National Flood Insurance Program
Community Rating System

CRS Credit for Flood Warning Programs

2006

FEMA

Note on this edition: This document was revised to reflect the following changes in the 2006 *CRS Coordinator's Manual*:

- CRS credit for TsunamiReady programs of the National Weather Service was increased.
- A copy of the list of critical facilities must be submitted with the community's annual recertification documentation.

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

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

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

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The following local governments provided material as examples for this publication. Their cooperation is appreciated.

Blackwell, Oklahoma
Des Moines, Iowa
Harmony Grove, California
King County, Washington
Los Angles, California
Panama City, Florida
Rapid City, South Dakota
Red River, New Mexico
Whatcom County, Washington
Wrightsville Beach, North Carolina.

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Introduction

Objective

ALERT flood warning flasher,
Harmony Grove, California

Warning time is a critical factor in mitigating flood losses. The more lead time available for appropriate action, the greater the reduction in flood damage that can be achieved. Hundreds of flood warning and response programs have been implemented in the United States over the last two decades. Their performance over this period has shown them to be an efficient and effective means of reducing losses of life and property from flooding and consequently, they have received increased attention in recent years. The Community Rating System (CRS) encourages and recognizes flood warning programs that provide timely warning of impending flood threats, disseminate warnings to floodplain occupants, and coordinate flood response activities.

The CRS

The Community Rating System is a part of the National Flood Insurance Program (NFIP). When communities go beyond the minimum standards for floodplain management, the CRS can provide discounts up to 45% off flood insurance premiums.

Communities apply for a CRS classification and are given credit points that reflect the impact of their activities on reducing flood losses, insurance rating, and promoting the awareness of flood insurance. The Insurance Services Office's ISO/CRS Specialist reviews the community's program and verifies the CRS credit. This includes a review of the written procedures and records for an activity and, in some cases, a visit to sites in the field.

A community applies using the *CRS Application*. CRS credit criteria, scoring, and documentation requirements are explained in the *CRS Coordinator's Manual*. Both publications are free from the office listed inside the front cover of this document.

The CRS encourages comprehensive flood warning and response programs and recognizes them under Activity 610 (Flood Warning Program).

The description of this activity is not intended to be a model for developing a flood warning or flood response program. As with the rest of the 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.

Credited Elements

This activity has five elements that provide credit for flood warning and response planning:

1. **Flood Threat Recognition System (FTR).** The first element of a flood warning program is the operation of a system that tells the community that a flood is on its way. This is termed a flood threat recognition system and is recognized as element FTR under this activity. The notice that a flood is coming can be provided by the National Weather Service, by a state or regional agency, by monitoring local rain and river gages, and/or in other ways. However, the community must have a system for receiving meaningful early notifications.

2. **Emergency Warning Dissemination (EWD).** The next element is the dissemination of the flood warning to residents of the community. This element is termed emergency warning dissemination and is shown as the acronym EWD. Various methods can be used, such as sirens, telephone calls, or the Emergency Alert System. The credit points are based on the dissemination methods used. Credit for this element is available only if the community has a creditable flood threat recognition system, an annual outreach project that covers flood warning and flood safety and reaches at least 90% of the target audience, and an adopted flood response plan.

3. **Other Response Efforts (ORE).** If the community implements the first two elements, then it is eligible for credit for implementing activities to minimize flood damage under this third element, other response efforts (ORE). These include activities like sandbagging, coordinating evacuation, barricading flooded streets and bridges, and issuing status reports to the media.

4. **Critical Facilities Planning (CFP).** If the community implements the first two elements, then it is also eligible for credit for implementing the fourth level of involvement: critical facilities planning, that is, coordination of the flood warning and response effort with critical facilities. A critical facility is a structure or a site that, if flooded, would result in severe consequences to public health and safety. Examples include hospitals, emergency operating centers, important bridges, and hazardous materials storage areas. Providing these facilities with early warning and coordinating with their flood response plans is recognized under this element.

5. **StormReady community (SRC).** This element credits a local government that has been designated by the National Weather Service as a StormReady or a TsunamiReady community and has a flood threat recognition system able to forecast the arrival time and peak flow or elevations of floods.

The requirements for crediting Activity 610 are explained in the Coordinator's Manual. This publication expands on the Coordinator's Manual and provides examples from different local governments. Several sections of plans and other materials from the City of Blackwell, Oklahoma, are reproduced throughout this publication, with marginal notes indicating the pertinent CRS elements.

Flood Threat Recognition System (FTR)

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.

The CRS recognizes two different types of flood threat recognition systems. The first is for those local governments that depend on an outside notice of an impending flood. The notice may come from the National Weather Service, the National Hurricane Center, the U.S. Army Corps of Engineers, the Bureau of Reclamation, or other agency that provides flood warnings or river level statements. Usually this type of system is operated on major rivers and coastal areas where there is more lead time of an impending flood.

ALERT rain gage

The CRS also recognizes local flood threat recognition systems. These systems are usually found on smaller streams, especially in mountainous areas where there is little lead time. They rely on local volunteers or automatic rain and river gages to provide real-time data that can be used to develop early warning of flooding or potential flood conditions. They may be operated by the community, by a regional entity, by a state agency, or in combination with a federal agency.

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 follow-up system of monitoring and predicting flood levels.

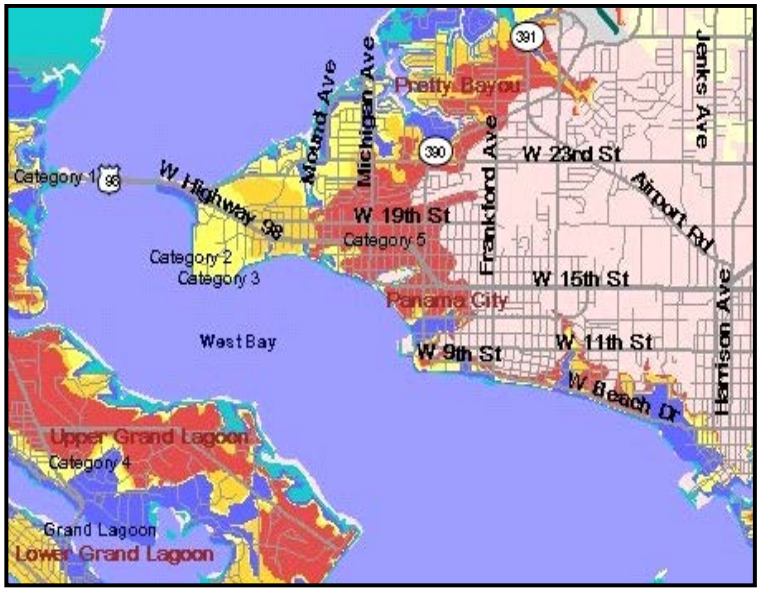
Procedures

To receive credit for either type of flood threat recognition system, the local government requesting FTR credit must submit documentation describing the flood threat recognition system. This description must include (1) an identification of flood hazards; (2) an

explanation of the data collection, communications, and data analysis components of the system; (3) an explanation of how and when system components are maintained and tested; and (4) the amount of warning lead time the system provides for each source of flooding covered by the warning program.

1. Identification of flood hazards: The hazard identification needs to describe the local flood hazard and not be a broad or generic discussion of flooding in general. A flood threat recognition system should be tailored to the needs of an area; therefore, the hazard assessment should include a description of the areas that are expected to be affected. These areas should be shown on a map or otherwise described. The description should include source of water, depth of flooding, special hazards, and a discussion of past floods where such data are available.

In coastal areas, numerical models are used in the hazards analysis to identify the timing, severity, and sequence of wind and hurricane surge hazards that can be expected from hurricanes of various categories, tracks, and forward speeds striking the study area. Two of the models used for this analysis are the Sea, Lake and Overland Surges from Hurricanes (SLOSH) and the Special Program to List Amplitudes from Hurricanes (SPLASH) models. During the preparation of the study, additional areas expected to be inundated by freshwater flooding from rainfall are added to the inundation maps.



Panama City, Florida, inundation map for hurricane categories 1 through 5

This step involves gathering and reviewing existing flood studies, including the Flood Insurance Study, drainage problem studies, and SLOSH and SPLASH models that identify areas inundated during hurricanes. For CRS credit, the community does not need to conduct studies to develop new flood data.

In addition to the Federal Emergency Management Agency (FEMA), other agencies that can assist with flood hazard identification include the U.S. Army Corps of Engineers; the Natural Resources Conservation Service; the Bureau of Reclamation; the Tennessee Valley Authority; the National Weather Service; and state and regional planning, flood, and water resources management agencies.

2. Data collection, communications, and data analysis: 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. This description will be different for each type of flood threat recognition system.

Non-Local Flood Threat Recognition System

These systems include the National Hurricane Center's notices and river stage forecasts from the National Weather Service, Corps of Engineers, Bureau of Reclamation, Tennessee Valley Authority, or other agency that monitors river stages. In descriptions of these systems, local governments must include information about how warning messages are handled and how the data relate to local conditions, as detailed below.

Tell how warning messages are received and processed. If the community uses a non-local service, the description for the flood threat recognition system must demonstrate that it is prepared to receive and act on flood warnings on a 24-hour basis.

The flood threat recognition system lets local officials know that a flood is coming. It should also provide or enable estimates to be made of the time of onset of flooding and crest height. Notification systems with these capabilities include:

- River stage reports from the National Weather Service, U.S. Army Corps of Engineers, or other agency that monitors river stages;
- Reports from the National Hurricane Center; and
- Reports from an IFLOWS (Integrated Flood Observing and Warning System) that rainfall in watersheds above the community will cause the river to crest at a certain stage at a certain time at a specific location in the community.

Thirteen River Forecast Centers of the National Weather Service have hydrologic forecasting responsibility for the main stem rivers and their larger tributaries.

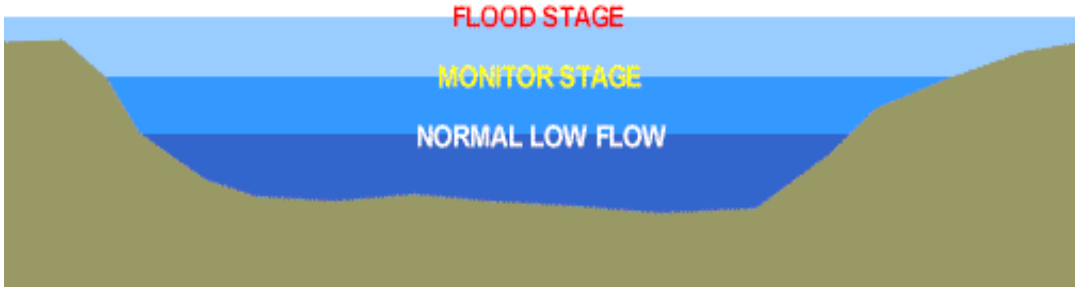
To receive CRS credit the community's program must meet the following three requirements.

- Monitoring equipment, such as the NOAA Weather Wire or NOAA Weather Radio, must be located in an office that will be able to respond to the notice 24 hours a day. Typical locations are police or fire dispatch offices. These credit points are also provided if the county or another agency monitors the flood threat recognition system and there are procedures to contact someone in the community on a 24-hour basis.

- The documentation must identify a person responsible for monitoring the system. That person must also have instructions on what to do once a flood threat is recognized. For example, the instructions could have the dispatcher call the emergency manager or implement other specified flood response steps.

- The information received must be keyed to one or more specific sites in the community. A system that provides a National Weather Service notice of predicted stream levels at a gage or other reference location, such as a bridge, in or near the community is creditable. However, a general National Weather Service notice, such as "low-lying areas may flood," or spring snowmelt forecasts, does not receive credit. The example on page 7 shows the level of detail necessary for effective action by local authorities and property owners.

Tell how the data received relate to local conditions. For additional credit the local government must describe how the site-specific data are then extended to other locations within the community. 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 the announcement from



Monitor Stage—The stage at which initial action must be taken by concerned interests (livestock warning, removal of equipment from lowest overflow areas, or simply general surveillance of the situation). This level may produce overbank flows sufficient to cause minor flooding of low-lying lands and local roads.

Flood Stage—The stage at which overbank flows are of sufficient magnitude to cause considerable inundation of land and roads and/or threat of significant hazard to life and property.

BULLETIN

SOUTHERN CALIFORNIA RIVER FORECAST

CALIFORNIA NEVADA RIVER FORECAST CENTER, NATIONAL WEATHER SERVICE
AND THE CALIFORNIA DEPARTMENT OF WATER RESOURCES, SACRAMENTO, CA

ATTENTION...THE FOLLOWING STAGES OF PARTICULAR SIGNIFICANCE
HAVE OCCURRED OR ARE EXPECTED TO OCCUR

FORECASTS ARE BASED ON PRESENT AND FORECASTED METEOROLOGICAL
AND HYDROLOGIC CONDITIONS AT TIME OF ISSUANCE.

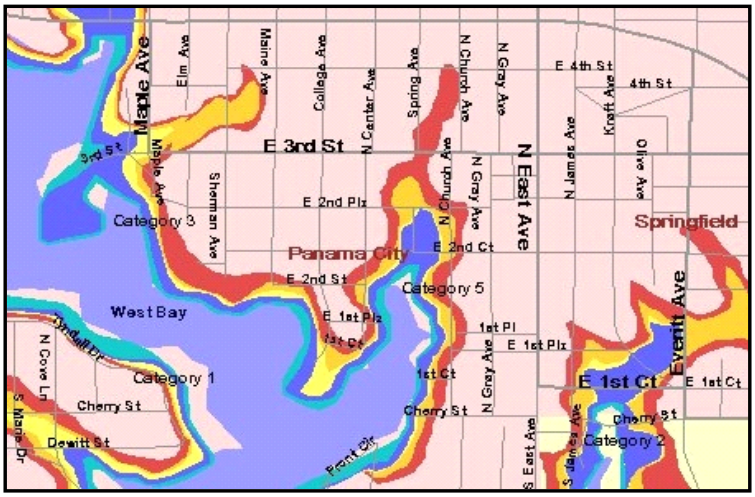
SAN DIEGO RIVER AT
FASHION VALLEY 6 AM STAGE 2.5 FT
FORECAST TO FLUCTUATE NEAR PRESENT LEVEL THRU THURSDAY AFTERNOON
THEN FORECAST TO RISE ABOVE MONITOR STAGE LATE THURSDAY EVENING
THEN FORECAST TO RISE ABOVE FLOOD STAGE EARLY FRIDAY MORNING
THEN FORECAST TO CREST NEAR 12.0 FT LATE FRIDAY MORNING
MONITOR STAGE 8.3 FT, FLOOD STAGE 11.3 FT

UNLISTED FORECAST POINTS ARE EXPECTED TO REMAIN BELOW MONITOR STAGE.
ALL THOSE AFFECTED BY RIVER CONDITIONS SHOULD REMAIN ALERT FOR
RAPID CHANGES AND FOR POSSIBLE FORECAST REVISIONS

Example of a river stage forecast from the National Weather Service

the outside agency. Local governments have accomplished this using a variety of methods, described below.

- 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.
- Using SLOSH inundation maps to convert a forecast from the National Hurricane Center to a predicted area of inundation throughout the community. The example at right is from Panama City, Florida.
- 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.

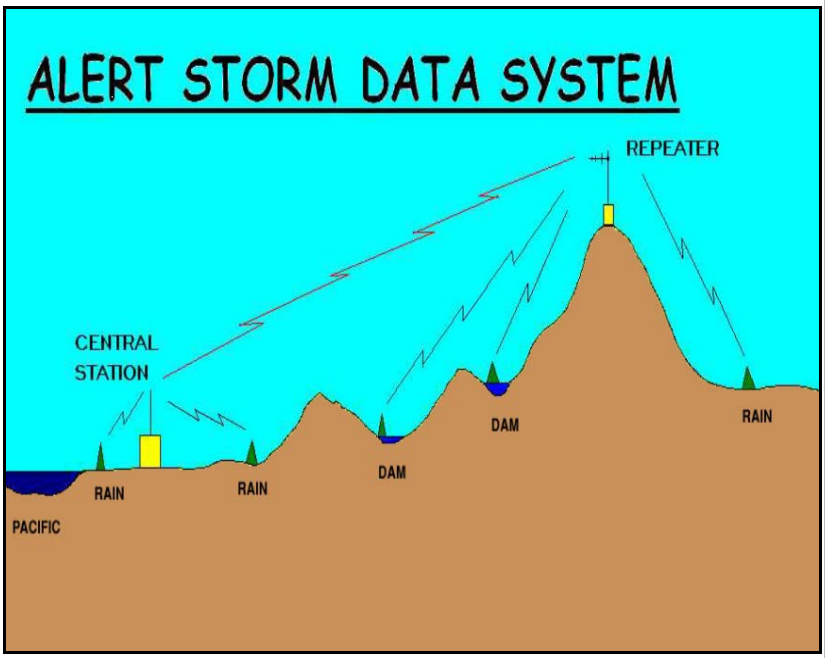


A portion of Panama City, Florida's inundation map

Localized Flood Threat Recognition System

These systems 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 or ALERT, IFLOWS, and similar automated systems for transmitting the gage data to a microprocessor that converts the data to a flood prediction. Local governments must describe three components of these systems, as noted below.

Describe the data collection system. Both manual and automated systems are used today. Under both, the flood threat recognition system is based on upstream river and rain gages. The difference between the two is that the manual system relies on human gage readers to call and report the readings, while an automated system relies on an automated precipitation and/or river gage data collection and reporting system (e.g., IFLOWS, ALERT, or comparable system).



Schematic of an ALERT collection and reporting system

Describe the gage density. Gage data are analyzed to predict downstream arrival time and peak flow or crest elevations. In general, the more gages there are, the more useful the data and the more accurate the prediction. CRS credits those systems where the density of the gage network is at least one rainfall gage per 10 square miles of watershed or if all upstream tributaries with watersheds larger than 10 square miles are gaged.

Describe the prediction model. The community should tell how the flood stage forecast is prepared. If a manual technique is used, describe how the system predicts downstream arrival time and peak flow or elevations. If a computerized flow prediction model is used, describe how the system analyzes the data collected to predict arrival time and peak flow or elevations. For both the manual and computer model methods, give the locations of the prediction points. They must be in the community or close enough to it to ensure that the prediction is applicable to the community's emergency response plan.

The National Weather Service has established guidelines and procedures under which a county/community can forecast floods, thus enabling advance warnings to those communities located along small tributary streams. The procedures use a system of stream and rain gages installed at specified sites (coordinated with problem areas) around the Local Flood Warning System (LFWS) area.

Sample of Flood Advisory Table

EXAMPLE FLOOD ADVISORY TABLE ANYTOWN MUDDY R

FLOOD STAGE 6.0 FT FLOOD OF RECORD 11.70 FT 01/22/59
DRAINAGE AREA 175 SQ MI GAGE DATUM 610.30 FT MSL

CREST ABOUT 10 HOURS AFTER HEAVY RAIN ENDS

MAXIMUM HEIGHT 12.9 FT EXAMPLE ON 3/04/48 BACKWATER FROM ICE

	STAGE FEET	DISCHARGE 1000 CFS	AVERAGE BASIN RAINFALL (INCHES) FOR TIME DURATION OF GUIDANCE USED												
	3.0	0.4	0.1	0.2	0.3	0.4	0.4	0.5	0.6	0.9	1.2	1.4	1.7	2.1	2.6
	3.5	0.6	0.1	0.3	0.4	0.4	0.5	0.6	0.7	1.0	1.4	1.7	1.9	2.5	2.9
	4.0	0.8	0.2	0.3	0.4	0.5	0.6	0.8	0.9	1.2	1.6	1.9	2.3	2.8	3.4
	4.5	1.2	0.3	0.4	0.6	0.7	0.8	0.9	1.1	1.4	1.9	2.3	2.7	3.3	3.8
	5.0	1.6	0.4	0.6	0.7	0.9	1.0	1.2	1.3	1.7	2.2	2.7	3.2	3.7	4.2
	5.5	2.2	0.6	0.7	0.9	1.1	1.4	1.5	1.6	2.1	2.5	3.0	3.5	4.1	4.6
FS	6.0	2.9	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	3.5	4.0	4.5	5.0
	6.5	3.6	0.9	1.2	1.4	1.6	1.8	2.0	2.3	2.8	3.3	3.8	4.3	4.8	5.3
	7.0	4.3	1.1	1.4	1.6	1.8	2.0	2.2	2.4	3.0	3.5	4.1	4.6	5.1	5.6
	7.5	5.3	1.4	1.6	1.8	2.0	2.3	2.5	2.7	3.3	3.8	4.4	4.9	5.4	5.9
	8.0	6.4	1.6	1.9	2.1	2.3	2.6	2.8	3.1	3.6	4.2	4.7	5.2	5.8	6.3
	8.5	7.4	1.9	2.2	2.4	2.6	2.9	3.1	3.4	4.0	4.5	5.0	5.5	6.1	6.6
	9.0	8.5	2.2	2.5	2.7	2.9	3.2	3.4	3.7	4.3	4.8	5.4	5.9	6.4	6.9
	9.5	9.7	2.5	2.8	3.0	3.3	3.5	3.8	4.0	4.7	5.2	5.7	6.2	6.8	7.2
	10.0	11.0	2.8	3.1	3.4	3.6	3.9	4.2	4.4	5.0	5.6	6.1	6.6	7.1	7.6
	10.5	12.5	3.2	3.5	3.8	4.0	4.3	4.6	4.9	5.5	6.1	6.6	7.0	7.6	8.0
	11.0	14.2	3.6	4.0	4.2	4.5	4.7	5.0	5.3	6.0	6.5	7.0	7.5	8.0	8.4
	11.5	16.0	4.1	4.5	4.7	5.0	5.2	5.5	5.8	6.5	7.0	7.5	8.0	8.5	8.9
	12.0	18.0	4.6	5.0	5.2	5.5	5.8	6.1	6.3	7.0	7.5	8.0	8.5	9.0	9.4

3 HR UNITGRAPH PEAK ORDINATE = 3900.CFS FLOOD STAGE R.O. = 0.75

The daily reading and maintenance of these gages is the responsibility of local observers. Rainfall amounts are reported by these observers to a designated local Flash Flood Coordinator. The Flash Flood Coordinator uses these amounts to calculate the average precipitation over the area. Using a procedure developed by the National Weather Service River Forecast Center to determine the threat for flash flooding, the Flash Flood Coordinator will notify the emergency services agency director if the potential for flash flooding exists or if flooding is imminent. The Flash Flood Coordinator must relay this same information to the National Weather Service office having flood warning responsibility for the county.

In the application of the self-help hydrologic forecast procedures for floods and flash floods, the following information is needed:

1. The amount of water available for runoff. (This includes snowmelt as well as rainfall and is usually referred to as the average basin rainfall.)

2. A method of determining the amount of runoff produced. (The Advisory Table (or categorical procedure) relates rainfall to runoff for a location with the use of the current advisory rainfall (or flood guidance) and the runoff procedure.)
3. The length of time of rainfall that produces runoff (duration of significant rainfall).
4. The amount of water in the stream before a runoff-producing event.
5. Reservoir release changes from upstream reservoirs.

To develop flood forecast procedures for small streams where they are not provided by the National Weather Service, the local government should consult with the Weather Forecast Office in its area.

Example from Whatcom County, Washington
Manual System Using a Spotter Network

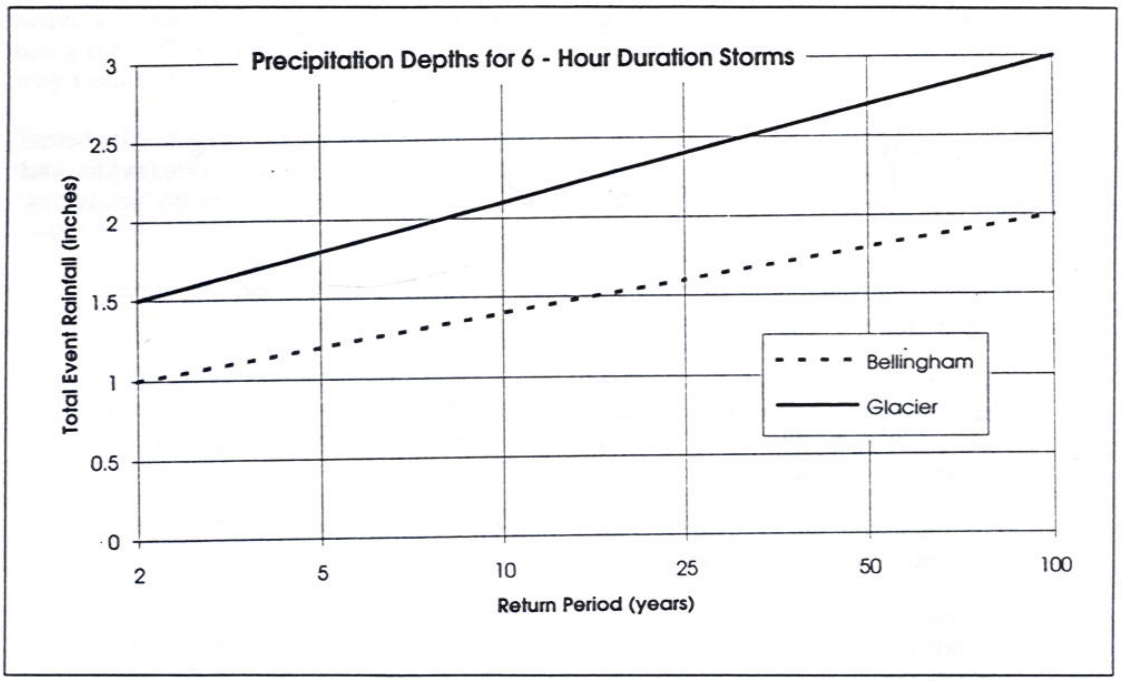
Whatcom County, Washington, uses a precipitation spotter network for its flood forecasting, monitoring, and warning program. Working with the National Weather Service, they have examined historical records to determine the relationship between precipitation and discharge peaks. These have been compiled and formatted for the county to use in assessing the potential severity of an impending flood.

The chart below shows total precipitation depths compiled for six different return periods and two different durations at Bellingham and the Glacier Ranger Station. Rainfall frequency-duration curves for the two locations are presented in the figure on page 11. These data can be used to determine the return period of actual precipitation events.

Precipitation Depth Totals for Theoretical Events

Precipitation Event Return Period/Duration	Bellingham Precipitation (inches)	Glacier Ranger Station Precipitation (inches)
2-year 6-hour	1.0	1.5
5-year 6-hour	1.2	1.8
10-year 6-hour	1.4	2.1
25-year 6-hour	1.6	2.4
50-year 6-hour	1.8	2.7
100-year 6-hour	2.0	3.0
2-year 24-hour	1.7	3.3
5-year 24-hour	2.2	3.8
10-year 24-hour	2.6	4.3
25-year 24-hour	3.1	4.8
50-year 24-hour	3.5	5.3
100-year 24 hour	4.0	5.8

Table from NOAA's *Atlas Number 2—Precipitation-Frequency Atlas of Western Washington, Volume IX—Washington.*

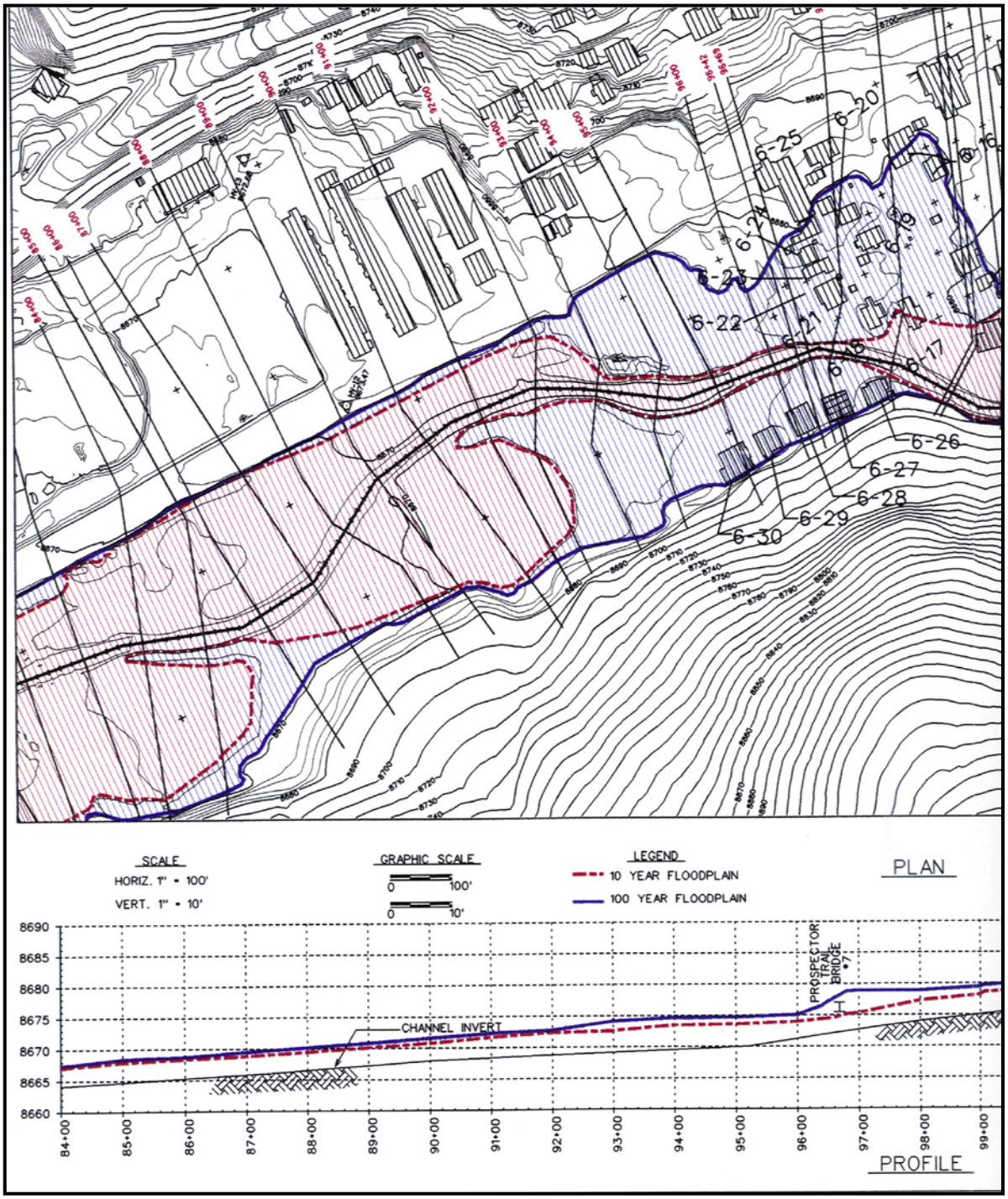


Example rainfall frequency-duration curves from Washington study.

The Town of Red River, New Mexico, uses a similar system with weather spotters (volunteer observers) to identify the level of threat. The town uses the 10- and 100-year flood elevations from the U.S. Army Corps of Engineers' *Flood Plain Delineation Study for the Town of Red River, New Mexico* to identify the level of threat. Flows from the 2-year event up to the 10-year event are identified as "level 1" and are shown as a red zone on their flood warning maps. Flows from the 10-year event up to the 100-year event are identified as level 2 and are shown as a blue zone.

The maps were originally prepared in 1994. The town adds other houses and facilities as they are built in the floodplain. These are shown with a different cross hatching pattern and in an approximate location only. The structures are also listed on the address notification list maintained by the town.

Graphically displaying the stage information on maps with structures and facilities makes it easier to identify mitigation and emergency actions that should be taken during a flood. By combining topographic and flood level data, the town can calculate expected flood depth ranges and velocities for each neighborhood, commercial area, or facility. These are used to identify areas that should be warned and evacuated. Red River also uses the information to plan ahead for street closures, shelter capacity requirements, the number of sandbags that will be needed, etc.



Red River, New Mexico, flood study profile and map, Plate 6.

3. Maintenance and testing of system components: 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.

4. Warning lead times: Flood warning times for each stream or body of water covered by the program must be provided. 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.

CRS Credit

A total of 40 points is available for either a local or non-local flood threat recognition system. The scoring is based on whether the data collection and data analysis components of the system are manual or automated, and on the percentage of the floodplain occupants covered. See page 55 for a discussion of the impact adjustment.

Credit Calculation

The end result of this work is an initial score for the community's flood threat recognition system (FTR). It is the product of the credit points multiplied by the impact adjustment ratio. See page 55 for a discussion of the impact adjustment. In the *Coordinator's Manual*, the credit calculation is shown as the following formula:

cFTR = FTR x rFTR, where

cFTR is the total credit for FTR,

FTR is the points for FTR, which range from 15 to 40, and

rFTR is the impact adjustment ratio, which ranges from 0.25 to 1.0.

cFTR can range from 3.75 to 40.

Documentation

In order to confirm that a community's program meets the CRS credit criteria and to assist in calculating credit points, several types of documentation must be submitted with the request for credit. For a community's first application for a CRS classification, worksheet page 41 of the *CRS Application* is submitted along with the documentation described on the bottom of that page.

CITY OF BLACKWELL

FLOOD WARNING PROGRAM

FLOOD HAZARD

FTR - Flood Hazard Description

The City of Blackwell is located in Kay County in north-central Oklahoma. The primary water course and cause of flooding in Blackwell is the Chikaskia River, which flows in a southeasterly direction from its source, just southeast of Pratt, Kansas, to its confluence with the Salt Fork of the Arkansas River about 12 miles south of Blackwell.

At Blackwell, the Chikaskia flows southeasterly from an area immediately north of the City skirting it on the northeast sides and forming part of the eastern corporate boundary. It continues until it reaches an area near the southern corporate boundary and then continues southeasterly towards the confluence with the Salt Fork of the Arkansas River. The route of the river through the City starts at mile 26.0 and ends at mile 28.5.

The Chikaskia is a flat, slow-moving river that drains farm land. It has a drainage area of 1,865 square miles. Flood velocities average 6 feet per second in 100-year floods and 8 feet per second in 500-year floods. Present land use along the Chikaskia River through Blackwell is mainly agricultural along the east side and residential on the west side.

The Chikaskia River and its flood characteristics have been studied by the Tulsa District, U.S. Army, Corps of Engineers, and have been reported as “Flood Plain Information,” June 1976. The Federal Emergency Management Agency (FEMA) has also done a *Flood Insurance Study* for the City, dated 1979.

In addition to the Chikaskia, the Corps of Engineers study identifies two tributaries within the City that contribute to flood conditions.

Tributary 1

The southern tributary flows from east to west through the City. The drainage area is near the confluence with the Chikaskia River and covers an area of 2.32 square miles.

Tributary 2

The northern tributary also flows from east to west. It has a drainage area near the confluence with the Chikaskia River and covers an area of 1.53 square miles. Several drainage problem areas exist in the City, which can result in flash flooding. This occurs when heavy local rains are severe enough to overload the existing underground storm sewers and open channels.

The majority of the flood-producing storms that occur over the Chikaskia River watershed usually occur in the spring and summer. The larger floods have usually resulted from localized, intense thunderstorms. Although thunderstorms occur more frequently during the spring and summer, they may occur at any time of the year, as seen in the October 1986 flood, in which flood elevation levels reached the 34-ft. mark, and again in September 1987 at the 33-ft. mark.

FTR - Flood Hazard Description

Flooding of the Chikaskia in Blackwell can also occur with heavy rainfall upstream as well as from locally intense storms or a combination of both. In the western part of the City, flooding results from locally intense thunderstorms combined with the effects of the backwater from the Chikaskia River.

Both in-city tributaries have short reaches that contain adverse stream bed slopes, which cause ponded waters after the floodwaters have receded. Most of the open channels and culverts on the tributaries are built to convey the 10-year and in some cases the 50- or 100-year floods. However, some of the channels and culverts are undersized for even the 10-year floods and can produce some backwater conditions. In addition, floatable material, such as lumber crates, wood building materials, trees, and empty storage tanks, may be carried away by the floodwaters, causing serious damage to downstream structures and clogging culvert openings. This creates a more hazardous flooding problem. The hazards are especially severe on the two tributaries where, in some cases, very small culverts may be plugged by even small floating debris.

Because of the extent of flooding during a major flood, several thoroughfares are submerged. The affected transportation facilities in the floodplain include portions of U.S. Highway 177, Oklahoma Highway 11, the AT & SF railway, various county roads, city streets, and alleys. The Flood Forecast Map and Flash Flood map found in the Appendix indicate the areas affected in Blackwell by different levels of flooding.

In flood conditions, structures that are affected are mainly residential and commercial on the east and north side of town near the banks of the Chikaskia, and along Highway 11. An industry, Blackwell Acme, now Eagle Foundry, is under flood threat at the 100-year level. The Blackwell Pollution Control Plant is under threat at the 500-year level. An intersection near the Blackwell Regional Hospital and Red Cross is subject to flash flooding. A list of specific areas affected by different levels of flooding is in the Appendix.

FLOOD THREAT RECOGNITION SYSTEM

FTR - Description

The National Weather Service issues flash flood watches and warnings for Kay County. Warning is provided for the Chikaskia River at Blackwell, Oklahoma, by teletype link in the Police Dispatch office. The National Weather Service has a forecasting gage located near Corbin, Kansas, that provides a 12- to 14-hour warning for downstream flooding. The National Weather Service in conjunction with the U.S. Army Corps of Engineers of Tulsa also has a forecasting gage at mile 26.0 on the Chikaskia in Blackwell that provides more current local flood crest conditions. The Office of Emergency Preparedness has access to the Corps of Engineers data base in Tulsa via telephone modem. The Blackwell Office of Emergency Preparedness has an Emergency Operations Center. This center is manned when the first flood alert is received and local monitoring of the flooding conditions begins. The local flood gage can be read manually as often as every hour. Contact is made with residents at Lake Blackwell to monitor the rising of the river upstream.

Warning Time

FLOOD WARNING TIMES

Flood warnings provided by the National Weather Service give at least 12 hours of notice of potential flooding upstream. Monitoring at Lake Blackwell Dam gives a 2-hour notice of intensified flooding conditions on the local level. Local monitoring provides as much warning as possible, usually with a two- or three-hour notice to affected citizens.

EQUIPMENT NEEDED TO OPERATE THE PROGRAM, MAINTENANCE AND TESTING

FTR - Maintenance

The teletype system utilized by the Police Dispatch is used daily and kept in working order. Radio systems are also used on a daily basis and a daily radio check is run by the Police Dispatch for the Fire Department and other departments as requested. The outdoor sirens are tested every Friday at noon, with the only exceptions being if Kay County or any adjoining county is under any kind of a watch. Any failures in the system are corrected on a priority basis. Sirens and public address systems on police and fire vehicles are used on a regular basis and kept in working order. Gages, transmission equipment, and base stations for the National Weather Service are maintained by that agency. The Corps of Engineers maintains its gage also. The City of Blackwell assists in this maintenance and routine checks by manually reading the gages in Blackwell and calling the readings to the Corps and the NWS.

PROCEDURES FOR DRILLS

FTR - Testing

The flood threat recognition and warning dissemination program provides for regular drills held in March prior to the rainy season as a part of Public Flood Awareness Week. This is coordinated by the Director of the Blackwell Office of Emergency Preparedness. Flood conditions are simulated and all involved personnel from the City, County, and Emergency Operations Center as well as the Blackwell Regional Hospital, Red Cross, KOKB radio station and cable television take part in the drill. After the drill, warning and response actions will be evaluated and modifications to the program will be made as needed. This annual drill provides an opportunity to train new personnel of the various agencies involved for the flood warning program.

STAFF RESPONSIBILITIES

The initial responsibility for flood threat recognition and warning lies with the City of Blackwell Police Dispatch. Upon receiving a teletype bulletin, the Dispatch calls the Blackwell Emergency Preparedness Director and notifies the City Manager of Blackwell. The Emergency Operations Center is opened and the flood conditions are monitored on a local basis as well as by contact with the NWS. At that point the responsibility for the warning and dissemination program shifts to the Director of the Emergency Operations Center. The Director notifies the radio station and cable television. In addition, the Director notifies the City Manager if additional warnings are needed, such as emergency vehicle messages, neighborhood warnings, sirens, or bullhorns. The Director also notifies the County and State highway departments as to flood threat conditions.

Emergency Warning Dissemination (EWD)

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.

A siren warning can reach many people fast, but it doesn't tell them what to do.

This element credits a community's arrangements for disseminating a flood warning to the general public.

Prerequisites

This element has five prerequisites.

1. The community must receive flood threat recognition (FTR) system credit.

2. The community must have adopted an emergency response plan. The term "plan" includes annexes and standard operating procedures (SOPs) that may be developed pursuant to the plan. The items for which EWD credit is requested must be in that plan or in its annexes or procedures.

3. The warning must be disseminated in ways that can reach people in a timely manner, including under conditions of night or heavy storms. If the warning lead time is under 12 hours, it is not sufficient to rely solely on radio and TV announcements. In coastal communities, hurricane and tropical storm warnings are provided 24 hours in advance, so using the Emergency Alert System would suffice. However, as noted below, more points are available for using multiple methods of disseminating the warning.

4. The warning dissemination equipment and procedures must be tested at least annually. This requirement is met if (1) the tests are done specifically for a flood warning drill, (2) the community responds to a real flood warning, or (3) there is a drill or real warning to respond to another hazard, provided the personnel and equipment involved are substantially the same. For example, if both flood warnings and tornado warnings are disseminated via siren activated by the fire department, an annual test or drill of either, or an event for which the system was used, will meet this requirement for that method of dissemination.

5. Many floodplain residents may not know whether a siren means a flood, a fire, a tornado, or an invasion. Even if they know that a flood is on the way, often they do

not know what to do. Therefore, for CRS credit for warning dissemination, the community must have an annual program to tell the public about its warning program and flood safety measures, such as evacuation.

The community must conduct an annual outreach project covering the topics "flood warning" and "flood safety" as discussed in Section 331 of the *Coordinator's Manual.* This may be credited under Outreach Projects to the Community (OPC), Outreach Projects to Floodplain Residents (OPF), or the community's Outreach Project Strategy (OPS) under Activity 330 (Outreach Projects). Additionally, a project that is not credited by the CRS but reaches at least 90% of the properties in the floodplain and adequately covers "flood warning" and "flood safety" can meet this public information requirement. If an OPS is used, the strategy document must discuss the best way to publicize warning and safety information to the target audience.

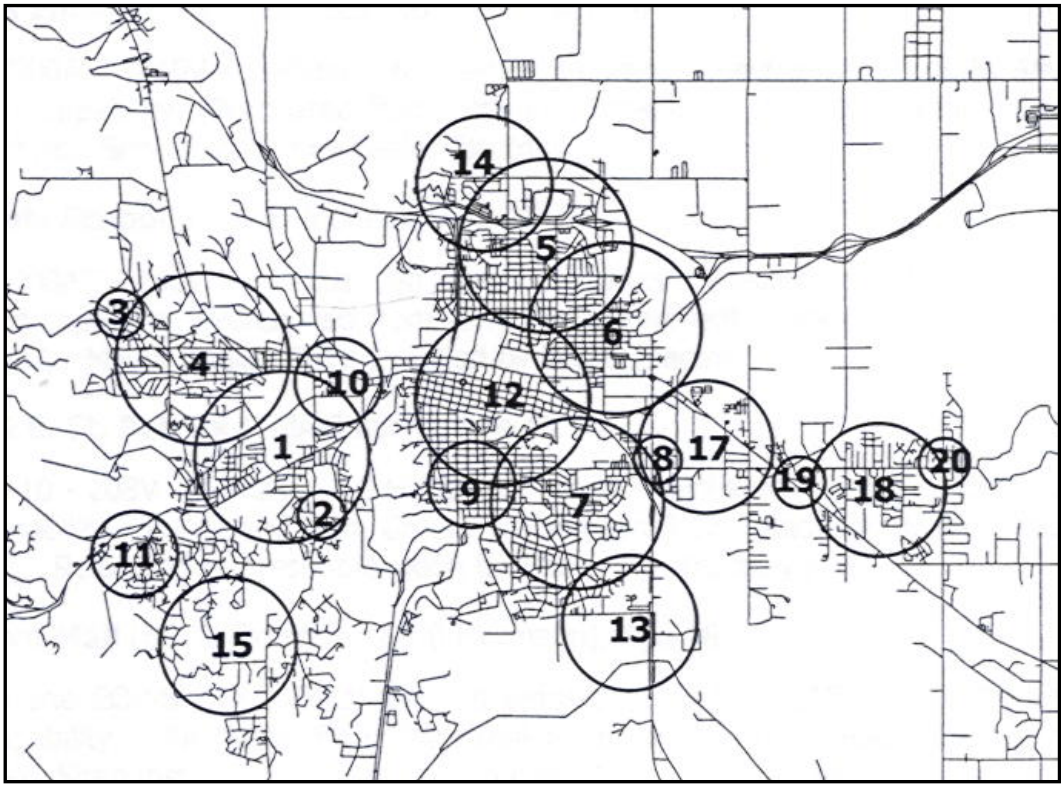
The criteria for this requirement are spelled out in Activity 330 in the *Coordinator's Manual* and in *CRS Credit for Outreach Projects*. The latter publication includes brochure examples from local governments to illustrate how they have advised their residents about flood warnings and flood safety.

CRS Credit

Credit for Emergency Warning Dissemination (EWD) is based on the methods of warning dissemination to the general public. A maximum of 60 points can be earned for EWD credit. 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. Warning dissemination policies, procedures, and methods credited by CRS include those described below.

Evacuation message sign in Wrightsville Beach, North Carolina

1. Adopted warning message policies and procedures. This credit recognizes adopted message policies and procedures that encourage quick action to provide the proper early flood warning. The CRS credits procedures that specify when and how a warning is issued and specifies the messages to be disseminated under different conditions. The documentation must include instructions so the staff can quickly issue the appropriate warnings. Without such a policy, staff members may debate whether the recognized flood threat warrants a warning or they may not know whom to warn or when.

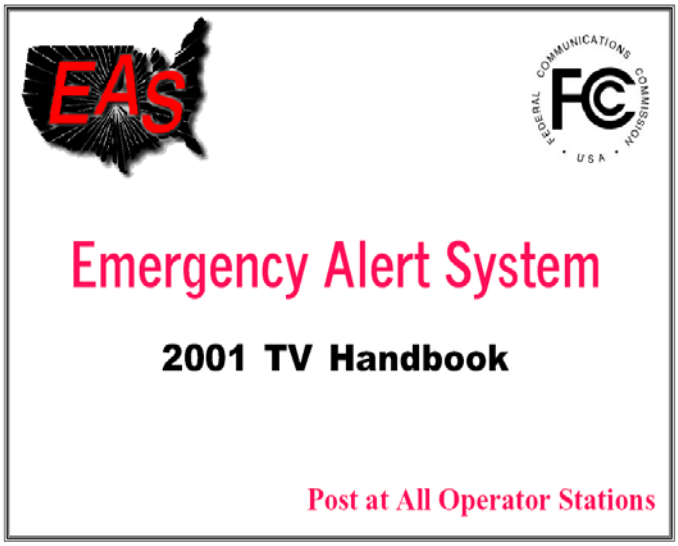


Map of public warning siren coverage for Rapid City, South Dakota

2. **Outdoor sound and siren systems.** Some communities find that an outdoor voice-sound system or a fixed siren system that covers the flood hazard area is a quick, effective way to provide flood warnings. Care should be taken in the design and testing to ensure that occupants inside homes and businesses can hear the signal or message when the buildings are closed and storm conditions exist.

3. **Door-to-door and mobile public address systems.** Some communities disseminate warnings by door-to-door contact or mobile public address systems. This approach allows site-specific messages to be given to residents in threatened areas. However, it is time- and resource-intensive. The emergency operations plan or standard operating procedures should describe how this task will be implemented.

4. **Emergency Alert System.** One of the quickest ways to reach a large number of people with an emergency message is the Emergency Alert System (EAS). Local government participation in the activation of the EAS for natural disaster emergencies is governed by federal regulation and the local area EAS plan. CRS credit is available to local governments that can activate the EAS. Procedures for activation should be in a standard operating procedure and include information on who is authorized to activate the system. They should also describe the authentication procedure.



Handbooks that provide guidance to local governments, radio and television stations, and cable operators are available from the Federal Communications Commission.

5. **Telephone warning.** A telephone calling tree or automatic telephone dialing system can be credited, provided that the warning dissemination is to ALL FLOODPLAIN OCCUPANTS. However, these prerequisites must be kept in mind: the system must provide adequate lead time and be tested annually. Telephone numbers must be updated annually. A telephone procedure that only contacts community staff or critical facilities is not credited under this element.

6. **Cable television override system.** Local governments that can activate the EAS on the cable television system serving the jurisdiction receive CRS credit.

7. **Local AM radio transmitters.** Due to gaps in the NOAA Weather Radio coverage area, some local governments have installed or contracted with other AM radio transmitter sites to expand the warning area. In addition to flood warning and evacuation messages, some local governments find these stations helpful in disseminating information on public safety and property protection measures. Note that this does not include local commercial AM radio stations.

8. **Other systems.** Additional points may be possible for warning systems not listed. Communities should submit requests for such credit to their ISO/CRS Specialist.

Credit Calculation

The end result of this work is an initial score for the community's emergency warning dissemination system (EWD). It is the product of the credit points multiplied by the impact adjustment ratio. See page 55 for a discussion of the impact adjustment. In the *Coordinator's Manual*, the credit calculation is shown as the following formula:

cEWD = EWD x rEWD, where

cEWD is the total credit for EWD,

EWD is the points for EWD, which range from 10 to 60, and

rEWD is the impact adjustment ratio, which ranges from 0.25 to 1.0.

cEWD can range from 2.5 to 60.

Documentation

To confirm that a community's program meets the CRS credit criteria and to help calculate credit points, several types of documentation must be submitted with the request for credit. For a community's first application for a CRS classification, the application form on page 41 of the *CRS Application* should be used. This form should be submitted along with the documentation described on the bottom of that page.

CITY OF BLACKWELL, OKLAHOMA

DISSEMINATION OF WARNINGS

EWD - Cable

Dissemination of warnings is done through the Blackwell Emergency Operations Center in Blackwell and the Blackwell Police Dispatch. Warnings are distributed as follows:

1. For slowly developing floods – the local radio station 1580 AM is contacted by Blackwell Office of Emergency Preparedness and given information for flood evacuation. Updated information is given as deemed appropriate. Public handout information, newspaper articles, and other outreach activities annually advise citizens to listen to 1580 AM. Cable television override will also run advisories for flooding potential and evacuation.

EWD – Public

2. For rapidly developing or flash floods – The local cable system's cable override will be utilized to make the public aware of existing conditions concerning the Chikaskia River. The Fire Department may make a door to door canvass of the hazard areas to warn residents. If time is short, warnings are to be given by public address systems from police, fire, or emergency vehicles as they drive through the hazard areas.

STAFF RESPONSIBILITIES

EWD – Messaae Reception

The initial responsibility for flood threat recognition and warning lies with the City of Blackwell Police Dispatch. Upon receiving a teletype bulletin, the Dispatch calls the Blackwell Emergency Preparedness Director and notifies the City Manager of Blackwell. The Emergency Operations Center is opened and the flood conditions are monitored on a local basis as well as by contact with the NWS. At that point the responsibility for the warning and dissemination program shifts to the Director of the Emergency Operations Center. The Director notifies the radio station and cable television. In addition, the Director notifies the City Manager if additional warnings are needed, such as emergency vehicle messages, neighborhood warnings, sirens, bullhorns. The Director also notifies the County and State highway departments as to flood threat conditions.

EWD - Message Procedures

Task 1.A – Issue Flood Warnings

The objective of this task is to provide the general public with early notification that a flood along the Chikaskia River is imminent.

Flood Condition A:

1. When the NWS announces a flood threat on the Chikaskia River, the Police Dispatch notifies the Director of Emergency Preparedness. The Director notifies the local radio station, KOKB, 1540 AM, and information about the flooding and evacuation is provided. The local cable television channel override will also run advisories for flooding potential and evacuation.
2. The radio station, KOKB, has prepared messages for each flood condition. They list the names of intersections of streets and areas of town that are expected to flood. The radio station also has information about flood safety precautions, and under Flood Conditions B, C, or D, it knows that the American Red Cross building or another building will be designated as the evacuee reception center.
3. Police and fire department personnel are alerted to flood conditions and are on standby to give warnings in the threatened areas by public address system.

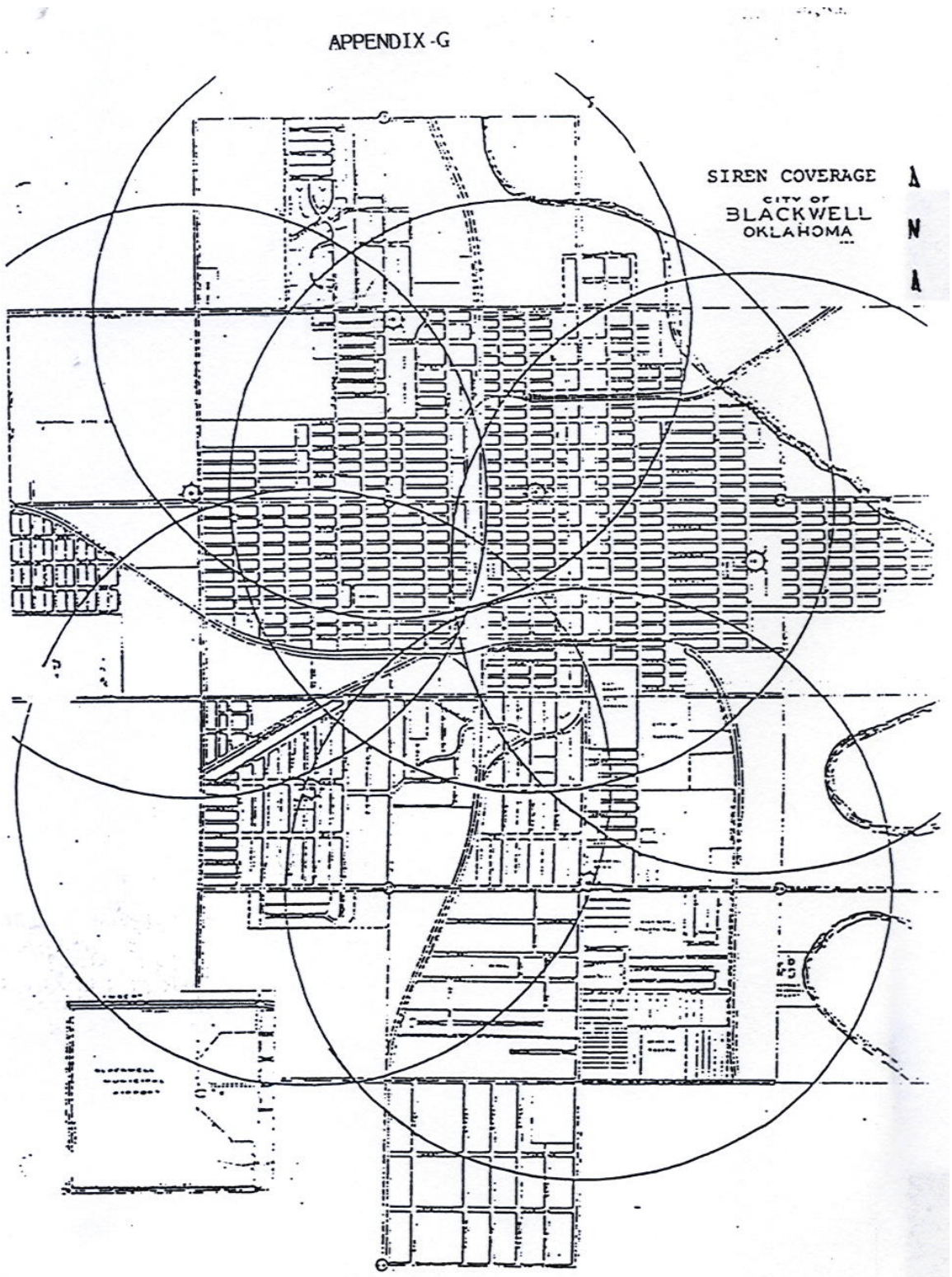
NOTE: *Blackwell, Oklahoma has sample messages for different stages of flooding. Below is a sample of the message used when flood stage is 34 to 36 feet.*

EWD – Example Warning Message

SEVERE FLOODING WILL OCCUR OVER SEVERAL CITY BLOCKS IN NORTH AND EAST PORTIONS OF BLACKWELL. DEPTH IN HOMES MAY RANGE UP TO NEARLY 6 FEET. OTHER HOMES AND BUSINESSES WILL BE ISOLATED BY DEEP WATER WHICH WILL BE DANGEROUSLY SWIFT IN PLACES. HIGHWAY 177 NORTH OF TOWN WILL BE CLOSED BEFORE THE STAGE REACHES 33 FEET. THE BLACKWELL AVENUE, OR RADIO TOWER ROAD, EAST OF TOWN WILL BECOME IMPASSABLE SEVERAL HOURS AHEAD OF THE FLOOD CREST. HUBBARD ROAD SOUTHEAST OF TOWN WILL BE CLOSED AFTER THE STAGE REACHES 30 FEET.

IMMEDIATELY EVACUATE PERSONS AND PROPERTY TO PLACES THAT ARE AT LEAST 6 FEET HIGHER THAN NEARBY RIVER BANKS. DO NOT ENDANGER LIVES BY ATTEMPTING TO TRAVEL ON SUBERMERGED ROADS. THEY MAY BE WASHED AWAY.

THIS FLOOD AS FORECAST COULD PRODUCE OVERBANK DEPTHS 2 OR SO FEET MORE THAN SEEN ON OCTOBER 3, 1986 WHEN THE STAGE WAS ABOUT 34 FEET AT THE BLACKWELL GAGE.

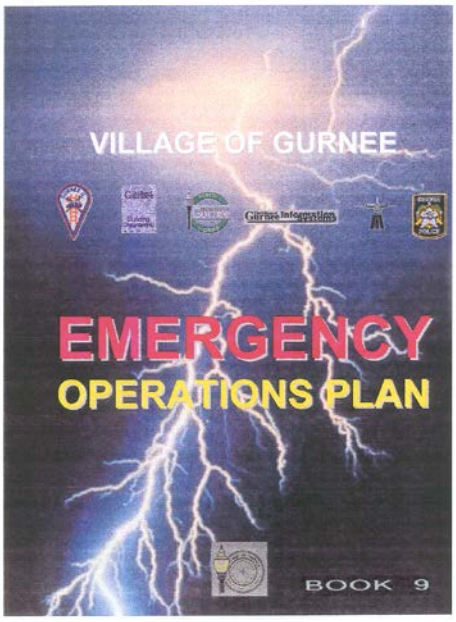


Siren coverage for Blackwell, Oklahoma

Other Response Efforts (ORE)

This element credits the flood response tasks undertaken by the community, other agencies, the private sector, and volunteer organizations. These tasks should be itemized in the community's flood response plan.

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.



One community's response plan

Prerequisites

There are three prerequisites for credit.

1. The community must receive credit for its flood threat recognition system and for disseminating a flood warning to the general public.

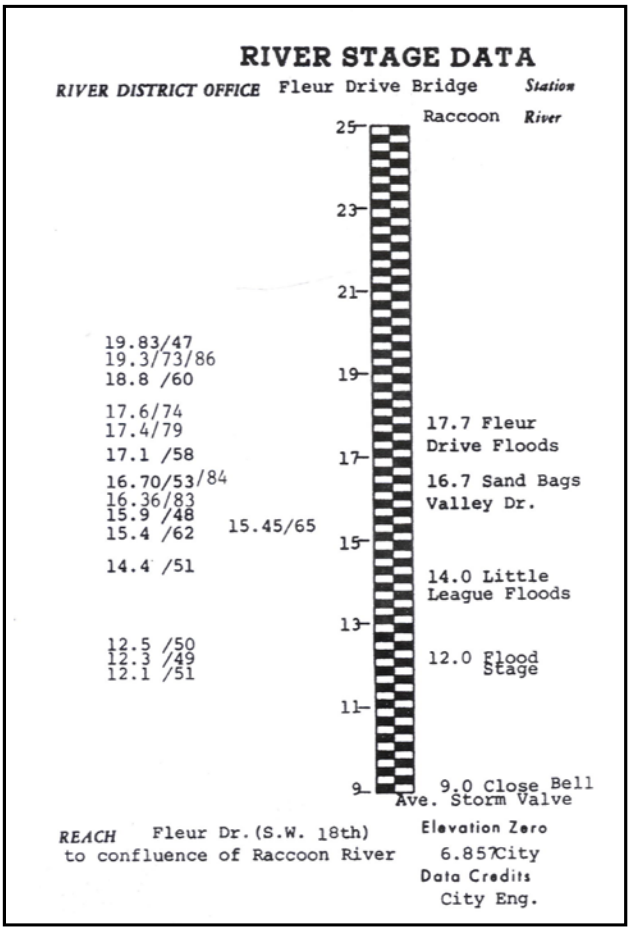
2. The community must conduct at least one exercise of the response plan each year. The exercise may be a table top exercise, drill, or response to an actual disaster. If the flood response plan is part of a multi-hazard plan, then the exercise may be in response to another type of disaster provided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

3. The other response tasks must be included in the community's adopted flood response plan.

CRS Credit

Up to 50 points of credit are available for Other Response Efforts (ORE). The amount of credit awarded is based on the emergency plan's identification of flood tasks, tying tasks to predicted flood levels, and identifying resources needed to complete response tasks.

1. **Flood tasks keyed to flood levels.** The CRS credits community flood response plans or multi-hazard plans keyed to specific predicted flood levels furnished by the flood threat recognition system. For example, many coastal communities have established task assignments for different categories of hurricanes. Response tasks are keyed to predicted water or wave heights and the estimated time remaining until the landfall of gale force winds.



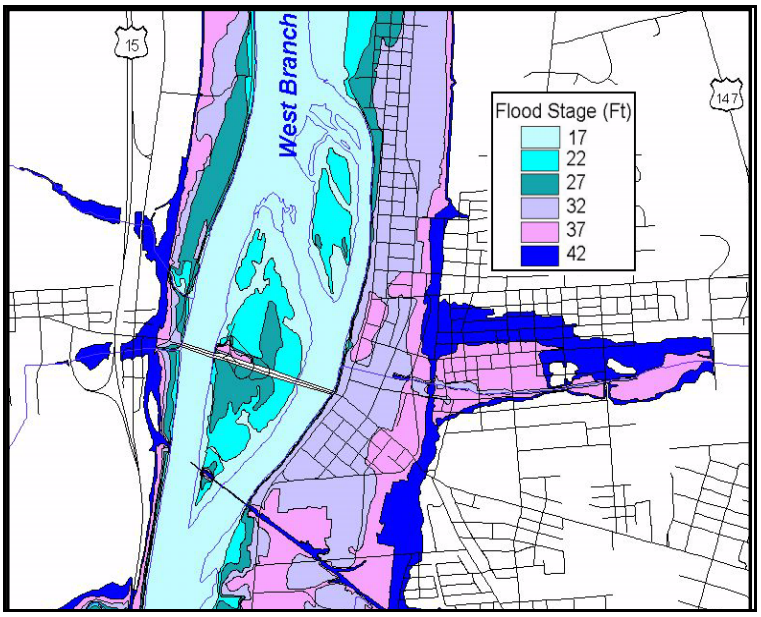
River stage data for Des Moines, Iowa

Some local governments maintain records of their flood history at the river gage sites within their jurisdictions. They also identify areas that flood and the emergency actions that need to be completed before flood waters reach identified levels.

The river stage data to the left are from the City of Des Moines, Department of Public Works, Flood Emergency Plan. The city has stage or staff gages along the Des Moines and Raccoon rivers and along its other major streams. The flooding history, flood impact and emergency actions are identified for specific flood levels at each gage site.

The river stage data at the left are for the Public Works Department. Similar data should be maintained for each emergency response agency.

Riverine flood response plans are usually keyed to flood stage predictions at specific locations. A flood stage forecast map shows the areas inundated at each stage, so the community emergency planners can develop appropriate task assignments for each level of flooding. The plans should be changed periodically to reflect new conditions within the community.



Example of a flood stage forecast map

Emergency tasks and mitigation measures can best be incorporated in the local emergency operations plan when the potential for loss of life and property damage can be described. Evaluating flood loss potential is done by assessing the resident population and damageable property located on the floodplain that would be directly affected by flooding.

Table 11 RESIDENTIAL STRUCTURES WITHIN FEMA DESIGNATED FLOOD ZONES

	Number of Structures within SFHA (by Type)					
Flood Zone	Single Family	Duplex	3-9 Units	10-49 Units	50 or more Units	Mobile Home
A	2,466	45	213	360	450	174
A0	9,462	557	2,306	40	0	13
AO(AF)	409	0	5	70	32	55
A2-A24	695	39	177	180	43	43
A2(FW)-A6(FW)	18	0	1	0	0	0
AE	1,006	18	284	232	135	10
AH	1,162	23	166	435	227	1
D	29	0	0	1	3	0
V5-V14	468	19	12	93	16	19
TOTAL	15,715	700	3,164	1,412	907	315

Identification of residential structures within flood zones in the City of Los Angeles, California, floodplain management plan

Many communities have established stage damage charts that show the relationship between river stage and flood damage. These charts must be kept current to reflect changes in urban development. The relationship of river stage to inundation area is important in determining flood loss potential. Community flood studies, such as those developed for flood insurance, provide profiles and maps that reveal the magnitude of flooding expected and permit the identification of critical public services that are vulnerable to flooding. The chart below from King County, Washington, illustrates one method of displaying information about potential levels of flooding and their consequences.

Flood Phase Information

Phase	Flow at gage near Carnation	Description	Condition
1	1500 c.f.s.	Internal Alert	
2	2500 c.f.s.	Minor Flooding	San Souci area homes may be inaccessible and experience high water depths and velocities. Tolt River Rd and some driveways may overtop.
3	4500 c.f.s.	Moderate Flooding	Increased water depth and velocity in San Souci and other areas.
4	7000 c.f.s.	Major Flooding	Levees may overtop near Carnation. Channel changes may occur.

Potential flood conditions on Tolt River near Carnation, King County, Washington

A number of questions should be answered when evaluating flood loss potential.

- Is there a potential for loss of life associated with floods?
- What structures are located within the floodplain, especially critical facilities?
- What is the annual flood damage?
- What is the potential flood damage for a particularly severe flood?
- What percentage of property can be temporarily relocated?
- Where are the safe evacuation routes in relation to the area of inundation?
- What are the health and safety hazards associated with local flooding?

2. **Flood tasks assigned to agencies.** If the plan, its appendices, or approved standard operating procedures identify responsibility for flood response tasks for the community's staff and other public and private organizations, CRS credit is awarded. The tasks vary according to the flood hazard and the community's resources.

   Typical actions and responding parties include

   - Activating the emergency operations room (emergency management),
   - Closing streets or bridges (police or public works),
   - Shutting off power to threatened areas (utility company),
   - Holding children at school/releasing children from school (school district),
   - Passing out sand and sandbags (public works),
   - Ordering an evacuation (mayor),
   - Opening evacuation shelters (Red Cross),
   - Monitoring water levels (engineering), and
   - Security and other protection measures (police).

   The staff to which tasks are assigned will also vary. At a minimum, it should include employees of the community like the emergency manager and police, fire, and public works personnel. A good plan coordinates with other agencies, such as the school district, adjacent cities and counties, the state police, the National Guard, and private organizations such as the Red Cross, utility companies, and suppliers of flood fighting materials.

   If the other agencies and organizations agree, their activities should be included in the task assignments to help plan for a coordinated flood response.

3. **Estimate resources required for flood tasks.** CRS credit is provided if the plan includes a summary of the estimated resources required, the time required to carry out each flood response task, and where the necessary resources can be obtained. This credit is provided for those plans that include the details of how the tasks will be implemented.

For example, if a building is to be sandbagged, this credit would be provided if the plan notes who is responsible, how many sandbags will be needed, how long it will take, and where the bags, sand, and plastic sheeting will be obtained.

Credit Calculation

The end result of this work is an initial score for the community's Other Response Efforts (ORE). It is the product of the credit points multiplied by the impact adjustment ratio. See page 55 for a discussion of the impact adjustment. In the *Coordinator's Manual*, the credit calculation is shown as the following formula:

cORE = ORE x rORE, where

cORE is the total credit for ORE,

ORE is the points for ORE, which range from 10 to 50, and

rORE is the impact adjustment ratio, which ranges from 0.25 to 1.0.

cORE can range from 2.5 to 60.

Documentation

To confirm that a community's program meets the CRS credit criteria and to assist in calculating credit points, documentation must be submitted with the request for credit. For a community's first application for a CRS classification, use the application form on page 41 of the *CRS Application.* This form should be submitted along with the documentation described at the bottom of that page.

While much of the documentation for emergency warning and dissemination credit will be found in a community's multi-hazard plan or other comprehensive emergency response plan, 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 margin of the plan, and copies of only those pages should be submitted. Portions of the City of Blackwell Plan are reproduced below, with the margins marked to show the documentation.

Many municipal warning systems or response plans are part of county emergency management programs. It must be noted that each community is responsible for ensuring that its submittal is complete. It is the applicant's responsibility to send in all documentation, including items handled by the county or another agency.

CITY OF BLACKWELL

FLOOD EMERGENCY ACTION PLAN

PLAN OVERVIEW

Objective

This flood emergency action plan describes the actions to be taken when flooding appears imminent. The primary objective of the plan is to reduce the risk to life. Actions to reduce property damage and other economic losses are to be undertaken only if the use of resources for these purposes will not interfere with the primary objective.

Scope

This plan covers all incidents of imminent flooding affecting the city of Blackwell from all sources. The provision in the plan is designed to deal with flooding up to the 500-year flood. All departments and employees of the City are directed to cooperate in carrying out the plan when it is activated.

FTR - Data Collection

Basis for the Plan

Flood data was collected for the "Flood Plain Study" prepared by the Tulsa District, U.S. Army Corps of Engineers, 1976, and a Federal Emergency Management Agency (FEMA) Flood Insurance Study for the City in 1979. Warning times are established by the National Weather Service (NWS). The NWS provides flood crest predictions for the Chikaskia River at Corbin, Kansas, and at mile 26.0, located at the State Highway 11 Bridge in North Blackwell. Several residents along the Chikaskia River have gages and provide eyewitness information to the Office of Emergency Preparedness, and this information is passed on to the NWS.

FTR - Flood Hazard Description

A Flood Stage Forecast map was prepared based on elevations of manholes and other known elevation reference marks. The copy of this map is located in the Emergency Operations Center (EOC) and is enclosed as Appendix A.

Five Flood Conditions

This Flood Emergency Action Plan is based on five flood conditions displayed on the Flood Stage Forecast map.

1. **Flood Condition A:** the ten-year flood. Condition A on the Chikaskia River means a flood stage of 33.6 ft. As the river reaches the 10-year flood level of 33.6 ft. and the river continues to rise, the Mayor needs to consider signing a Declaration of Emergency. Waters at this level would also rise in Tributary 1 and Tributary 2. At this level as many as 162 residences and one church would be affected. Most of these homes will be affected by water in the streets and in park areas along the tributaries and the River. Three businesses will be similarly affected.

2. **Flood Condition B:** no known flooding in Blackwell has reached the 50-year. Condition B on the Chikaskia River means a flood stage of 38 feet at the State Highway 11 bridge gage. Tributaries 1 and 2 will also rise under Condition B. At this level of flooding, approximately 48 additional residences are threatened; park land and railroad access land will be most affected. A total of 16 businesses will be similarly affected under these conditions. No public facilities will be threatened.

3. **Flood Condition C:** the 100-year flood according to the Flood Insurance Study Rate Map. Condition C on the Chikaskia River means a flood stage of 40 feet at the State Highway 11 bridge gage. Tributaries 1 and 2 would continue to rise; an additional 167 residences and 16 businesses would be affected, mostly by flooded streets. The Oklahoma National Guard armory would be threatened. The Blackwell Regional Hospital would have flood waters in a portion of the parking lot but would not be affected.

4. **Flood Condition D:** the 500-year flood. Condition D on the Chikaskia River means a flood stage of 42 feet at the State Highway 11 bridge gage. Tributaries 1 and 2 would continue to rise. An additional 262 residences would be affected. Two public schools would be affected. An additional two businesses would be affected, including one foundry, Eagle Iron. A listing of all affected businesses can be found in Appendix B.

5. **Flash Flooding:** refers to any rapid fall of rain in amounts in a short period of time that will not cause long-term flooding problems but due to the rapid accumulation will cause short-term problems. Street flooding is a primary concern with certain intersections historically causing problems for motorists. No residences are affected by flash flooding, however, the Blackwell Regional Hospital and the Western Kay County American Red Cross are both affected by the flooding of the intersection at Thirteenth Street and Ferguson Avenue. Both facilities experience flooding in the parking lots next to the intersection. With excessive amounts of rain, both have experienced some flooding at the entry area of the buildings. Areas affected are shown on the Flash Flood map in Appendix A.

Activation of the Plan

This plan, or appropriate parts of the plan, is to be put into operation under any of the following conditions:

1. Issuance of a flood warning for the Chikaskia River by the National Weather Service.
2. Issuance of a flash flood warning for the area by the National Weather Service.
3. If direct communications with the National Weather Service are lost and heavy rainfall is known to by occurring in the Chikaskia River watershed.

The decision to activate the plan is to be made by the Emergency Preparedness Director or the designated alternate. Upon activation of the plan, notice is to be given by the Director to the City Manager and the heads of appropriate city departments. Once activated, the conduct of the plan will be directed by the Director with the advice and assistance of liaison personnel from each city department. Only those parts of the plan appropriate to the situation shall be activated.

FLOOD RESPONSE TASKS

The tasks making up the plan are not all intended to be carried out whenever the plan is activated. Some of the tasks are necessary to deal with flooding on the Chikaskia River, Tributaries 1 and 2; some are applicable only to flash flooding. The tasks to be carried out for each situation are based on the predicted flood stage and resulting flood condition. Generally Flood Condition A tasks will be initiated first, followed by Flood Condition B tasks upon direction of the Office of Emergency Preparedness.

ORE - Flood Response Tasks

Summary of Task

1. Flooding of the Chikaskia River and its tributaries:
    a. Issue flood warnings.
    b. Provide traffic control along the river and along tributary floodplain.
    c. Monitor conditions and close additional roads as necessary.
    d. Protect the Pollution Control Plant.
2. Flash flooding in low lying areas:
    a. Issue flood warnings.
    b. Provide traffic control along South Thirteenth Street and other areas subject to rapidly rising water.
3. All cases of flooding:
    a. Open the Emergency Operations Center.
    b. Maintain contact with the National Weather Service, Emergency Broadcast System and other warning systems.
    c. Coordinate emergency response with other City of Blackwell Departments.
    d. Open and operate evacuee reception center in coordination with American Red Cross.

EWD - Television Override and Messaaes

FLOODING OF THE CHIKASKIA RIVER AND ITS TRIBUTARIES

Task 1.A – Issue Flood Warnings

The objective of this task is to provide the general public with early notification that a flood along the Chikaskia River is imminent.

Flood Condition A:

1. When the NWS announces a flood threat on the Chikaskia River, the Police Dispatch notifies the Director of Emergency Preparedness. The Director notifies the local radio station, KOKB, 1540 AM, and information about the flooding and evacuation is provided. The local cable television channel override will also run advisories for flooding potential and evacuation.
2. The radio station, KOKB, has prepared messages for each flood condition. The messages include the list of street intersections and the areas of town that are expected to flood. The radio station also has information about flood safety precautions, and under Flood Conditions B, C, or D, they know the American Red Cross building or another building will be designated as the evacuee reception center.

3. Police and fire department personnel are alerted to flood conditions and are on stand by to give warnings in the threatened areas by public address system.

Flood Conditions B, C, and D: same as Flood Condition A.

Task 1.B – Provide Traffic Control Along the Chikaskia River and its Tributaries

ORE - Flood Tasks

Flood Condition A:

Manned traffic control points would be established at North Main and Florence Avenue and at Doolin Avenue and Sixth Street. There would also be manned traffic control points at South Main and Furguson and at South Main and Southwest Boulevard. It is the responsibility of the Oklahoma Department of Transportation to provide barricades and manned traffic control at these points because this is a State maintained highway. At the request of ODOT these points may also be manned by the police department with uniformed officers, provided through mutual aid agreements or by volunteers approved by the police department.

Barricades/flashers would be placed at the following locations by the street department.

ORE - Flood Tasks Based on Flood Levels

Along the Chikaskia River

a) McKinley Avenue and E Street
b) Oklahoma Avenue and E Street
c) Blackwell Avenue and E Street
d) Bridge Avenue and E Street
e) Lincoln Avenue and E Street
f) Santa Fe Avenue and D Street.

When flood waters have reached the location of Bridge and I streets, the television cable override will be used to warn livestock owners in the flood areas to evacuate livestock.

Along Tributary #1

a) B Street and Furguson Avenue
b) B Street and Adams Avenue
c) First Street and Furguson Avenue
d) First Street and Southwest Boulevard
e) Second Street and Furguson Avenue
f) Second Street and Southwest Boulevard
g) Third Street and Furguson Avenue
h) Third Street and Southwest Boulevard
i) Third Street and Crest Avenue
j) Third Street and Ikred Avenue
k) Third Street and Coolidge Avenue
l) Coolidge Avenue and Southwest Boulevard
m) Enlows Avenue and Southwest Boulevard.

Along Tributary #2

a) Sixth Street and Florence Avenue
b) Fourth Street and Kansas Avenue
c) Fourth Street and Frisco Avenue
d) Fourth Street and Florence Avenue
e) Second Street and Doolin Avenue
f) First Street and Florence Avenue
g) A Street and Doolin Avenue
h) B Street and Doolin Avenue.

Flood Condition B:
Manned traffic control points will be established at the following points: Sixth Street and Doolin Avenue, North Main Street and Florence Avenue, South Main Street and Furguson Avenue and South Main Street Adams Avenue, D and Blackwell Avenue, D and Lincoln Avenue. These will be manned in the same manner as under Condition A. Unmanned traffic control points will be marked with barricades and/or flashers and will be located as follows:

Along the Chikaskia River

a) Dewey Avenue and D Street
b) McKinley Avenue and D Street
c) Oklahoma Avenue and E Street
d) Blackwell Avenue and E Street
e) Bridge Avenue and D Street
f) Padon Avenue and D Street
g) College Avenue and D Street
h) Lincoln Avenue and D Street
i) C Street and College Avenue
j) B Street and Lincoln Avenue
k) B Street and Lawrence Avenue.

At this point, D street will be closed to traffic, except for those affected by the flooding. Admission to the flooded area will be by passes issued by the Blackwell Police Department. A one way entrance to the east side of town that is flooded will be down Blackwell Avenue, east on D Street and north on Lincoln Avenue. No street parking will be allowed Bridge Avenue from D Street east into the flooded area as this street is designated for emergency vehicle access. A traffic control pattern is indicated on the Flood Forecast Map. The same measures will be taken for the north side of town, north of Main and Doolin, where a manned police barricade will be stationed. Unmanned traffic control points will be marked with barricades and/ or flashers and will be located as follows:

Along Tributary #1

a) First Street and Furguson Avenue
b) Second Street and Furguson Avenue

c) Third Street and Furguson Avenue
d) Sixth Street and Sante Fe Avenue
e) Ninth Street and Sante Fe Avenue
f) Lloyd Avenue and Furguson Avenue
g) Eighth Street and Furguson Avenue
h) Sixth Street and Furguson Avenue
i) Coolidge Avenue and Southwest Boulevard
j) Enlows Avenue and Southwest Boulevard
k) Third Street and Coolidge Avenue
l) Third Street and Ikred Avenue
m) Third Street and Crest Avenue
n) Third Street and Southwest Boulevard
o) Second Street and Crest Avenue
p) First Street and Crest Avenue
q) South Main Street and Adams Avenue
r) South Main Street and Hill Avenue
s) B Street and Carson.

Along Tributary #2

a) Thirteenth Street and Doolin Avenue
b) Thirteenth Street and McKinley Avenue
c) Eighth Street and Kansas Avenue
d) Dewey Avenue and Ninth Street
e) Sixth Street and Parkway Drive
f) Eighth Street and Florence Avenue
g) Dewey Avenue and Seventh Street
h) Ash Avenue and Park Drive
i) Sixth Street and Almack Drive
j) Dewey Avenue and Seventh Street
k) Sixth Street and McKinley Avenue
l) Fifth Street and McKinley Avenue
m) Dewey Avenue and Legion Drive
n) Fourth Street and Frisco Avenue
o) Fourth Street and Florence Avenue
p) Fourth Street and Kansas Avenue
q) Third Street and Doolin Avenue
r) Second Street and Florence Avenue
s) First Street and Kansas Avenue
t) B Street and Kansas Avenue
u) A Street and Florence Avenue.

Flood Condition C:

Manned traffic control points for Condition C will be the same as with Condition B except that the point of control on Doolin Avenue will be located at the Seventh Street intersection. Barricades would be in places as for Condition B with the following additions:

Along the Chikaskia River

a) D Street and Oklahoma Avenue
b) D Street and Blackwell Avenue
c) C Street and Lawrence Avenue
d) South Main Street and Lawrence Avenue.

Along Tributary 1

Barricades would be in place as for Condition B with the following additions:

a) Thirteenth Street and Furguson Avenue
b) Eighth Street and Franklin Avenue.

Along Tributary 2

Barricades would be in place as for Condition B with the following additions:

a) Eighth Street and Ash Avenue
b) Eighth Street and Parkway Drive
c) Eleventh Street and McKinley Avenue
d) Ninth Street and McKinley Avenue
e) Fifth Street and Oklahoman Avenue
f) Fourth Street and Dewey Avenue
g) North Main Street and Florence Avenue
h) B Street and Florence Avenue.

Flood Condition D:

Manned traffic control points for Condition D would include Seventh Street and Doolin, North Main Street and Kansas Avenue, South Main Street and Lawrence Avenue, and South Main Street and Adams Avenue. These will be manned in the manner stipulated under Condition A. Unmanned barricades will be relocated, with a few additions to previous points to further isolate land along the river or tributaries. Barricade and flasher locations include:

Along the Chikaskia River

a) B Street and Kansas Avenue
b) B Street and Frisco Avenue
c) B Street and Dewey Avenue
d) C Street and McKinley Avenue
e) D Street and Blackwell Avenue
f) D Street and Bridge Avenue
g) D Street and Padon Avenue
h) D Street and College Avenue

i) C Street and Padon Avenue
j) B Street and College Avenue
k) B Street and Lincoln Avenue
l) B Street and Lawrence Avenue
m) C Street and Lawrence Avenue
n) South Main Street and Lawrence Avenue

Along Tributary 1

a) First Street and Lawrence Avenue
b) Second Street and Furguson Avenue
c) Third Street and Furguson Avenue
d) Sixth Street and Sante Fe Avenue
e) Ninth Street and Sante Fe Avenue
f) Eighth Street and Furguson Avenue
g) Sixth Street and Furguson Avenue
h) Coolidge Avenue and Southwest Boulevard
i) Enlows Avenue and Southwest Boulevard
j) Third Street and Southwest Boulevard
k) Third Street and Ikred Avenue
l) Third Street and Crest Avenue
m) Second Street and Crest Avenue
n) First Street and Crest Avenue
o) South Main Street and Adams Avenue
p) South Main Street and Hill Avenue
q) South Main Street and Carson Avenue
r) B Street and Carson Avenue.

Along Tributary 2

a) Ninth Street and Doolin Avenue
b) Eighth Street and Rainbow Drive
c) Seventh Street and Almack Drive
d) Eighth Street and Florence Avenue
e) Thirteenth Street and Doolin Avenue
f) Thirteenth Street and McKinley Avenue
g) Eleventh Street and McKinley Avenue
h) Ninth Street and Dewey Avenue
i) Eighth Street and Dewey Avenue
j) Seventh Street and McKinley Avenue
k) Sixth Street and Oklahoma Avenue
l) Fifth Street and Oklahoma Avenue
m) Fourth Street and Dewey Avenue
n) Third Street and Kansas Avenue
o) Second Street and Frisco Avenue

p) First Street and Frisco Avenue
q) North Main Street and Kansas Avenue
r) A Street and Florence Avenue
s) B Street and Florence Avenue.

Task 1.C – Monitor Conditions and close additional roads as necessary

A Variety of methods will be used to monitor the river level and street flooding during all flood conditions.

a) The river gages at Blackwell and Corbin Dam in Kansas are monitored routinely by the NWS, OEP, and City Engineering staff.
b) The river gage at Blackwell and Corbin Dam will be monitored every thirty minutes to one hour by OEP staff as assigned by the Director once a flood warning is issued for the area.
c) In the event that telephone connections are lost to the gages, the gage located on State Highway 11 will be manually monitored by the City Engineering staff or a qualified volunteer assigned by the OEP Director, every thirty minutes.
d) Reports to the OEP or Police Department by citizens living along the River or one of the tributaries will be recorded and analyzed on a case-by-case basis.

Task 1.D – Pollution Control Plant

Flood Conditions A, B, and Flash Flooding:

a) With any significant rainfall, whether flash flooding or river levels at 27 feet, the staff at the Pollution Control Plant will begin to monitor conditions utilizing a gage on the side of the dike. Increased inflow from submerged manholes during any flooding will affect routine tasks at the Plant. Such inflow will affect the permitted release levels and quality standards of plant discharge. The plant is not in danger of flooding.

Flood Condition C:

a) When flooding level reaches Condition C—a 100-year flood—the Pollution Control Plant will not be threatened by flooding, although elevation measurements indicate flood waters would be one foot from the dike surrounding the Plant. The Plant is designed to withstand 100-year flooding.
b) Precautions described under Flood Condition D will be taken if levels increase above the 100-year level or if other situations indicated need for protection rather than monitoring.

Flood Condition D:

Condition D – a 500-year flood, the Pollution Control Plant would be inundated with flood water. To prepare for such flooding, the following steps should be taken:

1) Same as for Condition A.

2) Protective measures would be taken as needed and include:
   a. Obtaining bags and filling them with sand.
   b. Entire staff will stay at the plant to monitor flood levels and maintain the protective measures around the clock until the danger of flooding is past.
   c. The plant will maintain contact with the OEP through telephone or radio in order to estimate water levels and flow increase.

IN ALL CASES OF FLOODING

ORE - Flood Tasks

Task 3.A – Open the Emergency Operations Center

Upon notification of a flood warning from the NWS, either directly or through the Police Department teletype, the Director of the Office of Emergency Preparedness will open the Emergency Operations Center (EOC).

a) All necessary EOC staff will be contacted, including the City Manager.
b) Contact by radio with local and state response agencies will be established.
c) Contact with NWS will be maintained.
d) EOC staff will implement tasks to be completed, including but not limited to:
   1) Monitoring river gages either manually or by phone,
   2) Mapping flood advancement,
   3) Coordinating response with various agencies, and
   4) Contacting affected businesses, residences, etc.

EWD – Emergency Alert System and Public Address

Task 3.B – Maintain contact with the National Weather Service, Emergency Broadcast System and other warning Systems

a) Contact will be established with the National Weather Service Emergency.
b) Contact will be established with the local station (KOKB AM 1520) and the Emergency Broadcast network in this area (WBBZ AM radio).
c) Warnings will be issued to affected areas after consultation of NWS and local officials using the local television cable override.
d) Businesses outside of the flood area will be contacted by telephone so that employees residing in the affected area can return home to prepare for imminent flooding.
e) In the event that telephone service is not available, police and fire personnel will deliver statements. Police and fire vehicles will alert the general citizens by driving up and down areas expected to flood, sounding sirens and utilizing the public address system as an alerting device.

Task 3.C – Open and operate evacuee reception center through cooperation with American Red Cross and the Oklahoma Department of Human Services

According to the Emergency Operations Plan for the Blackwell Office of Emergency Preparedness, all sheltering activities will be conducted in cooperation with the American Red Cross and the Oklahoma Department of Human Services.

a) Both agencies will be contacted by OEP.

b) Both agencies will be asked to send a representative to the EOC for consultation and to maintain contact with the agency throughout the flood emergency.

c) The OEP will provide information as accurately as possible so that appropriate shelters can be established to provide necessary service to all who need shelter, food, etc., and so that shelters will be established in locations which will not be affected by a continual rise in flood levels.

ORE – Resources Needed

SUMMARY OF NEEDED RESOURCES

The resources needed to carry out this Flood Emergency Action Plan are shown in Appendix G on Tables 1, 2, 3, 4, and 5 for Flood Conditions A, B, C, D, and Flash Flooding, respectively.

NOTE: *The table on page 47 is an example of the method Blackwell uses to identify resources needed to complete each flood response task. This example identifies the resources needed for Condition C or the 100-year flood event.*

STAFF AND VOLUNTEER ASSIGNMENTS

Emergency Preparedness Director

The Director of Emergency Preparedness (OEP) is responsible for the overall direction of the conduct of this flood emergency plan. Specifically, the director or designated alternate is responsible for:

1. Activating the warning and response plan, opening the EOC, and directing the conduct of those tasks appropriate to the situation.
2. Notifying the City Manager and members of the EOC staff (which includes department heads within the city) whenever the plan is activated and keeping them apprised of conditions.
3. The City Manager or his representative will be the authorizing authority to make such purchases or requisition of materials and supplies as are needed to carry out the emergency response tasks.
4. The City Manager or his representative will provide for access of information to the public through available media or other means.
5. Monitoring the implementation of this plan.

Police Department

The dispatcher on duty at the time of notification is given of activation of this plan will work with the Police Chief or designated alternate from the EOC who will

1. Serve in the Emergency Operations Center until relieved,
2. Direct that all department staff be put on standby and that all vehicles be fueled and serviced as needed,
3. Activate Mutual Aid with Sheriff's Office and other law enforcement agencies as needed, and

ORE - Flood Tasks

4. Ensure the implementation of tasks related to traffic control, coordination of evacuation activities, and providing security to evacuated areas.

Street Department

When notified of the activation of this plan, the Street/Park Superintendent shall

1. Designate a liaison to serve in the Emergency Operations Center until relieved.
2. Provide for staffing of the Public Works Department office on a 24-hour basis.
3. Ensure implementation of tasks related to providing flashers and barricades for designated intersections, provide sand for sandbagging as required, and provide transportation for equipment as needed.

Fire Department

When notified of the activation of this plan, the Fire Chief shall

1. Designate a liaison to serve in the Emergency Operations Center until relieved,
2. Direct all departmental staff to be put on standby and that all vehicles be fueled and serviced as needed, and
3. Activate Mutual Aid with area Fire Departments to ensure needed staff levels for the implementation of tasks related to providing door-to-door warning, conducting search and rescue operations and providing for care of casualties.

EWD – Door- to- Door

Pollution Control Plant

When notified of any flood watch or warning, the Plant supervisor will ensure that needed staff will be available for the implementation of Task 1.C.

American Red Cross and Oklahoma Department of Human Services

Pursuant to the Blackwell Emergency Operation Plan, the Chapter Manager of the American Red Cross and County Director of the Oklahoma Department of Human Resources will work together to provide shelter and emergency needs for any evacuees in the following manner:

1. Each agency will have a representative at the EOC.
2. The American Red Cross will provide the shelter and adequate staff to meet the immediate shelter needs of the evacuees.
3. The American Red Cross will provide food for evacuees.
4. The American Red Cross will provide a canteen for Emergency Response personnel involved in evacuations or rescues.
5. The American Red Cross and Department of Human Services will work together to operate a registration center for evacuees.
6. The American Red Cross and Department of Human Services will work together to provide for long-term needs of those whose houses are damaged in the flood.

KEY FACILITIES

Appendix 1 lists key facilities that have an important role in the conduct of flood emergency operations through implementing their own emergency plan, providing further warning to workers, or assisting in the conduct of the city's emergency response plan.

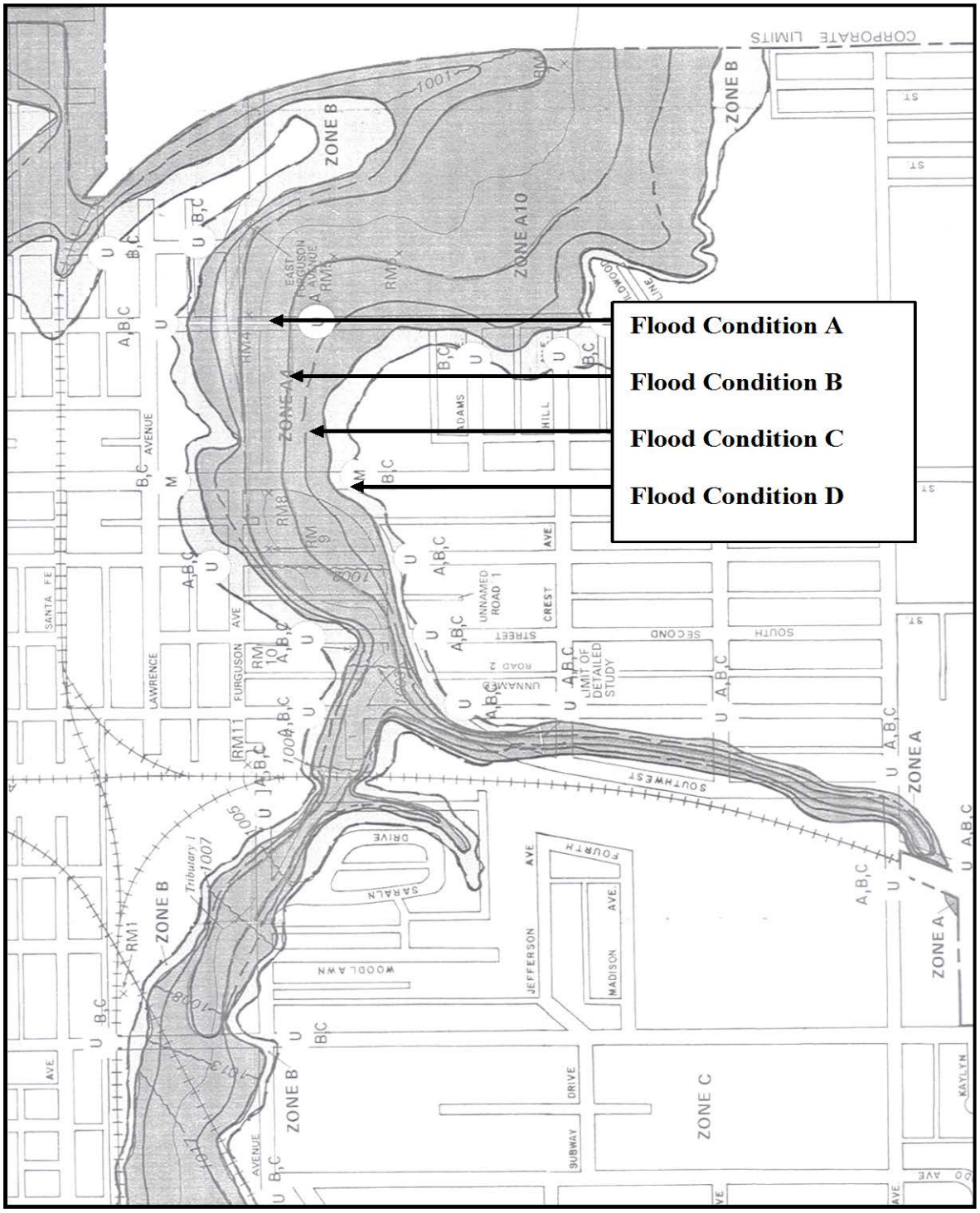
ALTERNATE SITES

In the case of a partial power failure, the Emergency Operations Center would be moved to the American Red Cross with the Blackwell Police Department as the second alternate. In the case of total power failure, operations would be coordinated by the use of automobile phones and radios.

FLOOD AWARENESS WEEK

The City of Blackwell sponsors a Flood Awareness month every year in March or April. The following activities are scheduled during that month:

1. A declaration of Flood Awareness by the Mayor and City Council.
2. A table top drill is scheduled by the Director of Emergency Preparedness that includes all City department heads, the Red Cross, the Blackwell Regional Hospital, Department of Human Services, KOKB radio station, and the *Blackwell Journal Tribune*.
3. Public information handouts are available at the Utility payment windows and the Blackwell Public Library in both English and Spanish that covers all related topics of flooding in Blackwell such as the Flood Hazard, Flood Warnings, Flood Safety, Flood Insurance, Property Protection, Floodplain Development Permits, Drainage System Maintenance, and Traffic Control in Flooded Areas.
4. The Director of Emergency Preparedness and the Community Rating System Coordinator update this plan and all related documents. All revisions of this plan shall be prepared within two weeks of the tabletop drill.



Flood Stages Shown on Flood Insurance Rate Map (only a portion of the map shown).

Blackwell, Oklahoma — Historical Crest Stage Information

Significant River Levels		STAGE	DATE	STAGE	DATE
Worst flood in recent memory outside the USGS period of record occurred on June 10, 1923. Based on a high-water mark at a different location. USGS determined a flood discharge of 100,000 CFS.		37.00	6/10/1923		
	35.0 ft				
November 1, 1998 - A total of 51 homes receive minor to major damage in Blackwell and 166 residents are evacuated from the city during the event.		34.40	11/1/1998		
		34.31	5/10/1993		
October 3, 1986 - Floodwaters reach a half-foot in depth in some homes on the north side of Blackwell. Local streets are closed.		34.28	10/3/1986		
	34.0 ft				
October 11, 1973 - Motorists are rescued from the intersection of Highway 177 and Highway 11. Ten city blocks in Blackwell are flooded.					
		33.85	10/11/1973		
		33.42	10/12/1985		
	33.0 ft	33.00	6/10/1995		
		32.90	5/28/1987	32.89	9/28/1987
		32.88	11/17/1996	32.56	7/2/1999
------ MAJOR FLOODING STAGE -------	**32.0 ft**	31.95	4/30/1995	31.88	9/26/1996
		31.67	8/4/1995	31.65	5/7/1987
	31.0 ft	30.90	3/17/1998	30.83	6/25/1999
		30.31	9/24/1997	30.27	4/15/1999
---- MODERATE FLOODING STAGE -------	**30.0 ft**	30.04	5/29/1995	29.90	6/19/1999
At 29 feet, city streets in the east and north sides of Blackwell begin to flood. Hubbard Road floods east of Blackwell.		29.80	6/5/1995	29.61	1/31/1999
		29.37	7/15/1993	29.36	11/26/1992
		29.29	7/17/1997		
---------- FLOOD STAGE ---------- **---------- MINOR FLOODING STAGE -------**	**29.0 ft**	28.91	10/15/1985	28.73	7/22/1997
---------- BANKFULL STAGE ----------	**28.0 ft**	27.66	10/5/1998		
		27.31	4/23/1944	27.30	6/27/1997
	27.0 ft	27.02	12/25/1997	26.16	2/22/1997
---------- ACTION STAGE ----------	**26.0 ft**	26.01	7/15/1951		

APPENDIX B

BLACKWELL LOCATIONS AFFECTED BY FLOODING

FLOOD CONDITION A - 10 YEAR FLOOD

142 Residents - identified by aerial photo

3 Businesses:
- Mike Price Ford - 210 West Doolin
- Wieland Service Center - 515 1/2 West Doolin
- Antique Store - 515 West Doolin
- Taco Mayo - 121 West Doolin

1 Church:
- The Tabernacle - 721 North 1st

FLOOD CONDITION B - 50 YEAR FLOOD

17 Residents - identified by aerial photo

16 Businesses:
- Williams Oil Company - 614 West Doolin
- Town & Country Market - 604 West Doolin
- Pizza Hut - 528 West Doolin
- Doolin Dip Car Wash - 520 West Doolin
- Kentucky Fried Chicken - 510 West Doolin
- Deihl's Package Store - 432 West Doolin
- Sonic Drive In - 430 West Doolin (old)
- T.G.& Y.- 320 West Doolin
- Tastee Freeze - 121 West Doolin
- Dairy Queen - 801 South Main
- Dollar General Store - 809 South Main
- Stauffacher Laundry - 819 South Main
- Nelsen Bristow Chiropractic Clinic - 123 Southwest Blvd
- Phyllis Realty - 828 South 1st
- Veterans of Foreign Wars - 1006 West Ferguson
- Weldex of Blackwell - 1220 West Ferguson

Locations
Page 2

FLOOD CONDITION C - 100 YEAR FLOOD

147 Residents - identified by aerial photo

6 Businesses:
- Rogers Oil Company - 725 North Main
- Rogers Service Station - 729 North Main
- Kerr - McGee Short Stop - 728 North Main
- Delk's Car Wash - 802 North Main
- Sonic Drive In - 420 North Main
- Tony's Car Wash - 723 South Main

Public Facilities:
- Oklahoma National Guard Armory

FLOOD CONDITION D- 500 YEAR FLOOD

262 Residents - identified by aerial photo

3 Businesses:
- D & W Dozer - 402 West Doolin
- Eagle Iron - 402 East Frisco

Public Facilities:
- Blackwell Pollution Control Plant - outside City limits
- Parkside Elementary School - 502 East College
- Northside School and Center - 720 West Doolin

FLASH FLOOD CONDITIONS

Public Facilities:
- Blackwell Regional Hospital
- Blackwell Red Cross

Blackwell's Flood Warning Plan includes tables to identify the resources needed for each flood response task identified in the plan. The table below identifies the resources needed for Condition C or the 100-year flood event.

TABLE 3

Blackwell, Oklahoma
Needed Resources for Flood Condition (Condition C)

Task	1.A	1.B	1.C	2	3.A	3.B	3.C
Personnel							
Police	4	2		4	1	as needed	
Fire	as needed		*	*	1	*	*
Public Works	4	2		4	1		
Pollution Control			4				
Red Cross/DHS					2	as needed	
Equipment							
Barricades/Flashers	65						
Sandbags*	available from local supply store						
Sand**	available from city supply						

Critical Facilities Planning (CFP)

This element credits warning and coordinating with critical facilities. The CRS defines four types of critical facilities.

- Those structures or facilities that produce, use, or store highly volatile, flammable, explosive, toxic, and/or water-reactive materials;

Some critical facilities need special consideration in flood warning plans.

- Hospitals, nursing homes, and housing likely to contain occupants who may not be sufficiently mobile or otherwise able to avoid death or injury during a flood;
- Police stations, fire stations, vehicle and equipment storage facilities, and emergency operations centers that are needed or contain equipment needed for flood response activities before, during, and after a flood; and
- Public and private utility facilities that are vital to maintaining or restoring services to flooded areas before, during, and after a flood.

The community should develop its own list of facilities that are critical to the flood response (e.g., emergency operating center, hospital, etc.) or that would cause special problems during a flood (e.g., wastewater treatment plant, chemical storage areas, etc.).

Prerequisites

There are three prerequisites for credit.

1. The community must receive credit for the flood threat recognition system and for disseminating a flood warning to the general public.
2. The community must update the information on the critical facilities at least annually.
3. Coordination with critical facilities must be included in the community's adopted flood response plan.

CRS Credit

There are three ways to obtain credit for Critical Facilities Planning (CFP).

1. **Maintain a list of critical facility locations and contacts.** CRS credit points are provided if the flood response plan includes the names and telephone numbers of the operators of critical facilities affected by flooding. The list must include the names of

either those people responsible for day-to-day operation of a facility or a contact person designated by the facility. Examples of the latter would be the facility's security office or emergency manager.

Communities must send a copy of this list to the ISO/CRS Specialist with their annual recertification. If the list is very long, one or two pages from the list will suffice. Recertifications are due October 1 of each year.

2. **Special notices and warnings.** Points are provided if the community has arrangements for providing special warnings or early notifications directly to the facilities that need them. Not all critical facilities will need an early warning, but coordination with them will identify those that do. Some may want as early a notice as possible in order to implement their own flood response plans. Others may need a direct call because they cannot be reached by the system that warns the general public or they need specific flood data provided by the flood threat recognition system. There is no credit if the community only notifies other city departments unless the community owns all of the critical facilities in the floodplain.

3. **Critical facility flood response plans.** CRS points are provided if the critical facilities that need them have their own flood response plans that have been developed or reviewed by the community. Many larger facilities have their own emergency plans. This credit is provided if the community has reviewed the plans so it can better coordinate the community's and the facilities' responses to flooding.

Credit Calculation

The initial score for the community's Critical Facilities Planning (CFP) is based on the sum of the credit received for maintaining a list of critical facility locations and contacts (CFP1), providing special notices and warnings to critical facilities (CFP2), and the percentage of critical facilities with flood response plans (CFP3). There is no impact adjustment for CFP1 or CFP2. To receive these credits, all critical facilities that are affected by flooding must be identified, contact names and numbers must be maintained, and appropriate warnings must be provided to the operators. Only CFP3 has an impact adjustment, which is discussed on page 55. In the *Coordinator's Manual*, the credit calculation is shown as the following formula:

cCFP = CFP1 + CFP2 + (CFP3 x rCFP), where

cCFP is the total credit for CFP,

CFP1 is the credit for maintaining the critical facility list, 10 points,

CFP2 is the credit for special notices and warnings, 20 points,

CFP3 is the credit for critical facility flood response plans, 20 points,

CFP is the points for CFP, which range from 10 to 50, and

rCFP is the impact adjustment ratio, which ranges from 0.25 to 1.0.

cCFP can range from 5 to 50.

CRITICAL FACILITIES

CFP – Critical Facilities Identified with Methods of Warning and Level of Flooding

Alternate Sites for EOC Operations – in the case of a partial power failure, the Operations Center would be moved to the American Red Cross or the Blackwell Police Department, depending upon the degree of power failure. In the case of total failure, the operations and warning would be coordinated using automobile mobile phones and radios.

City Mobilization Center – will be located at the City Warehouse on Lawrence and B Street.

Site-Specific Warnings – the only facility that is located in a flood zone that would not hear a siren warning is Eagle Iron, Inc. who would be notified by telephone or emergency vehicle.

Special Recipients – a calling list of specific recipients is maintained by the police department. The two nursing homes, Southwest Cupid Manufacturing Company, and the schools have direct connections to an alarm system in the Police Department that is activated to provide early or advance notice of flooding or other emergency situations. This system is voice- and bell-activated and has an emergency generator back up in case of power failure.

Other locations on the calling list would be notified by squad car in case of power failure. Currently there are some facilities that by nature of their location at the far west edge of the city limits near the I-35 intersection do not hear the siren. These facilities are on the calling list but are not affected in by flooding conditions as they are located quite some distance from the Chikaskia.

Pollution Control Plant – flood preparation alert begins when the Chikaskia River level reaches 27 feet. Water levels are monitored by a gage located on the side of the dike at the plant. The plant is manned 24 hours a day during flooding. Although flooding is not a threat to the plant itself until water nears the 500-year flood stage, flood operation response is necessary for effluent discharge when the Chikaskia floods.

NOTE: *Critical facilities located in the floodplain are identified in the list of residents, businesses, and public facilities affected by flooding. The buildings are grouped by the flood level that will affect the location. See pages 45–46. The city updates its list of facility contacts every year.*

Documentation

To confirm that a community's program meets the CRS credit criteria and to assist in calculating credit points, documentation must be submitted with the request for credit. For a community's first application for a CRS classification, the application form on page 41 of the *CRS Application* should be used. This form should be submitted along with the documentation described on the bottom of that page.

StormReady and TsunamiReady Programs (SCR)

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 jurisdictions by meeting the guidelines established by the National Weather Service in partnership with federal, state, and local emergency management professionals. More information on these programs can be found at http://www.nws.noaa.gov/stormready/ and http://www.stormready.noaa.gov/tsunamiready/.

Prerequisites

There are two prerequisites for this element.

1. The local government must receive credit for a flood threat recognition system operating within its jurisdiction.
2. The flood warning program must be able to forecast the arrival time and peak flow or elevation of floods.

Additionally, for TsunamiReady credit, the community must

3. Meet the mapping requirements described in CRS Credit for Management of Tsunami Hazards, sections 410TS and 430TS; and
4. Adopt a tsunami hazards operations plan or annex that addresses actions to take after a tsunami warning.

CRS credits for StormReady and TsunamiReady are not automatically granted to each local government that receives the StormReady or TsunamiReady designation from the National Weather Service. The CRS flood threat recognition requirements go beyond those of the StormReady and TsunamiReady programs. For example, the CRS requires a flood stage forecast on specific streams or areas. Warnings that only say "expect flooding in low areas along small streams" are not detailed enough to warrant CRS credit. These types of messages are not specific enough to encourage people to initiate property protection measures that reduce flood insurance claims.

In addition to identifying how the local government will receive the tsunami warning, the tsunami operations plan should

- Describe how the warning will be disseminated to the public;
- Identify evacuation routes and/or buildings to be used for vertical evacuation;
- Tell how critical facilities will be warned; and
- Tell how the "all clear" message will be disseminated.

CRS Credit

The StormReady and TsunamiReady programs have communications and educational requirements that go beyond the traditional CRS requirements. Therefore, CRS credit points are awarded to local governments that receive credit for flood threat recognition (FTR), are designated by the National Weather Service as StormReady or TsunamiReady communities, and meet the above prerequisites.

Twenty-five (25) points are provided for obtaining and maintaining the designation as a National Weather Service StormReady community and meeting the CRS prerequisites. A separate and additional 30 points are provided for obtaining and maintaining the designation as a National Weather Service TsunamiReady community and meeting the CRS prerequisites.

Credit Calculation

There is no impact adjustment for StormReady or TsunamiReady credit. A StormReady community receives 25 points, a TsunamiReady community receives 30 points, and a community in both programs receives 55 points.

Documentation

No additional documentation is required for the StormReady community credit. The ISO/CRS Specialist checks the community's status on the National Weather Service's website and the documentation for flood threat recognition (FTR) to confirm that the CRS prerequisites are met.

TsunamiReady communities provide a copy of their tsunami hazards operations plan.

Evaluation Report

It is important that problems be corrected if the flood warning program does not perform as anticipated. Therefore, if the community is flooded and the damage meets a certain threshold, it must prepare an evaluation report on how the system operated and what improvements may be needed.

The report is not required if there was no flood during the year. A report is needed only 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. For each flood meeting these criteria, this report must describe how the program operated in response to the flood, and any improvements that may be needed. The following format is recommended:

1. The cause or source 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 (i.e., evaluation of EWD);
4. Governmental and private response activities, such as evacuation or flood fighting (i.e., evaluation of ORE);
5. Impact of the flood on critical facilities (i.e., evaluation of CFP);
6. Description of deaths, injuries, property damage, and impact on public health and safety;
7. Examples of 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.

The report does not need to cover items 3 through 5 if the community is not receiving CRS credit for these elements. 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.

This report will generally not need to be longer than a few pages. If an “after action” report was done for other purposes, it will probably include most or all of the needed items. If it does not, the missing items may be included in a cover letter.

CRS Final Scoring

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 modifies the credit points to reflect how much of the community's developed areas are covered by its flood warning program. The impact adjustment is based on the number of buildings in the Special Flood Hazard Area (SFHA) that receive the flood warning.

Full Coverage

In some cases, a flood warning program is implemented throughout the community. Where a community implements a warning program that serves everyone in the SFHA, the impact adjustment variables for those elements are 1.0. A written statement that all buildings in the SFHA are covered by the program is sufficient documentation. However, this is only possible if the flood threat recognition system covers all of the floodplains that have buildings on them.

Partial Coverage

In some communities the flood warning program does not cover all of the floodplain areas. Local governments may not have the resources to develop flood threat recognition systems on small streams where there are few residents or in areas where the flooding is shallow.

If the community does not provide warning to all occupants in the SFHA, the CRS credit points must be adjusted to reflect the impact of the program. This is the "impact adjustment," which is done by multiplying the credit points for FTR, EWD and ORE by the percentage of the community covered. The impact adjustment ratio is based on the percentage of buildings in the SFHA that are covered. CFP3 is adjusted by the percentage of critical facilities with flood response plans.

For example, suppose a community has a large river and a coastal area shown on its FIRM. There are 100 buildings within the coastal SFHA and there are 20 buildings within the river's non-coastal SFHA. Buildings in the SFHA total 120. The community has a flood threat recognition system for coastal flooding, but not for flooding on the non-coastal reach of the river. Buildings covered by the flood threat recognition total 100. The percentage of buildings covered by FTR would be calculated as follows:

$$rFTR = \frac{bFTR}{bSF} = \frac{100}{120} = 0.83$$

For documentation, the local government should list each river or stream covered by the flood warning program and identify the number of buildings in the SFHA. The number of buildings in the SFHA must be the same number used in several other CRS activities. It is explained in more detail in Section 300 of the *Coordinator's Manual.*

To simplify the CRS application process, the impact adjustment is not included in the *CRS Application.* When the ISO/CRS Specialist conducts the verification visit, he or she will help determine the appropriate impact adjustment and will help with any needed calculations.

Documentation

Although much of the documentation for emergency warning and dissemination credit will be found in a community's multi-hazard plan or other comprehensive emergency response plan, 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 margin of the plan, and copies of only those pages should be submitted.

One way to help the reviewer find what is needed is to write a short narrative of the community's program. This report can include some of the specific statements needed for credit for the various elements and can reference portions of other documents as attachments.

For example, the narrative report could describe the equipment used for flood threat recognition in a few sentences and refer to a map attached from another document. The narrative report could also state that maintenance is performed at least annually. The narrative report can be used to document the impact adjustment ratios.

Many municipal warning systems or response plans are part of county emergency management programs. It must be noted that each community is responsible for ensuring that its submittal is complete. It is the applicant's responsibility to send in all documentation, including items handled by the county or another agency.

Verification Visit

During the verification visit, the ISO/CRS Specialist will ask the local government to complete a questionnaire that will help determine the documentation needed to ensure that the local warning program receives the appropriate credit

For More Information

In most cases, communities can receive assistance from their state emergency management agency or the National Weather Service in establishing warning programs and planning and conducting drills. Most districts of the U.S. Army Corps of Engineers have handbooks on flood emergency procedures and offer help in developing flood response plans. The Tennessee Valley Authority also has a program to assist communities.

The following four publications can be downloaded free from FEMA's website.

Guide for All-Hazard Emergency Operations Planning, State and Local Guide 101. 1996. http://www.fema.gov/pdf/plan/0-prelim.pdf.

Hazardous Weather Resource Guide, A Source Book For: Planning For Hazardous Weather and Flooding. FEMA and the National Oceanic and Atmospheric Administration, National Weather Service. 1996.

Effective Disaster Warnings. National Science and Technology Council, Committee on Environment and Natural Resources. 2000. http://www.fema.gov/news/newsrelease.fema?id=9985

Emergency Management Guide for Business and Industry. FEMA. 2002. http://www.fema.gov/library/biz1.shtm.

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).

Copies of the following two publications are available free on the National Oceanic and Atmospheric Administration's website.

Automated Local Flood Warning Systems Handbook, Weather Service Hydrology Handbook No. 2. National Oceanic and Atmospheric Administration, National Weather Service. 1997. http://www.weather.gov/oh/docs/alfws-handbook/.

StormReady Organization and Operations Manual. National Oceanic and Atmospheric Administration, National Weather Service. 2000. http://www.stormready.noaa.gov/resources/fy2001manual.pdf.

The following CRS publication provides more information on aspects related to flood warning. It is available free by using the order form in Appendix E of the *Coordinator's Manual*, or from

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

CRS Credit for Outreach Projects discusses the requirements for notifying residents of the warning system and flood safety.