

600 FLOOD PREPAREDNESS ACTIVITIES

Activities in this series are usually coordinated at the local level by the emergency manager. They include actions that should be taken to minimize the effects of a flood on people, property, and building contents. The first activity, 610 (Flood Warning Program), covers flood warning, emergency response, and evacuation plans for the entire community. The other two activities ensure that flood protection structures do not exacerbate the damages caused during a flood.

Contents of Series 600

Section	Page
610 Flood Warning Program	610-1
611 Credit Points	610-3
612 Impact Adjustment.....	610-14
613 Credit Calculation.....	610-15
614 Credit Documentation.....	610-16
615 For More Information.....	610-20
620 Levee Safety.....	620-1
621 Credit Points	620-3
622 Impact Adjustment.....	620-5
623 Credit Calculation.....	620-6
624 Credit Documentation.....	620-7
625 For More Information.....	620-8
630 Dam Safety.....	630-1
631 Credit Points	630-3
632 Impact Adjustment.....	630-7
633 Credit Calculation.....	630-8
634 Credit Documentation.....	630-9
635 For More Information.....	630-9

List of Figures

610-1. Watertown's flood stage forecast map.....	610-7
620-1. Levee protection level	620-3
620-2. FEMA's levee safety criteria	620-10

[This page intentionally blank]

610 FLOOD WARNING PROGRAM

Summary of Activity 610

611 Credit Points. There are five elements in this activity for a maximum of 255 points.

- a. Flood threat recognition system (FTR): Up to 40 points are provided for a flood threat recognition system that forecasts flood elevations and arrival times at specific locations within the community.
- b. Emergency warning dissemination (EWD): Up to 60 points are provided for disseminating the warning to the general public.
- c. Other response efforts (ORE): Up to 50 points are provided for implementation of specific tasks to reduce or prevent threats to health, safety, and property.
- d. Critical facilities planning (CFP): Up to 50 points are provided for coordination of flood warning and response activities with operators of critical facilities.
- e. StormReady community (SRC): If FTR credit is received, 25 or 30 points are provided for designation by the National Weather Service as a StormReady community or a TsunamiReady community.

The community must receive credit for FTR to receive any credit under this activity and it must receive credit for EWD to receive credit for ORE or CFP.

612 Impact Adjustment. The credit points for each element (except SRC) are adjusted in one of three ways.

- a. Under Option 1, if the program is implemented throughout the Special Flood Hazard Area (SFHA), the impact adjustment ratio for an element is 1.0.
- b. Under Option 2, if the program is not implemented throughout the SFHA, a default impact adjustment ratio of 0.25 may be used.
- c. Under Option 3, if the program is not implemented throughout the SFHA, the impact adjustment ratios may reflect the number of buildings in the SFHA affected.

613 Credit Calculation. The credit points for each element are multiplied by the impact adjustment ratios and their products are totaled.

614 Credit Documentation. The community must submit the following.

- a. A description of the flood threat recognition system that tells how site-specific forecasts with flood elevations or flood flows and flood arrival times are generated by meteorologic and/or hydrologic data.
- b. [Required only if applying for EWD, ORE, or CFP credit under Sections 611.b through d]:
 1. Documentation of adoption of the flood response plan.
 2. Applicable portions of the plan or other documents.
 3. A copy of the materials that publicize the flood warning system.
- c. [Required if the impact adjustment ratios used Options 1 or 3 (Section 612.a or 612.c)] Documentation showing how the impact adjustments were determined. If Option 3 is used, a map showing the areas covered by the flood warning program.

The community must submit the following with its annual recertification:

- d. [Required if applying for credit for critical facilities planning (CFP1)] A page from the list of operators of the facilities affected by flooding, updated at least annually
If the community experienced a flood during the year, it must submit with its annual recertification:
- e. An evaluation report on the flood warning program's performance.

615 For More Information.

610 FLOOD WARNING PROGRAM

*NOTE: A separate publication, **CRS Credit for Flood Warning Programs**, gives an example of a community program and application documentation. Communities are encouraged to read this document before applying for this activity. It will improve the quality of the application and reduce the need for additional documentation later. For a free copy, see Appendix E.*

Credit is provided for a program that provides timely identification of impending flood threats, disseminates warnings to appropriate floodplain occupants, and coordinates flood response activities.

Background: With sufficient warning of a flood, a community and its floodplain occupants can take protective measures such as moving furniture, cars, and people out of harm's way. When a flood threat recognition system is combined with an emergency response plan that addresses the community's flood problems, a great deal of flood damage can often be prevented.

The National Weather Service issues specific flood warnings for specific locations along major rivers and coastlines. There is a small but growing number of communities with their own flood threat recognition systems, which enable advance identification of floods on smaller rivers. The full benefit of early flood warning is only realized if the community disseminates the warning to the general public and to critical facilities. Additional flood damage can be prevented if the community has a flood response plan that includes appropriate tasks, such as directing evacuation, sandbagging, and moving building contents above flood levels.

Activity Description: The community must have a flood threat recognition system that identifies an impending flood in order to receive credit under this activity. Additional credit is provided for disseminating a warning to the general public, carrying out appropriate flood response tasks, and coordinating the flood response plan with operators of critical facilities. A report on the operation of the system is required if a flood meeting the criteria in Section 614.d occurred during the previous year.

This activity is not intended to be a model for developing a flood warning or flood response program. As with the rest of the Community Rating System (CRS) activities, its objective is to provide a simple way to measure a local program's potential impact on flood insurance premiums. An effective flood warning or response program needs to be carefully prepared and tailored to the local flood hazards and the specific needs of the community.

The minimum requirement for credit for this activity is a flood threat recognition system to identify impending flooding. The system can use locally collected data or data from the National Weather Service or other rain, river, or storm monitoring agency.

Additional credit is available depending on the community's program for actions to be taken after an impending flood is identified. A "flood response plan" is the name given in this activity to the document that describes these activities. It may have different names in different communities, such as "flood warning plan," "flood preparedness plan," or "flood annex" to a multi-hazard plan. The plan must have been adopted by the community's governing board.

Three elements provide credit points for the flood response plan:

- Dissemination of the warning to the general public;
- Implementation of specific tasks to reduce or prevent threats to health, safety, and property, such as controlling evacuation routes, restricting access to flooded areas, and maintaining vital services; and
- Coordination of flood warning and response activities with operators of critical facilities, such as hospitals and hazardous materials companies.

NOTE: The community must have a warning dissemination program in order to receive credit for the flood response plan.

611 Credit Points

NOTE: No credit will be provided for this activity unless the documentation requirements described in Section 614.a are met.

Maximum credit for Activity 610: 255 points.

a. Flood threat recognition system (FTR) (Maximum credit: 40 points)

Credit is provided if the community has a system that provides an early notice of a flood for at least one location within the community. The notice must be generated by meteorologic and/or hydrologic data. The system must be able to forecast specific flood conditions in the future.

1. Prerequisites: To receive credit for this element:

- (a) The data collection, communications, and data analysis components of the flood threat recognition system must be regularly maintained and tested at least annually; and
- (b) The community must submit descriptions of the flood hazard and the flood threat recognition system.

2. Credit points: FTR = the total of the credit points in either (a) or (b) as follows:

(a) If the flood threat recognition system is operated by a federal, state, or other agency other than the community, FTR = the total of (1) and (2), as follows:

(1) 20, if the community demonstrates in its documentation that it is prepared to receive flood warnings on a 24-hour basis. The information received must be specific to one or more sites on each river in the community and include flood elevations and arrival times (or other specific data appropriate for warning); and

(2) EITHER:

((a)) 5, if a manual technique is used to predict downstream arrival time and peak flow or elevations; OR

((b)) 20, if a computerized flow or storm surge prediction model (e.g., HEC-2 or HUREVAC) is used to analyze the data to produce more locally pertinent flood threat information. This model may be either a “real-time” model run during the flood, or maps, charts, and other output from a model that provides detailed data for points other than those specifically forecast in Section 611.a.2(a)(1).

The flood threat recognition system lets local officials know that a flood is coming. It should also enable estimates to be made of the time of onset of flooding and crest height. Under Section 611.a.2(a)(1), credit for flood threat recognition is provided if the community documents that, on a 24-hour basis, it monitors, and is ready to react to, notification systems, such as:

- River stage reports from the National Weather Service, U.S. Army Corps of Engineers, or other agency that monitors river stages [FTR = 20].
- Reports from the National Hurricane Center [FTR = 20].
- Reports from an IFLOWS (Integrated Flood Observing and Warning System) system that rainfall in the watersheds above the community will cause the river to crest at a certain stage at a certain time at a specific location within the community [FTR = 20].
- Reports from the West Coast & Alaska Tsunami Warning Center (WC/ATWC) or the Pacific Tsunami Warning Center (PTWC) [FTR = 20]

Under Section 611.a.2(a)(2), credit is provided if the community documents that a computer model will allow the site-specific forecast provided through Section 611.a.2(a)(1) to be extended to other locations within the community:

- Using a flood profile produced by computer modeling (e.g., the profile in the community's flood insurance study) and a contour map to determine the area along the river that will be inundated by the flood that has been forecast. [FTR = 20 + 20 = 40]
- Using SLOSH inundation maps to convert a forecast from the National Hurricane Center to a predicted area of inundation throughout the community. [FTR = 20 + 20 = 40]
- Using a forecast peak flow at one point on a river from the National Weather Service or an IFLOWS system and the HEC-2 backwater model to produce a map of inundation areas throughout the community. [FTR = 20 + 20 = 40]

(b) If the flood threat recognition system is operated by a local, state, or other nonfederal agency, FTR = the total of the credit points in (1), (2), and (3) as follows:

(1) EITHER:

((a)) 15, for a collection system based on precipitation and/or river gage data that are manually read and reported (e.g., by volunteer);
OR

((b)) 20, for an automated precipitation and/or river gage data collection and reporting system (e.g., IFLOWS, ALERT, or comparable system);

(2) 10, if the density of the gage network is at least one per 10 square miles, or if all upstream tributaries with more than 10 square miles are gaged; and

(3) EITHER:

((a)) 5, if a manual technique is used to predict downstream arrival time and peak flow or elevations; OR

((b)) 10, if a verified digital flow prediction model is used to analyze the data collected to predict downstream arrival time and peak flow or elevations.

Flood threat recognition systems creditable under Section 611.a.2(b) include:

- Monitoring upstream river and rain gages by volunteers, neighboring communities, or others who report the data to an emergency operating center or other location [15 points] where the data are reviewed and flood predictions are made using graphs and charts [5 points for a manual technique to predict arrival times and peak flows]. [FTR = 15 + 5 = 20]

- Operating or participating in an ALERT, IFLOWS, or similar system. ALERT or IFLOWS systems consist of remote river and rainfall gages and a communication system that transmits the gage data to a microprocessor [20 points]. A hydrologic model converts the river and rainfall data to a flood prediction [10 points].
[FTR = 20 + 10 = 30]

It does not matter which agency provides the flood forecast to the community. What counts is that a knowledgeable person in the community is responsible for receiving information and making or communicating a locally useful flood prediction. Monitoring the NOAA (National Oceanic and Atmospheric Administration) Weather Radio and hearing that low-lying portions of several counties can expect flooding is not creditable under the CRS unless the community has its own followup system of monitoring and predicting flood levels.

Each system must have a schedule of maintenance, drills, and/or other training appropriate to its needs. An ALERT system usually has automatic daily tests, while a manual gage-reading system may only need an annual drill. The community's documentation must explain how and when the flood threat recognition system is maintained and updated (see Section 614.a.3).

If a system does not cover all of a community's sources of flooding, the areas affected are factored in during the impact adjustment. The impact adjustment is based on the number of buildings in the Special Flood Hazard Area (SFHA) that are affected (see Section 612).

Example 611.a-1. Watertown is flooded by three streams as shown in Figure 610-1: two small streams that are not mapped as having an SFHA, and the Riley River. The following text is included in Watertown's description of the flood threat recognition system as required by Section 614.a.3:

Watertown obtains warnings of flooding on Riley River from NOAA Weather Radio. The broadcasts include a stage predicted for the gage at the Cornhusker Street bridge. The emergency manager uses the flood stage forecast map (Figure 610-1) to determine what other areas will be affected by the predicted flood.

Broadcasts are monitored 24 hours a day by personnel at the police dispatch center. Because the radio is continuously monitored, there are no special procedures for testing. Maintenance is performed under contract with a local electronics store.

This system receives 20 points under Section 611.a.2(a)(1) for receiving and acting on National Weather Service warnings and 20 points under 611.a.2(a)(2)(b) for using the map to provide flood data for other points in the community.

FTR = 20 + 20 = 40

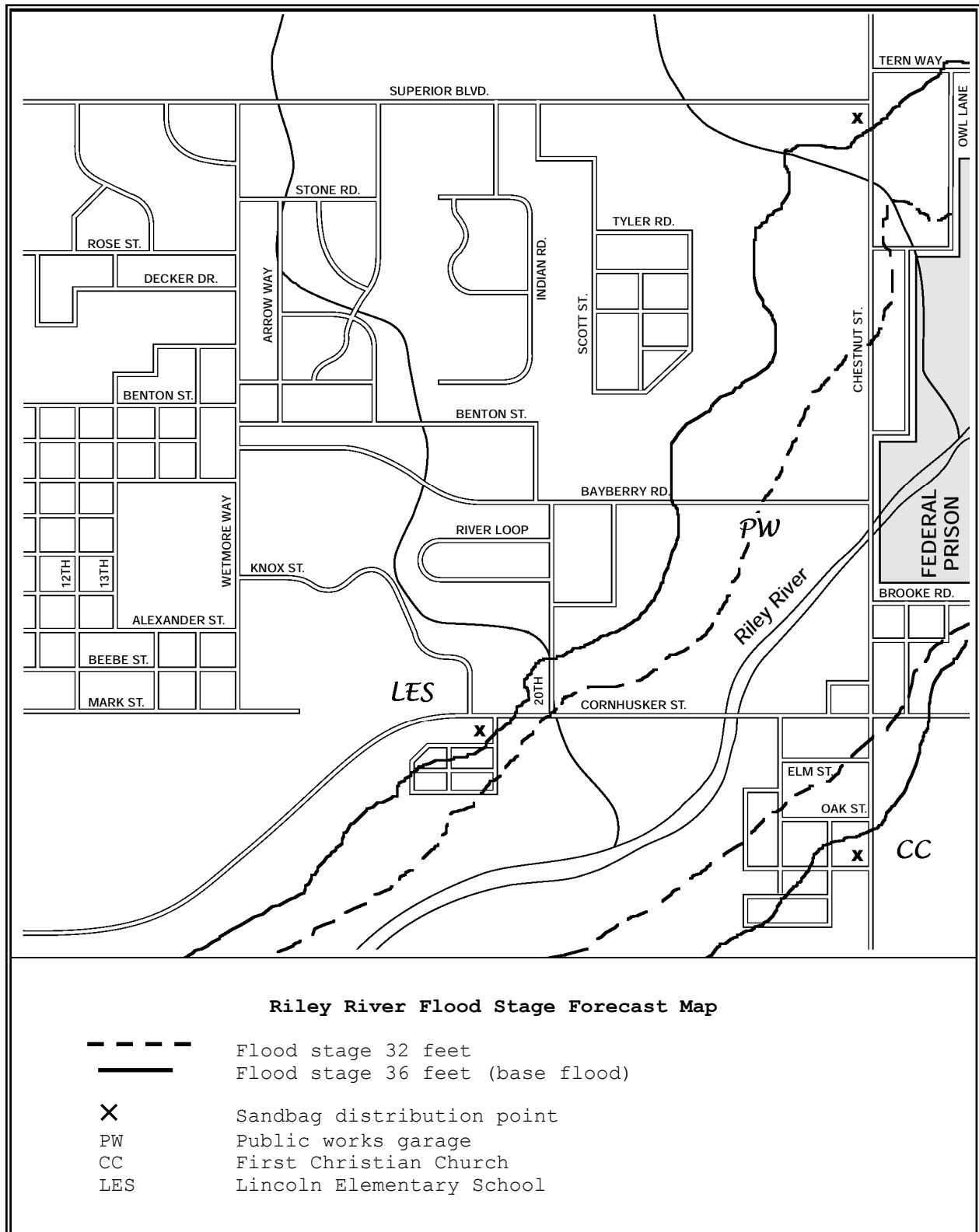


Figure 610-1. Watertown’s flood stage forecast map.

b. Emergency warning dissemination (EWD) (Maximum credit: 60 points)

This element credits arrangements for disseminating a flood warning to the public.

1. Prerequisites:

- (a) The community must receive credit for the flood threat recognition system (if FTR = 0, EWD = 0 and c610 = 0).
- (b) The community must have adopted an emergency response plan, and the items for which EWD credit is requested must be in that plan or in appendices or procedures adopted or developed as part of that plan.
- (c) The warning must be disseminated in ways that can reach people in a timely manner, including at night or in heavy storms. If the warning lead time is under 12 hours, it is not sufficient to rely only on radio and TV announcements.
- (d) The warning dissemination equipment and procedures must be tested at least annually.
- (e) The community must publicize the warning procedures at least annually. This may be done by using an outreach project credited under elements OPC, OPF, or OPS of Activity 330 (Outreach Projects) or a project that is not credited by the CRS but that reaches at least 90% of the properties in the floodplain. The publicity must cover the topics of flood warning and flood safety discussed in Section 331. If an OPS is used, the public information strategy document must discuss the best way to publicize warning and safety information to the target audience.

2. Credit points: EWD = the total of the following points if these measures are specified in the adopted plan:

- (a) 10, for having an adopted policy that specifies when and how a warning is issued and what messages will be used. The policy must provide adequate guidance to allow staff to quickly issue appropriate warnings;
- (b) 15, for either an outdoor voice-sound system or a fixed siren system;
- (c) 30, for dissemination of warnings by door-to-door contact or mobile public address systems;
- (d) 10, for warning dissemination through the Emergency Alert System;
- (e) 15, for a telephone system that reaches all floodplain residents;
- (f) 10, for warning dissemination using a cable television override system; and
- (g) 10, for local AM radio transmitters used for public announcements.
- (h) Additional points may be possible for warning systems not listed. Communities should submit requests for such credit to their ISO/CRS Specialist.

The emergency response plan must be adopted by the governing body of the community. Specific items for which EWD credit is applied must be included in the adopted plan. The term “plan” includes annexes and standard operating procedures (SOPs) that may be developed pursuant to the plan, but without specific adoption. It is a standard procedure for such a plan to require the development and frequent revision of such SOPs without formal adoption of each procedure and revision.

A community may include redundant warning dissemination systems in its flood response plans that total more than 60 points, but no more than 60 points are provided for this element. Credit is provided for either an outdoor voice-sound system or a fixed siren system, but not both.

To receive credit for this element, the community must receive credit for FTR under Section 611.a. The documentation must show that the warning will reach people in a timely manner. In areas subject to flooding with little lead time, sirens or fixed or mobile public address systems may be necessary.

In areas with longer warning lead times, slower methods such as telephone calling trees and going from door to door may be appropriate. Often areas subject to hurricanes and coastal storms can expect more than 24 hours of warning lead time. In these cases, radio and television announcements would suffice.

The warning equipment and procedures must be tested at least annually. Each approach should have its own appropriate testing schedule. Sirens and emergency alert systems are often tested weekly or monthly. A system that relies on telephone calling trees needs a provision for updating at least annually.

The community must conduct one or more annual outreach projects that may be credited under Activity 330 (Outreach Projects) as outreach projects to the community (OPC), to floodplain residents (OPF), or pursuant to a public information program strategy (OPS) that determined the most appropriate way to advise people about the warning system. The project must cover flood warning and flood safety as discussed in Section 331. An outreach project used for this publicity requirement must be sent to at least 90% of the target audience.

Example 611.b-1. Watertown’s emergency response plan describes its warning dissemination system. The plan includes guidance on what warnings to issue and to whom when the Riley River is predicted to reach different stages [10 points for the warning policy]. When the flood threat recognition system shows that the river is expected to exceed a flood stage of 30 feet, the City sounds its sirens, which are located throughout the community [15 points for a fixed siren system]. The police dispatcher also activates the Emergency Alert System and advises area radio stations about the hazard [10 points for use of the Emergency Alert System]. Different messages are used based on the predicted flood stage.

Sirens are tested on the first Monday of each month. The Emergency Alert System is tested every six months. Maintenance of the sirens and communications equipment is provided for by contracts with the manufacturers. A flood exercise is conducted every two years. In the other years, a different type of disaster is used to exercise the City's emergency response program.

The Police Department also sends a squad car along streets in the Riley River floodplain to warn residents with its public address system. The squad cars are used daily, so there is no special testing. They are maintained by local car dealers according to a preventive maintenance schedule [30 points for mobile public address system].

$$\text{EWD} = 10 + 15 + 10 + 30 = 65.$$

Because the maximum value for EWD is 60, $\text{EWD} = 60$.

c. Other response efforts (ORE) (Maximum credit: 50 points)

This element credits the other flood response efforts in the community's flood response plan.

1. Prerequisites:

(a) The community must receive credit for the flood threat recognition system and for disseminating a flood warning to the general public (if $\text{FTR} = 0$ or $\text{EWD} = 0$, $\text{ORE} = 0$).

(b) The community must conduct at least one exercise of the response plan each year. The exercise may be a table top exercise, drill, or response to an actual disaster. If the flood response plan is part of a multi-hazard plan, then the exercise may be in response to another disaster provided the parties and tasks involved are substantially the same.

2. Credit points: $\text{ORE} =$ the total of the credit points in (a), (b), and (c) as follows:

(a) 20, if the adopted plan is keyed to specific predicted flood levels or other appropriate data furnished by the flood threat recognition system;

(b) 10, if the adopted plan identifies responsibility for flood response tasks for the community's staff and other public and private organizations; and

(c) 20, if the adopted plan includes a summary of the estimated staff, equipment, supplies, and time required for each flood response task and the sources of the necessary resources.

Flood response tasks are assignments to be implemented by personnel within the local government, in other agencies (e.g., state police), and the private sector (e.g., contractors, volunteers, or the Red Cross). To receive full credit for this element, the tasks must be specific and flood-related. This level of detail is likely to be in an appendix or standard operating procedure attached to the plan.

Example 611.c-1. Watertown's emergency manager prepared a Flood Stage Forecast Map for Riley River, shown in Figure 610-1. Its flood response plan is keyed to predicted flood crests at the river gage on Cornhusker Street. At the predicted 32-foot stage, a flood will reach buildings south of Cornhusker and the city's Public Works garage. At the predicted 36-foot stage, the Cornhusker and Chestnut Street bridges will become impassable. The following are some of the city's flood response tasks:

32-foot stage predicted:

Police Department: direct evacuation out of the identified areas.

Fire Department: move two trucks and one ambulance to other side of river, so the entire town can be covered if the bridges are closed.

Public Works Department: sandbag the public works garage.

The Streets Department, Public Information Officer, other departments, and other agencies in the community, such as utility companies and the Red Cross, also have specific assignments.

36-foot stage predicted:

Police Department: direct evacuations.

Public Works Department: move all moveable equipment to high ground.

As noted under the example for EWD, Watertown's response plan is much more detailed than this example indicates. The EWD example also demonstrates that the town has a schedule for drills and exercises for its emergency response plan.

[20 points for keying response tasks to predicted flood levels and 10 points for itemizing flood response plans by the responsible department, agency, or organization. ORE = 20 + 10 = 30

d. Critical facilities planning (CFP) (Maximum credit: 50 points)

This element credits warning and coordinating with operators of critical facilities. Critical facilities are defined in Section 130.

1. Prerequisites:

- (a) The community must receive credit for the flood threat recognition system and for disseminating a flood warning to the general public (if FTR = 0 or EWD = 0, CFP = 0).

- (b) The community must update the information on its critical facilities at least annually.
- 2. Credit points: CFP = the credit points as follows:
 - (a) CFP1 = 10, if the adopted plan includes the names and telephone numbers of the operators of all critical facilities affected by flooding. This information must be updated at least annually;
 - (b) CFP2 = 20, if the adopted plan includes arrangements for providing special warnings or early notifications directly to all facilities that need them; and
 - (c) CFP3 = 20, if the critical facilities needing them have their own flood response plans that have been developed, reviewed, or accepted by the community.

As with the other elements of this activity, the community must receive credit for its flood threat recognition system in order to receive credit for this element.

See Section 130, Glossary, for the definition of “critical facilities” used to determine CRS credit. The community’s flood response plan must list the facilities considered critical in a flood. Facilities not subject to flooding generally do not need to be addressed, although in some cases loss of access can cause a critical situation. Other facilities in flood-free sites may be needed to support the flood response effort (e.g., sandbag suppliers and shelters for evacuees).

More credit points are available if the community provides warnings tailored to the needs of its critical facilities. The timing and type of notice would depend on the facility and its needs. For example, an industrial complex where there is a lot of noise may need a direct telephone call because no one would hear a siren. Another facility may need an early notice in order to get ready. To obtain the 20 points, the community does not need to provide a special warning to all critical facilities, only all of those identified in the flood response plan as needing one.

More credit is provided if there are flood response plans for individual critical facilities. The plans may be developed by the community or developed by the facilities’ operators and reviewed by the community. The facilities’ plans should include flood response tasks similar to those credited under Section 611.c, Other Response Efforts.

Example 611.d-1. Watertown’s multi-hazard plan lists all critical facilities in the community, their operators, and their telephone numbers. The list is updated by the emergency manager every six months. [CFP1 = 10 points]

There are three critical facilities affected by flooding of the Riley River: the Public Works garage, the First Christian Church, and Lincoln Elementary School. The first is in the floodplain and the last two are adjacent to the floodplain but are needed for the flood response plan. The City’s plan includes providing special warnings to these three facilities. [CFP2 = 20 points]

e. StormReady community (SRC) (Maximum credit: 55 points)

This element credits a local government that has been designated by the National Weather Service (NWS) as a StormReady or a TsunamiReady community.

1. Prerequisites:

- (a) The local government must receive credit for a flood threat recognition system operating within its jurisdiction. (if FTR = 0, SRC = 0).
- (b) The flood warning program must be able to forecast the arrival time and peak flow or elevations of floods.
- (c) For TsunamiReady credit, the community must:
 - (1) meet the other mapping requirements for special hazards credit, as described in *CRS Credit for Management of Tsunami Hazards*, sections 410TS and 430TS, and.
 - (2) have adopted a tsunami hazard operations plan or annex that addresses actions to take after a tsunami warning.

2. Credit Points:

- (a) SRC = 25 points for obtaining and maintaining the designation as a National Weather Service StormReady community.
- (b) SRC = 30 points for obtaining and maintaining the designation as a National Weather Service TsunamiReady community.

Warning and response programs for other hazards should be coordinated with and support flood warning and response activities. The StormReady element is an example of where local warning and public information activities directed toward other meteorological and hydrological hazards, such as thunderstorms and tsunamis, receive CRS credit because they have a direct flood loss reduction benefit.

The National Weather Service established the StormReady and TsunamiReady programs to help local governments improve the timeliness and effectiveness of hazardous-weather-related warnings for the public. By participating, local agencies can earn recognition for their jurisdiction by meeting the guidelines established by the NWS in partnership with federal, state, and local emergency management professionals.

The StormReady and TsunamiReady programs have communications and educational requirements that go beyond the elements credited by the CRS. Therefore, CRS credit is provided to local governments that receive credit for flood threat recognition (FTR) and are designated by the NWS as a StormReady or a TsunamiReady community. More information on the special hazard credits for tsunami programs can be found in *CRS Credit for Management of Tsunami Hazards*.

Example 611.e-1. Watertown was designated by the National Weather Service as a StormReady community on November 1, 2000. [SRC = 25 points]

612 Impact Adjustment

There is no impact adjustment for SRC because the program applies to the entire community.

a. Option 1:

1. If the flood threat recognition system, the warning dissemination system, and the flood response tasks cover the entire SFHA, rFTR, rEWD, and rORE = 1.0.
2. If all critical facilities affected by flooding have their own flood response plans, rCFP3 = 1.0.

There is no impact adjustment for CFP1 and CFP2. If the community's program does not cover all critical facilities affected by flooding, then CFP1 and CFP2 = 0. There is an impact adjustment for CFP3 based on whether all (Option 1) or some (Option 2) of the critical facilities have their own flood response plans.

b. Option 2:

1. If the flood threat recognition system, the warning dissemination system, and the flood response tasks cover less than the entire SFHA, rFTR, rEWD, and rORE = 0.25.
2. If only some of the critical facilities have their own flood response plans, rCFP3 = 0.25.

c. Option 3:

The impact adjustment ratios for FTR, EWD, and ORE are computed by dividing the number of buildings affected by each element by the total number of buildings in the SFHA (bSF):

$$rFTR = \frac{bFTR}{bSF} \quad rEWD = \frac{bEWD}{bSF} \quad rORE = \frac{bORE}{bSF}$$

rFTR and rORE cannot be greater than 1.0. rEWD cannot be greater than rFTR.

In most cases, a flood warning program is implemented throughout the community. This includes the regulatory floodplain and B, C, D, or X Zones that are not mapped for flooding. Where a community implements a warning program that serves everyone in the SFHA, the impact adjustment variables for those elements are 1.0.

Sections 301 through 303 discuss determining impact adjustment ratios based on buildings, including the variable bSF.

Example 612.c-1. Watertown's SFHA is limited to the Riley River floodplain. Its flood warning and response program for Riley River covers the entire SFHA. Therefore, the city uses Option 1: rFTR, rEWD, and rORE = 1.0.

613 Credit Calculation

- a. $cFTR = FTR \times rFTR$
- b. $cEWD = EWD \times rEWD$
- c. $cORE = ORE \times rORE$
- d. $cCFP = CFP1 + CFP2 + (CFP3 \times rCFP3)$
- e. $c610 = cFTR + cEWD + cORE + cCFP + SRC$

Example 613-1. Watertown's flood warning and flood response program is described in the previous sections:

FTR = 40	rFTR = 1.0	cFTR = FTR x rFTR = 40 x 1.0 = 40
EWD = 60	rEWD = 1.0	cEWD = EWD x rEWD = 60 x 1.0 = 60
ORE = 30	rORE = 1.0	cORE = ORE x rORE = 30 x 1.0 = 30
CFP1 = 10 CFP3 = 0	CFP2 = 20	cCFP = CFP1 + CFP2 + (CFP3 x rCFP3) = 10 + 20 + (0 x 0) = 30
SRC = 25		cSRC = 25
c610 = cFTR + cEWD + cORE + cCFP + SRC = 40 + 60 + 30 + 30 + 25 = 185		

614 Credit Documentation

The community must submit the following documentation with its application:

- a. A description of the community's flood threat recognition system. The following items must be included and the margins must be marked so these items can be located by the reviewer. If the community is only applying for credit for a flood threat recognition system under Section 611.a, only items 1 and 3 need to be submitted. The document should be marked as indicated:
 1. A description of the flood hazard ("flood hazard").
 2. A description of the areas affected by flooding and the impact of flooding on those areas ("flood impact").
 3. A description of the system used to recognize and evaluate an impending flood ("flood threat recognition system" or "FTR").
 4. Flood warning lead times for each stream or body of water covered by the program ("flood warning times").

This documentation is the basis for providing the community with credit for this activity. If the documentation is incomplete, does not address the elements' credit criteria, or is not adequately marked, the community may not receive all the credit points that its program deserves.

NOTE: The community's staff may be asked to complete a questionnaire on its flood warning program to facilitate verification of this activity.

The following provides guidance on what documentation is needed:

1. A description of the flood hazard: There must be a discussion of the nature of the flood hazard. A description that meets the criteria for step 4, "assess the hazard" items (a)(2) and (a)(3) for a floodplain management plan will usually suffice (see Section 511.a.4.(a)(2) and (3)). The community may find it helpful to show the flood hazard area on a map of the community that shows the streams and other bodies of water that affect the community (see Figure 610-1). The description of the flood hazard in the community's Flood Insurance Study, which was provided to the community by the Department of Homeland Security's Federal Emergency Management Agency (FEMA) when the community received its Flood Insurance Rate Map (FIRM), will generally provide a good basis for this description.

Example 614.a-1. Watertown's Flood Stage Forecast Map is shown in Figure 610-1. The following text is included in Watertown's documentation:

Watertown's primary threat of flooding is from the Riley River, which has a drainage area of 417 square miles. There are two smaller streams with drainage

areas that are not large enough to be mapped as SFHA on the city's FIRM. Although Riley River occasionally floods during the summer and fall, the principal cause of flooding is spring snow melt. Attached is the Flood Stage Forecast Map for the Riley River (Figure 610-1).

The duration of flooding varies depending on the cause of flooding. Summer thunderstorms immediately upstream of Watertown can cause the river to rise rapidly to a peak and to subside as quickly. Peak flows from thunderstorms farther upstream are attenuated as they move downstream. The peaks are lower, and the duration of flooding is longer. Flooding from snow melt and slow-moving winter frontal storms may persist for several days and have multiple peaks.

In all cases, velocities are less than 5 feet per second. Flooding on the Riley River has included logs and other debris that increase the hazards.

2. A description of the areas affected and the impact of flooding on the areas: A flood threat recognition system should be tailored to the needs of an area. A description that meets the criteria for step 5, "assess the problem," items (a) through (d) in a floodplain management plan will usually suffice (see Section 511.a.5(a)—(d)).

Example 614.a-2. The following text is included in Watertown's documentation:

Areas in FIRM Zones A and B along the Riley River are subject to flooding. Major parts of these areas have been flooded at least six times in the last 50 years. The Chestnut Street bridge has sustained minor damage several times due to battering by debris.

Within the area subject to overland flooding, properties subject to damage are primarily residential with a few commercial developments and one critical facility. The Riley River floodplain includes 86 houses and four non-residential buildings. There is only one critical facility in the Riley River floodplain, the city's Public Works garage.

Damage in the past has included water damage to contents, battering of structures, and secondary losses due to disruption of utility services. Flooding of bridges and the Public Works garage has impeded response and recovery work.

3. A description of the flood threat recognition system: The description must demonstrate that the flood threat recognition system is timely and reliable enough to allow a reasonable opportunity to reduce the impact of the flood on the community and its residents. If the notice of impending flooding is provided by the National Weather Service or other federal agency, the description must state how the

community receives the notice. If data are collected and analyzed by the community, state, or other non-federal agency, the system should be described in more detail.

Example 614.a-3. Watertown's description of the flood threat recognition system is included in the example in Section 611.a.

4. Flood warning times for each stream or body of water covered by the program: A response plan must be based on the amount of time the flood threat recognition system provides for the community to respond to the flood notification. Warning times can be estimated.

Example 614.a-4. The following text is included in Watertown's documentation:

The flood predictions provided by the National Weather Service provide Watertown approximately 12 hours of warning in advance of flooding from events in the upper part of the Riley River watershed. Accurate and timely warnings cannot be provided for floods resulting from rain within 10 miles upstream of the community.

b. [Required if the community is applying for credit under Sections 611.b through d]:

1. Documentation that the flood response plan has been formally adopted by the community's governing board.

Many communities have prepared multi-hazard emergency response plans or comprehensive emergency management plans. Unless such a plan has a flood annex, standard operating procedures, or other parts that specifically address the community's flood problem, it may not be specific enough to qualify for CRS credit. For CRS credit, a flood response plan must specifically relate to the flood hazard and identify activities that respond to the flood threat at different predicted stages.

An effective date or adoption date on the cover of the plan or a copy of the minutes of the meeting at which it was adopted will suffice.

2. Copies of those portions of the plan or other documents demonstrating that the credit is appropriate. The CRS acronyms must be marked in the margins.

Even where a multi-hazard plan or other comprehensive emergency response plan is used for parts of the documentation, other documentation may be required. Many of the specific items required to document these elements may be in appendices or standard operating procedures rather than in the body of the plan.

If a multi-hazard emergency response plan or comprehensive emergency management plan with many annexes is used to document the credit for this activity, the entire document should not be submitted with the CRS application. The specific documentation should be marked with the CRS acronyms in the margins, and copies of only those pages should be submitted.

3. A copy of the materials that publicize the warning system. The publicity must fully cover the topics of flood warning and flood safety as discussed in Section 331. The materials must be distributed each year and must reach at least 90% of the target audience.
- c. [If the community determines the impact adjustment ratios using Options 1 or 3 (Section 612.a or 612.c)] Documentation showing how the impact adjustments were determined. If Option 3 is used, a map showing the areas covered by the flood warning program is needed.

If Option 1 is used, a written statement that all buildings in the SFHA are covered by the program is sufficient.

- The community must submit the following with its annual CRS recertification:
- d. [If the community has credit for critical facilities planning (CFP1)] A page from the list of the operators of the critical facilities affected by flooding that must be updated at least annually (see Sections 214 and 611.d.2(a)).
 - e. If the community experienced at least one flood during the previous year that damaged more than 10 buildings, caused more than \$50,000 in property damage, or caused the death of one or more persons, it must submit the following documentation with its annual CRS recertification (see Section 214):

An evaluation report that describes the performance of the warning program. For each flood meeting the above criteria, this report must describe how the program operated in response to the flood, and any improvements that may be needed.

If there has been a flood that meets the above criteria, submission of the report with the annual recertification is necessary for continued credit under this activity. The report should include a discussion of the following items. The report does not need to cover items 3 through 5 if the community is not receiving CRS credit for these elements.

1. The cause of the flood and its estimated recurrence interval, if known;

2. Performance of the flood threat recognition system;
3. Dissemination of warnings and public response;
4. Governmental and private response activities, such as evacuation or flood fighting;
5. Impact of the flood on critical facilities;
6. Description of deaths, injuries, property damage, and impact on public health and safety;
7. Damage prevented by the flood warning system and response plan;
8. Lessons learned and changes needed in the warning program and response plan; and
9. The status of implementing the changes recommended by the last post-flood evaluation report.

If the evaluation identifies shortcomings in the flood warning system or failures in its operation, the report must identify remedial actions that will improve future operation.

615 For More Information

Additional information, reference materials, and examples can be found at the CRS Resource Center at <http://training.fema.gov/EMIWeb/CRS/>.

- a. The following publications are available at no cost (see Appendix E).

CRS Credit for Flood Warning Systems

CRS Credit for Management of Coastal Erosion Hazards

CRS Credit for Management of Tsunami Hazards..

- b. In most cases, communities can receive assistance from their state emergency services agency or the National Weather Service in establishing warning programs and planning and conducting drills.
- c. Most district offices of the U.S. Army Corps of Engineers have handbooks on flood emergency procedures and offer help in developing flood response plans.
- d. Copies of the following publications are available at no cost from

FEMA Distribution Center
P.O. Box 2010
Jessup, MD 20794-2012
1-800-480-2520
Fax: (301) 362-5335

Disaster Operations, A Handbook for Local Governments, FEMA, CPG 1-6, 1981.

Preparing for Hurricanes and Coastal Flooding: A Handbook for Local Officials, FEMA and the Office of Ocean and Coastal Resource Management, FEMA-50, 1983.

State and Local Guide (SLG) 101: Guide for All-Hazard Emergency Operations Planning. September 1996 (available from <http://www.fema.gov/pdf/rrr/0-prelim.pdf>).

e. FEMA has independent study courses from the Emergency Management Institute through its website. See <http://training.fema.gov/EMIWeb/>.

f. The following may be ordered from

National Technical Information Service (NTIS)
U.S. Department of Commerce
Springfield, VA 22161

Guidelines on Community Local Flood Warning and Response Systems, Federal Interagency Advisory Committee on Water Data, 1985. (NTIS order number PB 86 109 717, \$21.95).

Community Handbook on Flood Warning and Preparedness Programs, H. James Owen, for the U.S. Army Corps of Engineers, 1981. (NTIS order number AD-A108 669, \$15.95).

g. More information on StormReady can be obtained from the local National Weather Service office or the NOAA website at <http://www.nws.noaa.gov/stormready/>.

[This page intentionally blank.]

620 LEVEE SAFETY

Summary of Activity 620

621 Credit Points. There is one element in this activity for a maximum of 900 points.

- a. Levee protection level (LPL): Up to 100 points are provided based on the flood recurrence interval at the flood protection level. The levee's flood protection level is 3 feet below the lowest point of the crown. The following conditions must be met:
- b. The levee must have been constructed before January 1, 1991.
- c. The community must have a levee emergency plan that specifies actions to be taken at various flood stages.

622 Impact Adjustment. The credit points for each element are adjusted in one of three ways.

- a. Under Option 1, if all of the buildings in the Special Flood Hazard Area (SFHA) are protected by the levee, the impact adjustment ratio is 1.0.
- b. Under Option 2, if there are at least five buildings protected by the levee, a default impact adjustment ratio of 0.01 may be used and the community receives 9 points for this activity.
- c. Under Option 3, the impact adjustment ratio reflects the number of buildings in the SFHA protected by the levee.

623 Credit Calculation. The credit points for LPL are multiplied by the impact adjustment ratio and then by 9.

624 Credit Documentation. The community must submit the following.

- a. Levee protection level documentation. EITHER:
 1. A statement signed by the U.S. Army Corps of Engineers that states the levee protection level and the date of construction, OR
 2. A certification by a licensed professional engineer that states that the levee meets all of the NFIP levee recognition requirements except for height. The certification must also provide the date of construction and the levee protection level.
- b. The community's levee emergency response plan specifying actions to be taken at various flood stages.
- c. The map showing the area protected by the levee.
- d. Documentation showing how the impact adjustment ratios were determined.

The community must submit the following documentation with its annual recertification.

- e. A certification by a licensed professional engineer that the levee has been maintained in such a manner that it meets all the NFIP levee maintenance requirements.

625 For More Information.

620 LEVEE SAFETY

Credit is provided for maintaining levees and a levee emergency response plan for areas protected by less than base flood levees.

Background: If a levee or floodwall does not meet the base flood protection criteria, it is not recognized on the Flood Insurance Rate Map (FIRM). Because these levees do prevent damage from smaller, more frequent floods, they may receive CRS credit.

Many communities are protected to some extent by levees or floodwalls. (As used in this activity, the word “levee” includes floodwalls.) The National Flood Insurance Program (NFIP) has criteria (44 *CFR* 65.10, shown in Figure 620-2a–c) for recognizing whether a levee provides protection from the base flood. If it does, the protected area is mapped as a B, C, or X Zone and flood insurance rates are lower than if it remained an A Zone. The community is required to maintain the levee to its design standard in order to keep the favorable zone designation.

Activity Description: This activity provides credit to communities protected by levees that are properly maintained and operated but are not high enough to meet the criteria for base flood levees. A community may also receive credit for a levee that protects to the base flood elevation or above if the levee is not reflected on the community’s FIRM. There is no credit under this activity if the area protected by the levee is designated as an AO, A99, AR, B, C, or X Zone or an AE or A numbered zone with the base flood elevation lower than on the water side of the levee.

CRS credit is only provided for levees and floodwalls built before January 1, 1991, and those that provide protection to at least the 25-year flood elevation. SEE THE NOTE IN SECTION 621.

In addition to having adequate design and maintenance, there must be emergency response plans for situations in which the levees are threatened with overtopping or failure.

This activity is not intended to encourage construction of new flood control structures or to duplicate credit given to base flood levees by current mapping procedures.

The area protected by a levee on a community’s FIRM must show the protected area as an SFHA. The base flood elevation must be the same on both sides of the levee. If the area protected by a levee is mapped as a B, C, or X Zone, the levee was considered to provide base flood protection when the FIRM was prepared and no credit is available under this activity.

There are other activities related to levees that are not included here because they are credited elsewhere. For example, Activity 330 (Outreach Projects) could provide credit for advising residents of the protected area about the levee and its shortcomings.

621 Credit Points

Maximum credit for Activity 620: 900 points.

Levee protection level (LPL) (Maximum credit: 100 points)

For LPL credit, the following conditions must be met:

- a. LPL = flood recurrence interval at the flood protection level. If the flood protection level is at or above the base flood elevation, LPL = 100. There is no credit for levees below the 25-year protection level. The flood protection level can be determined in either of the following ways:
 1. The levee's flood protection level may be determined by the U.S. Army Corps of Engineers or other federal agency that has inspected the levee; or
 2. In the absence of a determination by a federal agency with jurisdiction, the levee's flood protection level is 3 feet below the lowest point of the crown.

The criteria in 44 *CFR* 65.10(b)(1) require that the crown of the levee be at least 3 feet above the base flood elevation. To be credited under this activity, the levee would not need to be that high, but it must meet the rest of the requirements of §65.10.

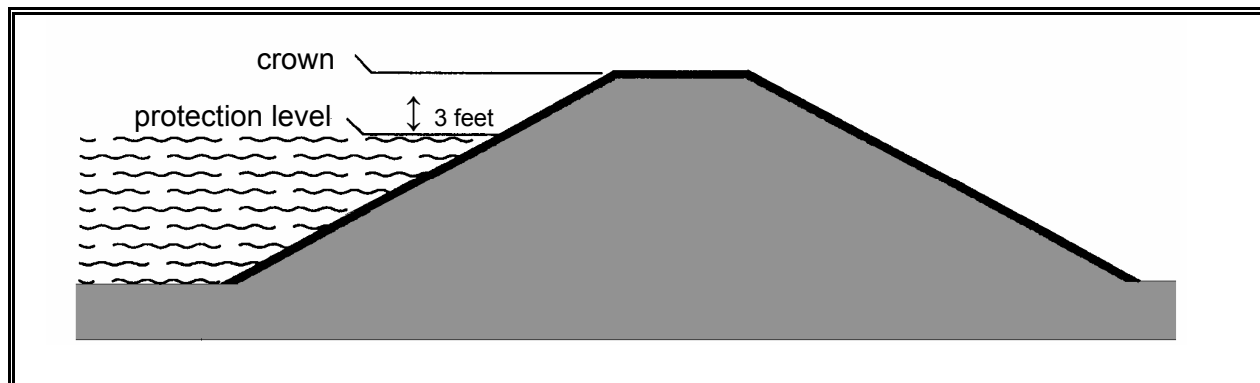


Figure 620-1. Levee protection level.

In the absence of a statement from the Corps or other federal agency with jurisdiction, the protection elevation of the levee is considered to be 3 feet below the crown of the levee (see Figure 620-1). For example, if the levee's crown is 3 feet above the 50-year flood level, LPL = 50. In 44 *CFR* 65.10(b)(1), there is a discussion of the circumstances under which a smaller freeboard is acceptable.

The recurrence interval for the protection elevation can be determined from the flood insurance study's profile. In any case, the flood protection elevation must be provided by the community.

Example 621.a-1. The elevation of the crown of Riverview's levee is 532 feet NGVD. Three feet below the crown is elevation 529. A check of the profile shows that 529 is halfway between the 50- and 100-year flood elevations. Therefore, LPL = 75.

To be eligible for credit under this activity, the levee must provide protection from at least a 25-year flood. Base flood levees may already be credited under the NFIP because areas in the floodplain that are protected by them are usually mapped B, C, or X Zones and flood insurance premium rates are substantially lower than those for unprotected floodplain properties.

Example 621.a-2. The elevation of 3 feet below the crown of Floodville's levee approximates the 10-year flood elevation on the profile. Therefore, LPL = 0 and there is no credit for this activity. Floodville may review the freeboard criteria in 44 CFR 65.10(b)(1) to see if the Department of Homeland Security's Federal Emergency Management Agency (FEMA) would accept 2 feet of freeboard.

***NOTE:** The area protected by the levee may be mapped as an A, AE, or numbered A Zone to reflect internal drainage problems. If it is an AO Zone, it definitely reflects internal drainage problems. Where the SFHA is based on an internal drainage problem, the protected area has a base flood elevation lower than the river's and the levee has been mapped as providing protection from the base flood. This activity does not provide credit for levees in these cases. If the area protected by the levee is later remapped as an X, A99, AR, or AO Zone or other SFHA that only reflects internal drainage, the community will lose its CRS credit for this activity. Remapping the floodplain due to a flood protection project provides a separate and greater flood insurance premium rate reduction (see Section 530).*

It is important to note that operation and maintenance "must be under the jurisdiction of a Federal or State agency, an agency created by Federal or State law, or an agency of a community participating in the NFIP." A levee maintained by a levee district is acceptable; one maintained by a homeowner's association is not.

- | |
|---|
| <ul style="list-style-type: none">b. The levee must have been constructed before January 1, 1991; andc. The community must have a levee emergency plan that specifies actions to be taken at various flood stages. Actions that must be included are:<ul style="list-style-type: none">1. Periodic patrols of the structure; |
|---|

2. Closing openings that are structural parts of the system (sandbagging is not acceptable);
3. Warning local emergency officials when the flood reaches within 4 feet of the crown of the levee;
4. Monthly communications checks with local emergency officials;
5. Annual inspections of emergency equipment and stockpiles; and
6. Annual drills.

The NFIP rules in 44 *CFR* 65.10(c), Operation plans and criteria, specify what needs to be done to protect the levee from failure. For example, the standards for allowable closures are found in 65.10(c)(1).

Items c.1 through c.6 specify what needs to be done to protect lives and property in the protected area if the levee fails or is overtopped. Acting when a flood is within 4 feet of the crown allows time to advise local officials that the levee protection is being threatened. A different threshold for advance notice of failure or overtopping may be submitted for review.

If the community requests credit for a flood response plan under Activity 610 (Flood Warning Program), items 1, 2, and 3 should be incorporated into that plan. Items 4, 5, and 6 should be coordinated with the maintenance, testing, and drills of the community's flood response plan. However, the emergency plan for the levee must be designed and implemented by the agency that operates and maintains the levee, which may or may not be the community.

622 Impact Adjustment

a. Option 1:

If all of the buildings in the community's SFHA are protected by a single levee or a levee system built to a single flood protection level, $rLP = 1.0$.

b. Option 2:

$rLP = 0.01$, where $bLP \geq 5$ and $bLP =$ the number of buildings protected by the levee.

c. Option 3:

$rLP = \frac{bLP}{bSF}$, where $bLP =$ the number of buildings protected by the levee.

$bSF =$ the number of buildings in the SFHA.

If the levee protects all of the buildings in the SFHA, the impact adjustment ratio $rLP = 1.0$ (Option 1).

If at least five buildings are protected by the levee (i.e., $bLP = 5$ or more), then a default impact adjustment ratio of 0.01 may be used. If the community has fewer than 500 buildings in its SFHA (i.e., $bSF < 500$), it will receive more credit points by using Option 3. If the levee protects more than 1% of the buildings in the SFHA, it will receive more credit points under Option 3. However, Option 2 may still be used if the community does not want to calculate bSF.

Otherwise, rLP is calculated by dividing the number of buildings that the levee protects (bLP) by the number of buildings in the SFHA (bSF) (Option 3). There is no credit for protecting buildings not in the SFHA as shown on the FIRM.

A discussion of impact adjustment ratios using buildings, including the variable bSF , appears in Sections 301 through 303.

Example 622.b-1. Riverview's levee protects 82 buildings in the SFHA: $bLP = 82$. There are 150 buildings in Riverview's SFHA: $bSF = 150$. Using Option 3,

$$rLP = \frac{82}{150} = 0.55$$

623 Credit Calculation

$$c620 = 9 \times LPL \times rLP$$

Example 623-1. Riverview's levee protects 82 buildings to approximately the 75-year flood level: $LPL = 75$. As noted above, $rLP = 0.55$.

$$c620 = 9 \times 75 \times 0.55 = 371.25 = 371$$

624 Credit Documentation

The community must submit the following documentation with its application:

a. EITHER:

1. A statement signed by the U.S. Army Corps of Engineers or other federal agency with jurisdiction that has inspected the levee that
 - (a) States the levee protection level; and
 - (b) Provides the date of construction; OR
2. A certification by a licensed professional engineer that
 - (a) States that the levee or floodwall meets all the NFIP levee recognition requirements (44 *CFR* 65.10) except for height (65.10(b)(1));
 - (b) Provides the date of construction; and
 - (c) Provides the protection elevation and the flood recurrence interval for that elevation. Data sources and calculations must be included.

The levee must be certified by a licensed professional engineer as meeting all of the NFIP's requirements for levee recognition as iterated in 44 *CFR* 65.10. These requirements are reprinted in Figure 620-2 and cover the levee design, operation, and maintenance in subsections (b), (c), and (d), respectively.

b. A copy of the community's levee emergency plan meeting the specifications of Section 621.c.

c. A map showing the area the levee protects, designated as "LP." No credit is provided for levees that protect vacant land or properties in B, C, or X Zones.

The credit points for this activity are adjusted in Section 622 according to the number of buildings protected (bLP). To assist in calculating and verifying the number of buildings protected, the area protected by the levee must be shown on a map.

The map may be the community's FIRM or the Impact Adjustment Map prepared in accordance with the instructions in Section 403. The data for the map can be found in the original design study for the levee. As an alternative, bLP can be the buildings in the area below the flood protection elevation as extrapolated from the best available contour map.

d. [If the community determines the impact adjustment ratios using Options 2 or 3 (Section 622.b or 622.c)] Documentation showing how bLP was determined. If the community used Option 3, documentation showing how bSF was determined.

The variable bSF represents the number of buildings in the SFHA. It is discussed in detail in Sections 302 and 303.

The community must submit the following documentation with its annual CRS recertification (see Section 214):

e. A certification by a licensed professional engineer that the levee has been maintained in such a manner that it meets all the NFIP levee maintenance requirements.

As an alternative to certification, the community may use a copy of the Corps' annual inspection report, provided that it rates the levee maintenance as "satisfactory" or "outstanding."

The following may be cause for loss of credit under this activity:

- Failure to properly maintain the levee;
- Failure to conduct the monthly checks and annual inspections and drills; or
- Failure to submit the appropriate documentation each year.

Many levees have been funded or partially funded by the Corps of Engineers or other federal or state agencies. To ensure that their investment is being properly maintained, these agencies often conduct inspections and send inspection results to the levee owner (e.g., the levee district). Copies of these results suffice as documentation that the levee is being maintained but not necessarily that the checks, inspections, and drills have been conducted.

625 For More Information

Additional information, reference materials, and examples can be found at the CRS Resource Center at <http://training.fema.gov/EMIWeb/CRS/>.

a. The following document is available at no cost from

U.S. Army Corps of Engineers, ATTN: CECW-PF
20 Massachusetts Avenue, N.W.
Washington, D.C. 20314

Design and Construction of Levees, U.S. Army Corps of Engineers, Office of the Chief of Engineers, Engineering Manual 1110-2-1913, 1978.

- b. See the documents listed for Activity 610 (Flood Warning Program) in Section 615.
- c. Rural communities can request help on this activity from the Natural Resources Conservation Service. Requests should be submitted to the local soil and water conservation district, which is usually located in the county seat.

44 CFR § 65.10 Mapping of Areas Protected by Levee Systems.

(a) General. For purposes of the NFIP, FEMA will only recognize in its flood hazard and risk mapping effort those levee systems that meet, and continue to meet, minimum design, operation, and maintenance standards that are consistent with the level of protection sought through the comprehensive flood plain management criteria established by § 60.3 of this subchapter. Accordingly, this section describes the types of information FEMA needs to recognize, on NFIP maps, that a levee system provides protection from the base flood. This information must be supplied to FEMA by the community or other party seeking recognition of such a levee system at the time a flood risk study or restudy is conducted, when a map revision under the provisions of Part 65 of this subchapter is sought based on a levee system, and upon request by the Administrator during the review of previously recognized structures. The FEMA review will be for the sole purpose of establishing appropriate risk zone determinations for NFIP maps and shall not constitute a determination by FEMA as to how a structure or system will perform in a flood event.

(b) Design criteria. For levees to be recognized by FEMA, evidence that adequate design and operation and maintenance systems are in place to provide reasonable assurance that protection from the base flood exists must be provided. The following requirements must be met:

(1) Freeboard. (i) Riverine levees must provide a minimum freeboard of three feet above the water-surface level of the base flood. An additional one foot above the minimum is required within 100 feet in either side of structures (such as bridges) riverward of the levee or wherever the flow is constricted. An additional one-half foot above the minimum at the upstream end of the levee, tapering to not less than the minimum at the downstream end of the levee, is also required.

(ii) Occasionally, exceptions to the minimum riverine freeboard requirement described in paragraph (b)(1)(i) of this section, may be approved. Appropriate engineering analyses demonstrating adequate protection with a lesser freeboard must be submitted to support a request for such an exception. The material presented must evaluate the uncertainty in the estimated base flood elevation profile and include, but not necessarily be limited to an assessment of statistical confidence limits of the 100-year discharge; changes in stage-discharge relationships; and the sources, potential, and magnitude of debris, sediment, and ice accumulation. It must be also shown that the levee will remain structurally stable during the base flood when such additional loading considerations are imposed. Under no circumstances will freeboard of less than two feet be accepted.

(iii) For coastal levees, the freeboard must be established at one foot above the height of the one percent wave or the maximum wave runup (whichever is greater) associated with the 100-year stillwater surge elevation at the site.

(iv) Occasionally, exceptions to the minimum coastal levee freeboard requirement described in paragraph (b)(1)(iii) of this section, may be approved. Appropriate engineering analyses demonstrating adequate protection with a lesser freeboard must be submitted to support a request for such an exception. The material presented must evaluate the uncertainty in the estimated base flood loading conditions. Particular emphasis must be placed on the effects of wave attack and overtopping on the stability of the levee. Under no circumstances, however, will a freeboard of less than two feet above the 100-year stillwater surge elevation be accepted.

(2) Closures. All openings must be provided with closure devices that are structural parts of the system during operation and design according to sound engineering practice.

Figure 620-2a. FEMA's levee safety criteria (page one).

(3) Embankment protection. Engineering analyses must be submitted that demonstrate that no appreciable erosion of the levee embankment can be expected during the base flood, as a result of either currents or waves, and that anticipated erosion will not result in failure of the levee embankment or foundation directly or indirectly through reduction of the seepage path and subsequent instability. The factors to be addressed in such analyses include, but are not limited to: Expected flow velocities (especially in constricted areas); expected wind and wave action; ice loading; impact of debris; slope protection techniques; duration of flooding at various stages and velocities; embankment and foundation materials; levee alignment, bends, and transitions; and levee side slopes.

(4) Embankment and foundation stability. Engineering analyses that evaluate levee embankment stability must be submitted. The analyses provided shall evaluate expected seepage during loading conditions associated with the base flood and shall demonstrate that seepage into or through the levee foundation and embankment will not jeopardize embankment or foundation stability. An alternative analysis demonstrating that the levee is designed and constructed for stability against loading conditions for Case IV as defined in the U.S. Army Corps of Engineers (COE) manual, "Design and Construction of Levees" (EM 1110-2-1913, Chapter 6, Section II), may be used. The factors that shall be addressed in the analyses include: Depth of flooding, duration of flooding, embankment geometry and length of seepage path at critical locations, embankment and foundation materials, embankment compaction, penetrations, other design factors affecting seepage (such as drainage layers), and other design factors affecting embankment and foundation stability (such as berms).

(5) Settlement. Engineering analyses must be submitted that assess the potential and magnitude of future losses of freeboard as a result of levee settlement and demonstrate that freeboard will be

maintained within the minimum standards set forth in paragraph (b)(1) of this section. This analysis must address embankment loads, compressibility of embankment soils, compressibility of foundation soils, age of the levee system, and construction compaction methods. In addition, detailed settlement analysis using procedures such as those described in the COE manual, "Soil Mechanics Design--Settlement Analysis" (EM 1100-2-1904) must be submitted.

(6) Interior drainage. An analysis must be submitted that identifies the source(s) of such flooding, the extent of the flooded area, and, if the average depth is greater than one foot, the water-surface elevation(s) of the base flood. This analysis must be based on the joint probability of interior and exterior flooding and the capacity of facilities (such as drainage lines and pumps) for evacuating interior floodwaters.

(7) Other design criteria. In unique situations, such as those where the levee system has relatively high vulnerability, FEMA may require that other design criteria and analyses be submitted to show that the levees provide adequate protection. In such situations, sound engineering practice will be the standard on which FEMA will base its determinations. FEMA will also provide the rationale for requiring this additional information.

(c) Operation plans and criteria. For a levee system to be recognized, the operational criteria must be as described below. All closure devices or mechanical systems for internal drainage, whether manual or automatic, must be operated in accordance with an officially adopted operation manual, a copy of which must be provided to FEMA by the operator when levee or drainage system recognition is being sought or when the manual for a previously recognized system is revised in any manner. All operations must be under the jurisdiction of a Federal or State agency, an agency created by Federal or State law, or an agency of a community participating in the NFIP.

Figure 620-2b. Page two of FEMA's levee safety criteria.

(1) Closures. Operation plans for closures must include the following:

(i) Documentation of the flood warning system, under the jurisdiction of Federal, State, or community officials, that will be used to trigger emergency operation activities and demonstration that sufficient flood warning time exists for the completed operation of all closure structures, including necessary sealing, before floodwaters reach the base of the closure.

(ii) A formal plan of operation including specific actions and assignments of responsibility by individual name or title.

(iii) Provisions for periodic operation, at not less than one year intervals, of the closure structure for testing and training purposes.

(2) Interior drainage systems. Interior drainage systems associated with levee systems usually include storage areas, gravity outlets, pumping stations, or a combination thereof. These drainage systems will be recognized by FEMA on NFIP maps for flood protection purposes only if the following minimum criteria are included in the operation plan:

(i) Documentation of the flood warning system, under the jurisdiction of Federal, State, or community officials, that will be used to trigger emergency operation activities and demonstration that sufficient flood warning time exists to permit activation of mechanized portions of the drainage system.

(ii) A formal plan of operation including specific actions and assignments of responsibility by individual name or title.

(iii) Provision for manual backup for the activation of automatic systems.

(iv) Provisions for periodic inspection of interior drainage systems and periodic operation of any mechanized portions for testing and training purposes. No more than one year shall elapse between either the inspections or the operations.

(3) Other operation plans and criteria. Other operating plans and criteria may be required by FEMA to ensure that adequate protection is provided in specific situations. In such cases, sound emergency management practice will be the standard upon which FEMA determinations will be based.

(d) Maintenance plans and criteria. For levee systems to be recognized as providing protection from the base flood, the maintenance criteria must be as described herein. Levee systems must be maintained in accordance with an officially adopted maintenance plan, and a copy of this plan must be provided to FEMA by the owner of the levee system when recognition is being sought or when the plan for a previously recognized system is revised in any manner. All maintenance activities must be under the jurisdiction of a Federal or State agency, an agency created by Federal or State law, or an agency of a community participating in the NFIP that must assume ultimate responsibility for maintenance. This plan must document the formal procedure that ensures that the stability, height, and overall integrity of the levee and its associated structures and systems are maintained. At a minimum, maintenance plans shall specify the maintenance activities to be performed, the frequency of their performance, and the person by name or title responsible for their performance.

(e) Certification requirements. Data submitted to support that a given levee system complies with the structural requirements set forth in paragraphs (b)(1) through (7) of this section must be certified by a registered professional engineer. Also, certified as-built plans of the levee must be submitted. Certifications are subject to the definition given at § 65.2 of this subchapter. In lieu of these structural requirements, a Federal agency with responsibility for levee design may certify that the levee has been adequately designed and constructed to provide protection against the base flood.

[52 FR 30316, Aug. 25, 1986]

Figure 620-2c. Page three of FEMA's levee safety criteria.

630 DAM SAFETY

Summary of Activity 630

631 Credit Points. There are two elements in this activity for a maximum of 175 points.

- a. State dam safety program (SDS): Up to 75 points are provided if the community is in a state with a dam safety program that has been accepted by FEMA for Community Rating System (CRS) credit. The state dam safety office must have stated that the community's program is in compliance with the state program.
- b. Dam failure emergency action plan (DFP): Up to 100 points are provided for the community's dam failure emergency action plan.

632 Impact Adjustment. There is no impact adjustment for SDS. The credit points for DFP are adjusted in one of three ways.

- a. Under Option 1, if the plan covers all buildings in the Special Flood Hazard Area (SFHA), the impact adjustment ratio is 1.0.
- b. Under Option 2, if the plan does not cover all buildings in the SFHA, a default impact adjustment ratio of 0.25 may be used.
- c. Under Option 3, if the plan does not cover all buildings in the SFHA, the impact adjustment ratios reflect the proportion of the buildings in the SFHA covered by the plan.

633 Credit Calculation. The credit points for DFP are multiplied by the impact adjustment ratios and added to SDS.

634 Credit Documentation.

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

- a. [Required only if applying for DFR or DFP credit under Section 631.b.1] The portions of the emergency plan or other documentation that show that it has dam failure inundation areas, flood elevations, and estimated arrival times, an annual report from the dam operator, annual exercises; and monthly communications checks.
- b. [Required only if applying for credit under Section 631.b.2] The portions of the community's emergency plan that detail at least three methods of disseminating a dam failure warning.
- c. [Required only if the community is applying for credit under Section 631.b.3]
 1. The portions of the community's emergency plan that indicate evacuation routes and procedures for notifying and evacuating critical facilities; and
 2. Documentation of the notification of occupants of the dam failure inundation area as discussed in Section 631.b.3.
- d. [If Option 3 was used to determine the impact adjustment ratios] The Impact Adjustment Map.

635 For More Information.

630 DAM SAFETY

Credit is provided to the community based on its state's dam safety program.

Background: A state dam safety program reduces the probability of dam failure and includes a much larger jurisdiction than the community. Community management of areas subject to flooding in the event of dam failure and community preparedness for dam failure further reduce the damage potential.

Dams can create a false sense of security for floodplain residents. Unlike levees, they do not need flood conditions to fail. They can be breached with little or no warning and send a wall of water downstream. The combination of high velocity, great depth, and short notice has proven particularly deadly and destructive. One way to minimize this hazard is to enforce construction and maintenance standards—usually through a state dam safety program.

There are almost 11,000 dams in the United States that are classified as “high hazard” dams. A “high hazard” dam is one whose failure would threaten life and property. Of these 11,000 high hazard dams, fewer than 5,000 have emergency action plans (EAPs). All states require EAPs for new dams, but only a few have statutes that require owners of existing dams to produce EAPs.

Although the legal definition of a dam for regulatory purposes varies from state to state, many dams are very small. A dam may be as low as 5 feet, with an impoundment of no more than 5 acre-feet of water. In many states, highway and railroad embankments may legally be dams, although they may not be rigorously regulated. This means that, if your community has one or more high hazard dams upstream, it should not necessarily expect a 100-foot wall of water to suddenly swamp developed areas. On the other hand, if a dam failure caused even a 25- or 50-year flood with no warning or preparations on a clear day, the results could be devastating.

Activity Description:

- a. The state dam safety element (SDS) provides credit for any community in a state with a dam safety program that has submitted the necessary documentation of its program to the Department of Homeland Security's Federal Emergency Management Agency (FEMA). Community Rating System (CRS) credit for this element will be determined for each state based upon the elements of its dam safety program.

Two conditions are prerequisites for credit under this element:

1. If a state does not receive credit for this element, no community within that state is eligible for credit for this element.

State dam safety programs are scored based on a separate Schedule for State Dam Safety Programs, based on the standards outlined in the *Model State Dam Safety Program* developed by the Association of State Dam Safety Officials (ASDSO) and published by FEMA as Publication 123. If the status of a state's dam safety program is unknown, the community should contact the FEMA Regional Office (see Appendix A). If a state program receives few or no points, it is hoped that local interest will encourage the appropriate state agency or legislature to improve the state program.

2. A community must meet state dam safety standards to receive credit for this element.

If a community owns or regulates the construction, operation, or maintenance of any dams, the community dam safety program must meet the state standards for dam safety in order for the community to be eligible for credit for this element. The separate dam safety Schedule requires states to advise FEMA when any community is in violation of the state's program.

Credit is provided for a community program that mitigates the threat to its floodplain properties from a failure of an upstream dam through emergency preparedness.

A community may also be eligible for credit under Activity 430 (Higher Regulatory Standards) if it requires new buildings to be protected from flooding caused by a dam failure.

631 Credit Points

Maximum credit for Activity 630: 175 points.

- a. State dam safety program (SDS) (Maximum credit: 75 points)

SDS = up to 75 points, if the community is in a state with a dam safety program that has been accepted by FEMA for CRS credit. The state dam safety office must have stated that the community's program is in compliance with the state program.

This credit is available to all communities in states with acceptable dam safety programs, including communities that are not downstream of any dams. There is no impact adjustment for this credit. Credit is automatically provided. The value of SDS is determined by FEMA based upon its review of the state dam safety program.

Example 631-1. Riverview is in a state with a dam safety program that has been credited by FEMA for 50 points. The state dam safety office has confirmed that the City does not own or regulate any dams.

SDS = 50

b. Dam failure emergency action plan (DFP) (Maximum credit: 100 points)

$$\text{DFP} = \text{DFP1} + \text{DFP2} + \text{DFP3}$$

1. DFP1 = 25, if the community has the following:

(a) An emergency action plan that

- (1) Specifies that the community will be notified in the event of an impending or actual failure of a dam upstream from the community;
- (2) Provides projected inundation areas, flood elevations, and estimated arrival times for flood peaks arising from a failure of the dam; and
- (3) Calls for an exercise at least annually. The results of the exercise are evaluated and used to revise the action plan.

(b) A procedure to obtain annual reports by the dam operators on the safety and operational status of their dams. Copies of these reports must be sent to the community and the state dam safety office; and

(c) Monthly communication checks between dam operators and emergency services officials.

Credit for this element is patterned after Activity 610, Flood Warning Systems. The first sub-element, DFP1, provides credit if the community demonstrates that it is aware of the hazard and can be reasonably sure of being notified if a dam failure is imminent or has occurred. Credit for the other sub-elements is based on specific items in the community's emergency preparedness plan.

Emergency action plans (EAPs) are usually prepared by dam owners so that they and downstream communities understand the potential results of the generally unlikely event of a dam failure and prepare for them. A good EAP will discuss the different ways a dam may fail and the floods that will result if such failures occur. An EAP that qualifies for DFP1 credit must also include a hydraulic analysis that produces a dam failure inundation map, flood elevations, and arrival times at various points downstream from the dam.

If a community has a dam upstream that has no EAP, it can either prepare its own EAP or work with the State Dam Safety Office to require that the owner provide one.

The annual report by the dam operators must include any factors that have changed since the EAP that affect the safety of the dam or increase the likelihood of failure. Such factors might include the results of recent inspections, revisions to the hydrologic studies used to forecast possible dam failures, revisions in the operation plans, and/or current conditions such as the water level of the reservoir and the snowpack in the watershed above the dam.

Example 631-2. Riverview has an adopted emergency action plan for the areas that would be affected by a failure of Safe Dam. It is based on an emergency action plan (EAP) prepared by the owner of Safe Dam. The owner has agreed by letter to provide a status report each March 1, when the reservoir of Safe Dam is normally at its highest level for the year. The plan specifies that the dam operator will contact the emergency manager once each month by radio and telephone to ensure that the established communications systems are in good order at all times. Riverview's emergency plan includes a provision for an annual exercise, although this exercise does not have to be based on dam failure.

DFP1 = 25.

2. DFP2 = 25, if the community has the following:

(a) Credit for DFP1, and

(b) An adopted emergency plan that details at least three methods of notifying affected residents of an imminent flood event resulting from a possible or ongoing dam failure. At least three of the following notification methods must be available:

- Sound or voice siren system,
- Telephonic notification, AM transmitters, and receivers dedicated to dam failure notification,
- NOAA Weather Radio. Receivers with Specific Area Message Encoding (SAME) are preferred,
- Mobile public address,
- Emergency Alert System,
- Cable television override, and
- Door-to-door notification.

Many communities have prepared multi-hazard emergency response plans or comprehensive emergency management plans. Unless such a plan has an annex, standard operating procedures, or other parts that specifically address the community's dam safety problem, it may not be specific enough to qualify for CRS credit. For CRS credit, a dam failure emergency action plan must specifically relate to the dam safety issue and identify appropriate response activities.

Because a dam failure is generally unexpected, and because the flood wave resulting from a dam failure can travel rapidly downstream, the warning dissemination methods appropriate for this hazard are those used in flash flood situations. In many cases, there will be only a few hours to evacuate, and in some cases, only minutes.

Example 631-3. Riverview's emergency action plan specifies four methods of warning dissemination:

DFP2 = 25.

3. DFP3 = 50, if the community:

- (a) Has credit for DFP1 and DFP2;
- (b) Has an adopted emergency plan that includes evacuation routes and detailed procedures for notifying and evacuating critical facilities, specifically including schools, hospitals, nursing homes, jails, and other locations where there are populations that may have difficulty evacuating the dam failure inundation area; and
- (c) At least annually notifies occupants in the dam failure area of the hazard, the area affected, evacuation routes, and flood safety topics appropriate to the hazard.

Because dams failures are rare events, it is difficult for people to believe that they are in danger. It is necessary for them to receive repeated messages so that if the event occurs they understand that they have to act quickly. When the time comes, they also have to know what to do and where to go. Depending on the community's situation, they may have to put the family in the car and leave immediately, leaving animals to fend for themselves and leaving all of their possessions.

Facilities with special populations are a particular concern in this type of emergency. It is likely that the staff of such facilities do not have the ability to evacuate their students, patients, clients, inmates, etc. and will need extraordinary assistance to avoid a catastrophe.

Example 631-4. Riverview has worked with the local telephone company to get dam failure information published in the telephone directory. The entry includes the dam failure inundation map from the EAP, evacuation routes from their own emergency plan, and flood safety information appropriate for the 6 hours of warning expected in the event of a dam failure.

Riverview has three critical facilities within the dam failure inundation area. The emergency plan specifies that a day care center with a capacity of 50 children will be evacuated by a city-owned bus to the high school six blocks away. The three story county hospital is outside the 100-year floodplain, and is subject to an estimated two feet of flooding in the event of a dam failure. Working with the Riverview emergency manager, the emergency power supply has been relocated and data processing and records departments were moved to the second floor. Inmates at the city jail will be evacuated to the federal prison outside of town using buses from the prison.

DFP3 = 50.

632 Impact Adjustment

There is no impact adjustment for SDS.

a. Option 1:

If the dam failure emergency plan covers all buildings in the SFHA, the impact adjustment ratio $rDFP = 1.0$.

b. Option 2:

If only some of the buildings in the SFHA are covered by the dam failure emergency plan, the community may use the default value $rDFP = 0.25$.

c. Option 3:

The impact adjustment ratio $rDFP$ is computed by dividing the number of buildings covered by the dam failure emergency action plan by the total number of buildings in the SFHA (bSF):

$$rDFP = \frac{bDFP}{bSF}, \text{ where}$$

$bDFP$ = number of buildings covered by the dam failure emergency action plan

bSF = the number of buildings in the SFHA

$rDFP$ cannot be greater than 1.0.

Example 632.1. Riverview is downstream from Safe Dam on Dang Creek. Even though the dam meets all the state’s dam safety requirements and is well maintained, Riverview has developed a dam failure emergency action plan in conjunction with the dam operator. The area along Dang Creek subject to inundation is larger than the Special Flood Hazard Area (SFHA) for Dang Creek mapped on the Flood Insurance Rate Map (FIRM). It covers 192 buildings, of which 68 are in the SFHA: bDFP = 192.

Riverview’s regulatory floodplain includes several other streams with dams upstream. These dams do not have emergency action plans, so Riverview does not have the information it needs for dam failure planning. There are 150 buildings in Riverview’s SFHA; bSF = 150.

$$rDFP = \frac{192}{150} = 1.28 \quad \text{The maximum value for } rDFP = 1.0, rDFP = 1.0$$

633 Credit Calculation

a. $DFP = DFP1 + DFP2 + DFP3$

b. $cDFP = DFP \times rDFP$

c. $c630 = SDS + cDFP$

Example 633-1.

- a. From the examples in Section 631, SDS = 50, DFP1 = 25, DFP2 = 25, DFP3 = 50

$$DFP = 25 + 25 + 50 = 100.$$

- b. From the example in Section 632, rDFP = 1.0

$$cDFP = 100 \times 1.0 = 100$$

- c. $c630 = 50 + 100 = 150$

634 Credit Documentation

There is no documentation required for the community to receive credit points based on the state's dam safety program. The credit points will automatically be added to the community's credit, provided the state verifies community compliance with the state's program.

The community must provide the following documentation:

- a. [Required only if the community is applying for credit under Section 631.b.1] The portions of the community's emergency plan or other documentation that show the dam failure inundation areas, flood elevations, and estimated arrival times, an annual report from the dam operator, annual exercises, and monthly communications checks.
- b. [Required only if the community is applying for credit under Section 631.b.2] The portions of the community's emergency plan that detail at least three methods of disseminating a dam failure warning.
- c. [Required only if the community is applying for credit under Section 631.b.3]
 1. The portions of the community's emergency plan that indicate evacuation routes and procedures for notifying and evacuating critical facilities; and
 2. A copy of the materials that notify occupants of the dam failure inundation area as discussed in Section 631.b.3. The materials must be distributed each year and must reach at least 90% of the properties in the dam failure inundation area. An outreach project to the community or to floodplain properties credited under Activity 330 (Outreach Projects) may qualify for this credit provided that it explains the dam failure hazard, the area affected, evacuation routes, and flood safety topics appropriate to the hazard.
- d. [Required only if the community determines the impact adjustment ratios using Option 3 (633.c)] The Impact Adjustment Map with the appropriate acronyms marked. Documentation showing how the impact adjustment ratio was determined.

635 For More Information

Additional information, reference materials, and examples can be found at the CRS Resource Center at <http://training.fema.gov/EMIWeb/CRS/>.

- a. More information on dam safety activities and state programs can be found on the website for the Association of State Dam Safety Officials at <http://www.damsafety.org/> and on FEMA's dam safety website, <http://www.fema.gov/fima/damsafe>.

- b. The following can be obtained from

Federal Emergency Management Agency
Mitigation Directorate
500 C Street, S.W.
Washington, D.C. 20472

Model State Dam Safety Program, Association of State Dam Safety Officials, FEMA-123, 1998.

Successes & Challenges: The National Dam Safety Program. Association of State Dam Safety Officials, 2002.

Suggested Procedures for Safety Inspection of Dams, Ohio Department of Natural Resources, 1987.

Dam Safety: An Owner's Guidance Manual, FEMA-145, 1987.

Federal Guidelines for Dam Safety: Emergency Action Planning for Dam Owners, FEMA-64, 2002.

Dam Inundation Mapping Pilot Study, FEMA, 1999.

FEMA's Dam Safety Office website: <http://www.fema.gov/fima/damsafe/>.

- c. The U.S. Army Corps of Engineers can provide technical information and advice to communities interested in developing dam safety programs. Requests for assistance should be submitted to the Flood Plain Management Services Coordinator at the District Office of the Corps.

The National Inventory of Dams (NID) includes almost 70,000 dams. The Corps hosts the NID at <http://crunch.tec.army.mil/nid/webpages/nid.cfm>.