly owned or controlled open space. This credit is in addition to the credit provided for open space (OS) in Activity 420.

The designation and zoning of tsunami hazard areas for open space uses as agriculture, parks and recreation, or natural hazard areas is recommended as the first land use planning strategy to consider. This strategy is designed to keep development at a minimum in hazard areas and to keep insurable buildings out altogether.

A second strategy is to acquire tsunami hazard areas for open space uses. Open space acquisition has several advantages over strictly regulatory approaches such as zoning.

Acquisition ensures that the land will be controlled by a public agency or nonprofit entity, and it removes any question about a regulatory taking. The primary disadvantage to acquisition is cost.

Open Space Tsunami Protection

Zoning and land use ensure that sites are safer. Hilo, Hawaii did not rebuild a neighborhood in its tsunami impacted area but instead built a memorial with open space for people to enjoy but not inhabit. A school at Laupahoehoe was relocated far uphill after two dozen children and teachers were lost to the 1946 tsunami that crashed into the original school buildings and surrounding staff homes. The grounds are now open space with a memorial stone.

421TS Credit Points

Preserved tsunami-prone area open space (TSOS) (Maximum credit: 50 points)

a. Prerequisites for credit:

1. The area must meet the credit criteria for open space preservation in Activity 420.
2. The area must be included in the tsunami hazard area mapped and credited under Activity 410TS.

b. TSOS = 50, adjusted by the impact adjustment ratio based on the amount of the tsunami hazard area that is preserved as open space.

The open space requirement may be met in one of three ways:

- (1) Public land such as state and local parks and easements: However, as noted in Section 403 of the *CRS Coordinator's Manual*, there is no open space credit for federal lands. All portions of city and county parks, forest preserves, state parks and state forests, and publicly owned beaches or natural areas that are within the tsunami hazard area may be counted for open space credit, except paved areas [see Activity 420 of the *CRS Coordinator's Manual*]. Separate parcels owned by a school district or other public agency can be counted, provided there are no buildings on them within the regulatory floodplain.
- (2) Preserve land: private wildlife or nature preserves that are maintained for open space purposes. Examples would be church retreats, hunting club lands, Audubon Society preserves, and similar privately owned areas that are set aside and not intended to be developed. A parcel set aside by a developer as a temporary "preserve" until the area develops is not considered preserved open space.

- (3) Restrictive development regulations: privately owned lands subject to state or local regulations that prevent construction of buildings. Credit is only given for such regulated lands that are vacant at the time of application for CRS credit. Some examples are setback regulations, natural areas regulations, or any state or local law that prohibits new buildings from a defined area.

422TS Impact Adjustment

- a. Option 1: If the entire area of the tsunami hazard is preserved as open space, the impact adjustment, rTSOS is 1.0.
- b. Option 2: If five or more acres of the tsunami hazard area are preserved as open space, the impact adjustment, rTSOS is 0.2.
- c. Option 3: Where more than 20% of the tsunami hazard area is preserved as open space the community may calculate an impact adjustment by dividing the area of tsunami-prone open space (aTSOS) by the area of the mapped tsunami hazard (aTS).

$$rTSOS = \frac{aTSOS}{aTS}$$

423TS Credit Calculation

Maximum Credit for tsunami hazard open space is 50 points.

$$c420TS = TSOS \times rTSOS$$

424TS Credit Documentation

1. The community must receive credit under 410TS.
2. The community must document that the area where open space credit is requested is in the tsunami hazard area and meets the open space requirements of Activity 420 (Open Space Preservation in the *Coordinator's Manual*).

The community must show that the open space areas are in mapped areas subject to tsunami hazards, as credited under Activity 410TS. The documentation must also show that the tsunami open space areas meet the preservation criteria for Activity 420.

430TS Regulation of Tsunami Hazard Areas

NOTE: This section is a supplement to Activity 430 (Higher Regulatory Standards) in the CRS Coordinator's Manual. Much of the discussion in this section relies on Activity 430. Please read that section before proceeding.

In areas where it is not feasible to restrict land to open space uses, other land use planning measures can be used to minimize flood damage. These include strategically controlling the type of development and uses allowed in hazard areas, and avoiding high-value and high-occupancy uses to the greatest degree possible. For example, plan designations and zoning districts can use density restrictions or large-lot zoning to ensure that only very low-density residential uses are allowed in hazard areas.

Credit is provided for regulating special hazard areas in a manner that recognizes those elements of the hazard not addressed by the NFIP minimum standards for floodplain management. This credit is in addition to credit provided for other regulatory standards under Activity 430 in the Coordinator's Manual.

431TS Credit Points

Maximum credit for Activity 430TS: 70 points.

- a. Prerequisite for credit: The regulations must be based on tsunami hazard mapping credited under Section 411TS.
- b. TSR = the total of the following points: (Not to exceed 70 points)
 1. 40 points, if new structures are required to be built at or above the tsunami flood elevation, provided the tsunami flood elevation is higher than the base flood elevation.
 2. 15 points, if regulations prohibit new critical facilities in tsunami hazard areas unless:
 - (a) the design can mitigate the vulnerability to such an extent that the resulting facility will perform as needed; and
 - (b) the risk is reduced through emergency response measures.

Critical facilities are defined in Section 130, the CRS' glossary. They include:

- Structures or facilities that produce, use, or store highly volatile, flammable, explosive, toxic and/or water-reactive materials;
- Hospitals, nursing homes, and housing likely to contain occupants who may not be sufficiently mobile to avoid death or injury during a flood;

- Police stations, fire stations, vehicle and equipment storage facilities, and emergency operations centers that are needed for flood response activities before, during, and after a flood; and
- Public and private utility facilities that are vital to maintaining or restoring normal services to flooded areas before, during, and after a flood.

Fire stations, power substations, hospitals, sewage treatment facilities, and other critical infrastructure generally should not be located in inundation zones. Relocation of these types of facilities out of inundation areas should be an integral part of any tsunami mitigation plan.

Where essential service facilities must be located in tsunami hazard areas, they should be designed or retrofitted to survive tsunami damage. Local governments must be careful when defining the performance level expected for critical facilities. Building performance levels describe the expectations of owners, occupants, and regulators relative to the amount of damage a building could sustain from a tsunami and the building's ability following a tsunami event to support the uses for which it was intended.

Critical facilities should be designed at the *re-occupancy* or *operational* performance level. Buildings constructed to a *re-occupancy level* should meet the safety level of performance, but additional precautions should be taken so they can be reoccupied within a few days to weeks after cleanup, minor repairs, and the restoration of utilities. This level requires the careful choice of the building location and the use of flood-resistant materials.

The most demanding requirements are used to design buildings to meet the *operational level* of performance. These buildings should be capable of resisting all expected forces and hazards. They must also have backup emergency systems and utilities so they can be used immediately following a tsunami.

Plans for critical facilities that are to be located in hazard areas should include providing redundant facilities and emergency response measures to lessen the impact of losing the infrastructure and critical facilities that will be placed at risk.

- | |
|---|
| <p>3. 30 points, for adopting tsunami construction requirements in the Coastal Construction Manual for new buildings in tsunami hazard areas.</p> |
|---|

Although a few communities have adopted tsunami resistant building design standards, the vast majority of coastal communities have not. Design and construction of new buildings in tsunami hazard areas should address forces associated with water pressure, buoyancy, currents and waves, debris impact, scour, and fire. Guidance for architects and engineers in the design for tsunami forces is included in FEMA's *Coastal Construction Manual*, also known as FEMA 55.

4. 15 points, if regulations require buildings in tsunami areas to be inspected for compliance with tsunami construction standards by a licensed professional engineer.

Construction inspection is important to ensure that buildings are constructed according to the appropriate standards. Independent inspections can be provided in several ways: 1) use of qualified permitting agency staff; 2) use of independent technical experts retained by the governing jurisdiction; or 3) requiring the owner to use such experts whose reports would be provided to the governing jurisdiction for review and acceptance. In some areas, licensed construction inspectors and consulting engineers provide these services.

5. 15 points, if regulations require substantially improved buildings and additions to existing buildings in the tsunami area to meet tsunami construction codes.

This credit complements the credit for regulating new buildings in 411TS.2.a. The retrofit of existing buildings should be encouraged when the effort will improve tsunami resistance to a level capable of meeting identified performance objectives, or to minimize floating debris that can damage nearby buildings. Retrofitting may be required when substantial modifications are made to existing structures or when there are changes in building occupancy.

Building codes primarily address new construction; generally, they do not address renovations and retrofitting comprehensively or in detail. Local building codes should be amended to fully address risk mitigation in the context of building renovation.

6. 15 points, if hazardous materials are prohibited from the tsunami hazard area.

Dry docks, refineries, power plants, and other shoreline industrial facilities are of special concern. Destruction or flooding of industrial facilities can add another environmental dimension to a tsunami disaster with burning oil, toxic chemicals, and other hazardous materials. Floating buildings, debris, and boats can crush pipes and tanks. Protecting industrial facilities with walls and stronger anchoring can help; however, locating these types of uses outside of inundation zones is the most effective mitigation technique.

432TS Impact Adjustment

The area affected by the tsunami regulations must exclude areas designated as open space that are receiving Open Space (OS) credit under Activity 420 (Open Space Preservation).

a. Option 1:

1. If new development within the entire area of the tsunami hazard is subject to the regulations, and no credit was requested for OS in Activity 420, the impact adjustment is rTSR is 1.0
2. If new development within the entire area of the tsunami hazard is subject to the regulations, and credit was requested for OS in Activity 420, the impact adjustment for $rTSR = 1.0 - rOS$.

As with other regulatory elements, areas for which open space credit (Activity 420) is requested must be excluded from the area credited for the tsunami regulations.

b. Option 2:

If the tsunami regulations cover only a portion of the tsunami hazard area, $rTSR = 0.25$.

c. Option 3:

If the tsunami regulations cover more than 25% of the tsunami hazard area, the impact adjustment ratio may be computed by dividing the area affected (aTSR) by the area of the mapped tsunami hazard (aTS). Any area for which TSOS credit is requested must be excluded from the element's area measurements.

$$rTSR = \frac{aTSR}{aTS}$$

433TS Credit Calculation

$$c430TS = TSR \times rTSR$$

The maximum credit for c430TS is 70 points, so if c430TS is greater than 70 points, $c430TS = 70$. This value is added to SHR in Activity 430. A minimum of 20 points is needed to meet the prerequisite for 410TS.

434TS Credit Documentation

The community must provide the following documentation:

- a. The state or local law or ordinance language that adopts the regulatory standard. The acronym TS must be marked in the margin of the sections of the ordinance that apply to this activity.

A photocopy of the appropriate pages of the ordinance is sufficient and should be attached to the activity worksheet. The Chief Executive Officer's application certification is considered to certify as well that the ordinance or statute has been enacted into law and is being enforced (see Section 212.a in the *Coordinator's Manual*).

The community must have the following documentation available to verify implementation of this activity:

- b. If the community calculates impact adjustment ratios using Option 3 (432TS.c) the Impact Adjustment Map prepared in accordance with Section 403 must be provided.
- c. An explanation of the procedures followed for enforcement.

The ISO/CRS Specialist will ask to see permit records for development in the tsunami hazard area to verify that the regulations are enforced.

430LZTS Low Density Zoning

Credit is provided for zoning areas to keep them substantially open. This credit is available for undeveloped land within low density zoning districts, as well as for areas developed in accordance with the density requirements.

431LZTS Credit Points

Areas subject to low density zoning in tsunami hazard areas (LZTS) (Maximum credit: 50 points)

Credit is given for those portions of the mapped tsunami hazard area subject to zoning rules that require a minimum of 1 acre per building or unit. Maximum credit is provided for a 10-acre or larger lot size.

s = the minimum lot size in acres.

$LZTSs = 5 \times s$, for areas with tsunami hazards and with minimum lot sizes of at least 1 acre.

The credit for low density zoning is based upon the traditional zoning approach of setting minimum lot sizes for different zoning districts. The bigger the lot size, the less dense the development will be in the tsunami hazard area.

432LZTS Impact Adjustment

The area affected by the low density zoning regulation must exclude areas designated as open space that are receiving Open Space (OS) credit under Activity 420 (Open Space Preservation).

a. Option 1:

1. If new development within the entire area of the tsunami hazard is subject to low density zoning regulations, and no credit was requested for OS in Activity 420, the impact adjustment, $rLZTS = 1.0$
2. If new development within the entire area of the tsunami hazard is subject to low density zoning regulations, and credit was requested for OS in Activity 420, the impact adjustment, $rLZTS = 1.0 - rOS$.

As with other regulatory elements, areas for which open space credit (Activity 420) is requested must be excluded from the area credited for low density zoning.

b. Option 2: The community may use the default value if its low density zone covers at least 5 acres of the tsunami hazard area. $rLZTS = 0.2$.

The use of Option 2 is limited to one zoning density for at least 5 acres. Communities with more than 20% low density zoning within their tsunami hazard area may find Option 3 provides more credit.

c. Option 3: The impact adjustment ratio for each low density zoning district is computed by dividing the area affected ($aLZTSs$) by the area of the mapped tsunami hazard (aTS). Any area for which TSOS credit is requested must be excluded from the element's area measurements.

$$rLZTSs = \frac{aLZTSs}{aTS}$$

If there is more than one low density zoning district within the tsunami hazard area, each must be appropriately designated on the Impact Adjustment Map (see Section 403) and the area of each must be determined in order to calculate the impact adjustments.

433LZTS Credit Calculation

Maximum Credit for tsunami hazard low density zoning is 50 points.

$$c430LZTS = \sum(LZTSs \times rLZTSs)$$

434LZTS Credit Documentation

The community must submit the following:

- a. The ordinance language that adopts the low density zoning standard. The appropriate acronym(s) (LZTS1, LZTS5, etc.) must be marked in the margin of the sections that pertain to the element.

A photocopy of the appropriate pages of the ordinance is sufficient. The CEO's certification of the application or modification is considered to include a certification that the ordinance or statute has been enacted and is being enforced (see Section 212.a).

The community must have the following documentation available to verify implementation of this activity:

- b. If the community calculates impact adjustment ratios using Option 3 (432LZTS.c) the Impact Adjustment Map prepared in accordance with Section 403 must be provided. Each area listed in Section 431LZTS for which credit is being requested must be designated on the Impact Adjustment Map and in the map's key.

Areas subject to low density zoning are designated as "LZTSs" on the Impact Adjustment Map (see Section 403), where the "s" designates the minimum lot size (in acres). An area of 5-acre zoning would be designated "LZTS5"; an area in which one structure is allowed on a 100,000-square-foot lot would be designated "LZTS2.3" (100,000 square feet is 2.30 acres).

- c. An explanation of the procedures followed for enforcement of the regulatory standard.

During the verification visit, the ISO/CRS Specialist will need to see site plans and final plats that will document how the land development criteria or zoning density is applied. The ISO/CRS Specialist will also visit a sample of new developments to verify that they have been constructed in accordance with the approved plans.

500 Flood Damage Reduction Activities

Coastlines have always been a favored location for human settlements. Because of the attractiveness of coastal locations and the long gaps between devastating tsunami events, coastal communities have continued to develop in recent times with new housing, maritime facilities, and resort developments. As a result, more people and facilities are threatened by the destructive force of tsunamis.

510 Floodplain Management Planning

Communities are encouraged to prepare and adopt tsunami hazard management plans that guide land use development, redevelopment, post-disaster recovery, and mitigation decisions. Credit for preparing, adopting, implementing, evaluating, and updating such a plan could be credited under Activity 510 (Floodplain Management Planning).

Section 511.a(4) of the CRS Coordinator's Manual provides extra points for a discussion of all special hazards that affect the community and for including a summary of the impact of each hazard on the community and its economy and tax base.

520 Acquisition and Relocation

If there are structures in areas of tsunami hazards that pose a danger to the occupants, or are repetitively damaged by tsunami flooding, acquisition and relocation may be the most cost-effective way of solving the problem. Although there is no extra credit for acquisition and relocation of properties in areas of tsunami hazard, the credit offered in Activity 520 is substantial.

Credit is only provided for buildings within the regulatory floodplain that is managed by the community, so the mapping of areas with tsunami hazards in Activity 410TS may be important for this credit.

Under current policy, if a flood damages an insured building and the state or community declares the building to be substantially damaged, an NFIP flood insurance policy claim may provide assistance to help pay to relocate the structure, up to a maximum benefit of \$30,000. This is in addition to coverage for the repair of physical damage from flooding. When properties are acquired and relocated using these funds and the vacant property is preserved as open space, CRS credit is available to the community.

530 Flood Protection

Elevating Buildings

Elevated buildings in subduction zones (West Coast, Alaska, and Puerto Rico) become soft story structures when elevated and then are even more vulnerable to severe ground shaking that occurs during the subduction zone earthquake prior to the tsunami wave it generates. However, in non-subduction zones, elevation should work but only if engineered for the force of tsunami currents and scour.

Structural Flood Control

It should be noted that the CRS does not provide credit for structural flood control projects that can result in a revision to the FIRM. Similarly, the CRS does not provide credit for coastal structural projects that may be installed to affect erosion rates, including seawalls, groins, and beach nourishment.

600 Flood Preparedness Activities

610 Flood Warning Program

TsunamiReady is a National Weather Service (NWS) initiative that promotes the development of community tsunami warning system capability for immediate response. The program supports better and more consistent tsunami awareness as its main goal is improvement of public safety during tsunami emergencies.

CRS TsunamiReady credit is described under Section 611.e of the *Coordinator's Manual*. To receive TsunamiReady credit communities must:

- (1) Meet the mapping requirements for special hazard credit, as described in Sections 410TS and 430TS, and
- (2) Have adopted a tsunami hazard operations plan or annex that addresses actions to take following a tsunami warning. This would be a document that covers steps similar to the emergency warning dissemination (EWD) and other response efforts (ORE) credited in Sections 611.b and c.

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GLOSSARY

Bathymetry—Depth measurement in a body of water

Critical facilities:

- Structures or facilities that produce, use, or store highly volatile, flammable, explosive, toxic and/or water-reactive materials;
- Hospitals, nursing homes, and housing likely to contain occupants who may not be sufficiently mobile to avoid death or injury during a flood;
- Police stations, fire stations, vehicle and equipment storage facilities, and emergency operations centers that are needed for flood response activities before, during, and after a flood; and
- Public and private utility facilities that are vital to maintaining or restoring normal services to flooded areas before, during, and after a flood.

Epicenter—The point on the earth’s surface directly above the focus of an earthquake.

Hazard disclosure—A state or local requirement or practice whereby realtors and/or sellers reveal known hazards associated with the property in question.

Inundation (map)—The area inundated by a tsunami.

Mitigation—A sustained action taken to reduce or eliminate the long-term risk to human life and property.

Recurrence interval—The time in years when an event will, on the average, be equaled or exceeded. For example, a 100-year flood will be equaled or exceeded, on the average, one every 100 years. It is the inverse of the annual exceedance probability. That is, the 100-year flood has an annual probability of being exceeded of 1/100, or 0.01.

Risk—Refers to potential losses associated with a hazard, defined in terms of expected probability and frequency, exposure and consequences. Associated terms include risk-reduction, risk assessment, risk analysis and acceptable risks.

Run-up—In this report, run-up refers to the maximum inland extent or elevation attained by a tsunami. There are other technical definitions. Run-up is also defined as the height of a tsunami above a general reference level (e.g., height of tide, mean low water, or sea level, if the tide level at the time of maximum wave was not observed).

Seiche—Oscillations in confined bodies of water (e.g., lakes, bays) caused by earthquakes, landslides, or high winds. Water moving back and forth from one side of a swimming pool or bathtub to another are often used as an analogy.

Subduction—The movement of one of the earth’s plates beneath another plate.

Tele-tsunami—Tsunamis observed at places at least 1000 km from their source.

Tsunami Mitigation Subcommittee—A multi-state subcommittee of the National Tsunami Hazard Mitigation Program. Representatives from Alaska, California, Hawaii, Oregon, Washington, and the Federal Emergency Management Agency meet on a scheduled basis to discuss progress in tsunami hazard mitigation within the respective states.

TsunamiReady program—A National Oceanic and Atmospheric Administration program patterned after the StormReady program. The program encourages tsunami-susceptible communities to adopt risk reduction activities.

OMB No. 1660-0022
Expires: June 30, 2007

National Flood Insurance Program
Community Rating System

CRS Credit for Mitigation of Tsunami Hazards

ACTIVITY WORKSHEETS

2006



FEMA

Public reporting burden for this information collection is estimated at 35 hours for the application and certification process. Burden means the time, effort, and financial resources expended by persons to generate, maintain, retain, disclose, or to provide information to us. You may send comments regarding the burden estimate or any aspect of the collection, including suggestions for reducing the burden to: Information Collections Management, U.S. Department of Homeland Security, Emergency Preparedness and Response Directorate, Federal Emergency Management Agency, 500 C St., S.W., Washington, D.C. 20472, Paperwork Reduction Project (OMB Control Number 1660-0022). You are not required to respond to this collection of information unless a valid OMB control number is displayed in the upper right corner of this form. Note: do not send your completed questionnaire to this address.

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AW-330	Outreach Projects
AW-340	Hazard Disclosure
AW-350	Flood Protection Information
AW-360	Flood Protection Assistance
AW-410	Additional Flood Data
AW-420	Open Space Preservation
AW-430	Higher Regulatory Standards
AW-430LD	Land Development Criteria
AW-440	Flood Data Maintenance
AW-450	Stormwater Management
AW-501	Repetitive Loss List
AW-502	Repetitive Loss Requirements
AW-510	Floodplain Management Planning
AW-520	Acquisition and Relocation
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AW-630	Dam Safety
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AW-720	Community Credit Calculations
AW-720m	Community Credit Calculations (Modification)
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AW-CE	Coastal Erosion Hazards
AW-DB	Dunes and Beaches
AW-IJ	Ice Jam Hazards
AW-MF	Mudflow Hazards
AW-SU	Land Subsidence Hazards
AW-TS	Tsunami Hazards
AW-UF	Uncertain Flow Path Hazards

INSTRUCTIONS

The following activity worksheets are to facilitate calculations of Community Rating System (CRS) credit points. They are not used for a community's initial application to the CRS. INITIAL APPLICATIONS FOR THE CRS ARE SUBMITTED USING THE WORKSHEET PAGES IN THE *CRS APPLICATION*.

These activity worksheets are for internal use by the community, for submittal of modifications, and for use by the ISO/CRS Specialist during verification and cycle verification of a community's program.

These worksheets are designed to be used in conjunction with *CRS Credit for Mitigation of Tsunami Hazards*. Each section of the worksheets corresponds to a section in that supplement. If a section is missing from the worksheets, it is because the *CRS Credit for Mitigation of Tsunami Hazards* supplement shows that no data or calculations are required for that section.

It is recommended that these worksheets be photocopied before they are used.

When used for submitting a modification, the Credit Points, Credit Calculation, and Credit Documentation parts of the worksheets should be completed for each activity for which credit is requested. Fill in the blanks with the value for each variable.

Each worksheet has a Credit Documentation section. Check the blanks to denote that all of the required documentation is available. In some cases, the documentation must be provided with the modification. In others, checking the appropriate spaces confirms that you will provide the documentation when needed. Please consult *CRS Credit for Mitigation of Tsunami Hazards* if you have questions about which documentation is to be provided with the request for a modification.

ATTACH THE REQUIRED DOCUMENTATION FOR AN ACTIVITY TO THE WORKSHEET FOR THAT ACTIVITY. If the documentation is ordinance language, attach only the necessary page(s) from the ordinance.

MARK THE MARGINS OF THE DOCUMENTATION WITH THE ACRONYM for the element so the ISO/CRS Specialist can identify the basis for the credit.

[This page intentionally blank.]

Community : _____

410TS ADDITIONAL FLOOD DATA

411TS Credit Points

a. Prerequisites:

____ 1. The area mapped is subject to regulations designed to minimize future exposure to tsunami damage.

____ 2. The FEMA Regional Office has approved the mapping study.

b. Tsunami Hazards: (MTS = one of the following methods):

1. Mapping tsunami areas outside the SFHA (50 points) _____

2. Where mapped areas in the SFHA have regulatory elevations higher than the base flood elevations on the FIRM (50 points) _____

3. Where mapped areas in the SFHA have regulatory elevations lower than the base flood elevations on the FIRM (25 points) _____

MTS = c410TS = _____

Add this credit to the value for AFDSH under Section 413 on page AW-410-2.

414TS Credit Documentation

____ a. A map that shows areas subject to tsunami hazards and other floodplains (including the SFHA) in the community.

____ b. A description of the method used for mapping the tsunami hazard and documentation that the method is acceptable to the FEMA Regional Office.

____ c. Documentation that shows the community receives at least 20 points under Section 421TS and/or Section 431TS.

Comments: _____

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AW-430	Higher Regulatory Standards
AW-430LD	Land Development Criteria
AW-440	Flood Data Maintenance
AW-450	Stormwater Management
AW-501	Repetitive Loss List
AW-502	Repetitive Loss Requirements
AW-510	Floodplain Management Planning
AW-520	Acquisition and Relocation
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AW-540	Drainage System Maintenance
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AW-SU	Land Subsidence Hazards
AW-TS	Tsunami Hazards
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Community : _____

420TS OPEN SPACE PRESERVATION

421TS Credit Points

a. Prerequisites:

___ 1. The area must meet the credit criteria for open space preservation in Activity 420.

___ 2. The area must be included in the tsunami hazard area credited under Activity 410TS.

b. TSOS = _____

422TS Impact Adjustment

a. Option 1: rTSOS = 1.0. = _____

b. Option 2: rTSOS = 0.2. = _____

c. Option 3: rTSOS = $\frac{aTSOS}{aTS}$ = _____

423TS Credit Calculation

c420TS = TSOS _____ x rTSOS _____ = c420TS = _____

Add this credit to the value for cSHOS on line 423d, AW-420-1.

424TS Credit Documentation

___ a. Documentation that the community receives credit under 410TS.

___ b. Documentation that shows that the area meets the preservation requirements for Activity 420 (Open Space Preservation in the *CRS Coordinator's Manual*).

Comments: _____

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AW-UF	Uncertain Flow Path Hazards

Community : _____

430TS HIGHER REGULATORY STANDARDS

431TS Credit Points

a. Prerequisites:

_____ The regulations are based on the tsunami mapping credited in Section 411TS.

b. Tsunami Regulations (TSR) Total of the following points (not to exceed 70 points).

1. Buildings must be built at or above the tsunami elevation that is higher than the base flood elevation on the FIRM (40 points) = _____
2. New critical facilities are prohibited in tsunami hazard areas unless mitigated and there are emergency response measures (15 points) = _____
3. The community has adopted the tsunami construction requirements in the *Coastal Construction Manual* (30 points) = _____
4. New buildings in the tsunami hazard area must be inspected by a qualified engineer (15 points) = _____
5. Substantially improved buildings and additions must meet tsunami construction codes (15 points) = _____
6. Hazardous materials are prohibited from the tsunami hazard area (15 points) = _____

TSR = total of above: (not to exceed 70 points)

TSR = _____

432TS Impact Adjustment

1. a. Option 1: $rTSR = 1.0$ = _____
 $rTSR = 1.0 - rOS.$ = _____
- b. Option 2: $rTSR = 0.25$ = _____
- c. Option 3: $rTSR = \frac{aTSR}{aTS}$ = _____

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Activity Worksheet No.	Title
AW-210	CRS Application Cover Page
AW-214	Recertification Worksheet
AW-230	Modification/Cycle Cover Page
AW-310	Elevation Certificates
AW-320	Map Information Service
AW-330	Outreach Projects
AW-340	Hazard Disclosure
AW-350	Flood Protection Information
AW-360	Flood Protection Assistance
AW-410	Additional Flood Data
AW-420	Open Space Preservation
AW-430	Higher Regulatory Standards
AW-430LD	Land Development Criteria
AW-440	Flood Data Maintenance
AW-450	Stormwater Management
AW-501	Repetitive Loss List
AW-502	Repetitive Loss Requirements
AW-510	Floodplain Management Planning
AW-520	Acquisition and Relocation
AW-530	Flood Protection
AW-540	Drainage System Maintenance
AW-610	Flood Warning Program
AW-620	Levee Safety
AW-630	Dam Safety
AW-710	Community Growth Adjustment
AW-720	Community Credit Calculations
AW-720m	Community Credit Calculations (Modification)
AW-CB	Closed Basin Lake Hazards
AW-CE	Coastal Erosion Hazards
AW-DB	Dunes and Beaches
AW-IJ	Ice Jam Hazards
AW-MF	Mudflow Hazards
AW-SU	Land Subsidence Hazards
AW-TS	Tsunami Hazards
AW-UF	Uncertain Flow Path Hazards

Community : _____

433TS Credit Calculation

c430TS = (TSR _____ x rTSR _____) c430TS = _____

c430LZTS (from AW-TS-5) c430LZTS = _____

cSH = total of above cSH = _____

Add this credit to the value for cSH on line 433k, page AW-430-2.

434TS Credit Documentation

- _____ a. The ordinance(s) or law language that adopts the regulatory standard(s).
- _____ b. [If using Option 3] An Impact Adjustment Map showing the regulated tsunami hazard area.
- _____ c. An explanation of the procedures followed for enforcement of the regulatory standard.

Comments: _____

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Community : _____

430LZTS LOW DENSITY ZONING

431LZTS Credit Points

LZTS__ = 5 x __ = 5 x _____

LZTS __ = _____

LZTS__ = 5 x __ = 5 x _____

LZTS __ = _____

LZTS__ = 5 x __ = 5 x _____

LZTS __ = _____

432LZTS Impact Adjustment

2. a. Option 1: rLZTS = 1.0 = _____

rLZTS = 1.0 - rOS. = _____

b. Option 2: rLZTS = 0.2 = _____

c. Option 3: rLZTS__ = $\frac{aLZTS}{aTS}$ = _____

rLZTS__ = $\frac{aLZTS}{aTS}$ = _____

rLZTS__ = $\frac{aLZTS}{aTS}$ = _____

433LZTS Credit Calculation

cLZTS__ = LZTS__ x rLZTS__ = _____

cLZTS__ = LZTS__ x rLZTS__ = _____

cLZTS__ = LZTS__ x rLZTS__ = _____

c430LZTS = total of above c430LZTS = _____

Add this to the value of c430LZTS on page AW-TS-4

434LZTS Credit Documentation

_____ a. The ordinance(s) or law language that adopts the zoning standard(s).

_____ b. An Impact Adjustment Map showing the regulated tsunami hazard area.

_____ c. An explanation of the procedures followed for enforcement of the regulatory standard.

Comments: _____

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