FLOOD HAZARD MITIGATION PLAN
FOR
COLORADO

August 2007

Prepared Pursuant to
Disaster Mitigation Act 2000 & Section 409, PL 93-288

Prepared for
Colorado Water Conservation Board
Department of Natural Resources

In Cooperation with
The Department of Local Affairs
Division of Emergency Management

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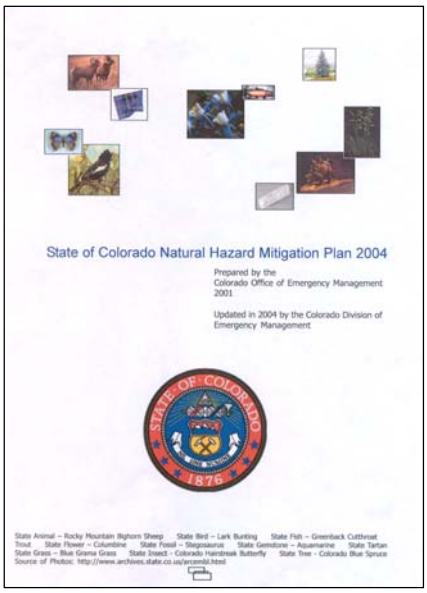
INTRODUCTION

The Disaster Mitigation Act of 2000 (P.L. 106-390) requires states to conduct mitigation planning for natural disasters that may affect the state. In 2000, a new Mitigation Planning section (§ 322) was added, which emphasized the need for state and local coordination on mitigation planning and implementation, as well as continuing the requirement for a state mitigation plan as a condition of federal disaster assistance. It requires the state's natural hazard mitigation plan to be updated every three years. The Interim Final Rule which implements these requirements was published by the Federal Emergency Management Agency (FEMA) on February 26, 2002. To date, a Final Rule has not yet been published; until it is, the Interim Rule is to be used for updates.



The State of Colorado adopted and received FEMA approval on its Natural Hazard Mitigation Plan (NHMP) in 2004.

The plan addressed several different natural hazards, including floods. Information for all natural hazards that impact the state was compiled in the Natural Hazard Mitigation Plan. Additional information on flood hazards was included as an Annex to the plan. This stand-alone document, The Flood Hazard Mitigation Plan for Colorado, describes in detail the process for flood planning in the state as well as long-term flood mitigation opportunities. Information on agency responsibilities and existing flood mitigation programs, local flood mitigation plans, and contacts for local government outreach and assistance are also included in the Flood Plan.

This report was developed in conformance with requirements of the FEMA Interim Rule, and is focused on updating the flood portions of the state's Natural Hazard Mitigation Plan. As such, it is built upon existing information contained in both the State of Colorado Natural Hazard Mitigation Plan 2004 and the Flood Hazard Mitigation Plan for Colorado (June 2004).

SECTION 1: PREREQUISITE

ADOPTION BY THE STATE

A. Formal Adoption by the State

With the submission of the 2007 State of Colorado Natural Hazards Mitigation Plan (NHMP), the NHMP is hereby approved and adopted by the State of Colorado-Department of Local Affairs, Office of the Governor. The Flood Hazard Mitigation Plan (Flood Plan) is incorporated as an annex to the Plan and is consequentially approved by the Office of the Governor. Adoption by the Office of the Governor empowers the Colorado Water Conservation Board (CWCB) and the Colorado Division of Emergency Management (DEM) to execute their responsibilities with respect to disaster preparedness, response, recovery, and mitigation.

B. Assurances of Continued Compliance with Federal Requirements

The State of Colorado assures it will comply with all applicable federal statutes and regulations in effect with respect to the periods for which it receives grant funding in compliance with 44 CFR Part 13.11(c). The State will amend the NHMP whenever necessary to reflect changes in state or federal laws and statutes, as required in 44 CFR Part 13.11(d). The adoption of this NHMP demonstrates the State of Colorado's commitment to fulfilling the mitigation objectives in the NHMP and authorizes the agencies identified in the NHMP to execute their responsibilities.

SECTION 2: PLANNING PROCESS

DOCUMENTATION OF PLANNING PROCESS

A. Description of Plan Preparation Process

The DEM took the lead on the 2007 update of the State of Colorado NHMP 2001 umbrella document. The original umbrella document was created in 2001 and was designed as a way to tie together various hazard-specific documents that had been developed over the previous years.

The Colorado Division of Emergency Management coordinated with other agencies on concurrent state planning and risk management efforts, including the extremely important natural hazard specific annexes to the state plan. The Colorado Water Conservation Board Flood Protection Section of the Department of Natural Resources hired a contractor to update the Flood Hazard Mitigation Plan, last updated during the 2003/4 process.

DEM mitigation and other agency staff reviewed drafts of updated annexes, state laws, executive orders, and regulations and identified state departments and offices that have some role or stake in natural hazard mitigation. Roles varied from owning property to doing construction to funding mitigation projects to providing technical assistance. Some agencies did not participate in 2004 based on limitations of use for this plan. Department representation on the State Hazard Mitigation Team is as follows:

- Department of Agriculture
- Department of Higher Education
- Department of Local Affairs
- Department of Natural Resources
- Department of Transportation
- Department of Personnel and Administration
- Department of Public Safety

Federal partners invited and willing to participate in the planning process either through meetings or electronic medium included USDA Farm Services Agency, FEMA, USDA Forest Service, National Weather Service, and U.S. Army Corps of Engineers. Local partners invited and willing to participate included the Colorado Emergency Managers' Association, Urban Drainage and Flood Control District, County Technical Services, Inc., and Rocky Mountain Insurance Information Association. Local emergency managers and state foresters participated through written and individualized methods. A complete list of participants is provided in Appendix I to the 2007 update to the NHMP.

Information and details of the responsibilities of individual departments and offices is provided in the section titled "State Assessment" of the 2007 update to the NHMP.

It was determined early on by DEM that multiple methods and medium were acceptable for input and comments and the process should not be limited to a few team meetings. Many meetings and contacts occurred early on to get specific projects and input started. A pre-planning meeting was conducted in Fall 2006 with key state representatives identified as

having major roles in the annexes update process. Colorado State Forest Service, Colorado Geological Survey, Colorado Division of Water Resources, Colorado Department of Higher Education, and Colorado Water Conservation Board were invited. Discussion included progress with annex updates, including this flood mitigation manual, and requirements for the umbrella document update in 2007. A pre-planning meeting also occurred with the Office of Risk Management (ORM) in Spring 2007 to review and determine possibilities for the state assets section. ORM provided DEM with their assets spreadsheet, as they did last time. The project was presented at the Flood Task Force meetings in early 2007. Presentations were given at the Governor's Conference on Emergency Management in early 2007 including the earthquake loss results, flood insurance, and community wildfire protection plan efforts. A presentation by the SHMO was given at the Local Emergency Managers' training in February 2007 to explain the plan update and invite their participation and input. Surveys and questionnaires were sent out to various parties soliciting input and ideas for the plan. Groups included local emergency managers, state foresters, and federal, state and local partners unable or too remote to attend meetings.

An email was sent to each representative outlining the purpose of this project. Each office received an invitation to attend the kickoff meeting. Several agencies were concerned with attending; however their participation was assured through emails and was encouraged to generate ideas for the plan update.

On May 24, 2007, CDEM convened a kick-off meeting with invited representatives (temporary State Hazard Mitigation Team). The purpose of the meeting was threefold. First, the agencies were provided a perspective concerning the current effort to revise Colorado's plan. Second, the agencies with information to share proceeded to give short presentations. Lastly, the participants were asked to provide input through "worksheets" that would be evaluated later by DEM. The first sheet asked participants to rank actions by priorities. Responses were received both at the meeting and through email. The second sheet asked for the participants to rank the probability for each hazard to occur with respect to a specific outcome. The third sheet asked the following questions: What mitigation programs does your agency administer? Please note why your program(s) is/are effective so we can cite this in the plan. What mitigation activities has your agency undertaken with respect to state property? What mitigation activities has your agency undertaken with respect to other property? Please list any new hazard-related legislation we should include in the plan update. The fourth sheet tried to get participants to ascertain how to define critical facilities by hazard. DEM asked participants to take that sheet back to their agency and

think about their assets at risk with respect to the particular hazards. Many that could not attend emailed their participation back to DEM.

The SHMT met one more time to review existing natural hazard data, identify agency roles and responsibilities, identify new sources of information, conduct risk assessments, prioritize goals, and identify potential actions. These meetings, along with the agenda items, are presented below.

Meeting 2: July 12, 2007

- Review and update the reported assets of each agency
- Review and update the risk assessment
- Identify strategies for protecting assets (existing and potential)

Participation Request 3: Early September, 2007

- Identify general and specific projects each agency is already doing with respect to protecting life and assets
- Identify general and specific projects each agency would like to do if funds were available
- Identify projects other agencies are doing (including local, state and federal government agencies)
- Update progress on mitigation projects already listed in the NHMP

During the plan preparation process, informal meetings were scheduled to identify federal requirements, discuss additional data needs and sources for the data, and to collect pertinent information. Typically, these meetings were conducted with representatives of the agencies that were included in the SHMT. With respect to the Flood Plan, a meeting was scheduled with the Governor's Flood Task Force on September 18, 2007 to present the results of the draft Flood Plan and obtain approval of the document.

The risk questionnaire was sent to all local emergency managers of the counties and cities with populations over 100,000 to fill out for their region. The mitigation specialist followed through, collecting them through email. The information was used to update the chapter/section on local information and to determine concerns by county/city/region for local emergency managers. Information from the local hazard mitigation plans was also used for the updates, risk assessments, strategies, and potential projects. Several local hazard

mitigation plans were completed between 2004 and 2006, giving the state more information for the state document update. A worksheet was developed and used by CDEM to review each local mitigation plan and can be found in Appendix B of the umbrella document.

Residents and interested parties could access the DEM web site to review the draft plan and provide comments through email.

In summary, preparation of the Flood Plan involved the following steps:

- Collection and review of the previous plan (NHMP 2004) including all appendices and annexes, with special attention focused on documents pertinent to the development of the Flood Plan. Documents that guided the development of the Flood Plan included: (a) Multi-Hazard Mitigation Planning Guidance, Part 1-Standard State Mitigation Plans (FEMA, November 2006); and (b) Standard State Hazard Mitigation Plan Review Crosswalk (FEMA, November 2006). The data collection effort involved information obtained from all levels of government (municipal, county, state, federal). In particular, local and regional pre-disaster mitigation plans were collected and reviewed along with updated planning information provided by the local and county governments.

- Comments from the FEMA review of the NHMP 2004 document were reviewed and scrutinized. Areas that were identified as being deficient were noted along with the specific information that would be necessary to address the comment.

- Based on the review of the existing plans, guidance documents, and review comments provided by FEMA, new requirements necessary for inclusion in the NHMP were identified, deficiencies in the NHMP 2004 document noted, and data needs/gaps earmarked.

- Coordination was conducted with several local, state and federal agencies along with representatives of the SHMT to collect data and information pertinent to the update of the NHMP.

- All pertinent data and information collected as part of the planning process was integrated to update the NHMP. To facilitate the ease of review, the presentation of the information in the NHMP and Flood Plan

followed the format and guidance provided by the Standard State Hazard Mitigation Plan Review Crosswalk (FEMA, November 2006).

B. Involvement in Planning Process

During the update to the NHMP and the Flood Plan, several individuals provided information and assistance to promote the development of the documents. These people, listed in Table 1, have performed invaluable service to the document, either by providing input and data, writing sections, performing analyses, or editing for content.

Table 1. Participants and Acknowledgments*

Name	Agency
Thuy Patton (CWCB Project Manager)	Colorado Water Conservation Board, Flood Protection Section
Brad Anderson (ACE Project Manager)	Anderson Consulting Engineers, Inc.
Marilyn Gally (State Hazard Mitigation Officer)	Colorado Department of Local Affairs, Division of Emergency Management
Rich Hansen (DEM Mitigation Planner)	Colorado Department of Local Affairs, Division of Emergency Management
Ken Crawford (Colorado Project Manager)	Federal Emergency Management Agency
Bonnie Heddin	Federal Emergency Management Agency
Laura Nay (County Plan Coordinator)	Department of Local Affairs
Jack Byers (Deputy State Engineer)	Colorado Department of Natural Resources, Division of Water Resources

***Local emergency managers also contributed to this document**

C. Agency Involvement in Plan Preparation Process

As stated previously, the SHMT reconvened in May 2007 as a means to provide input for the 2007 update to the NHMP. The agencies identified below are all represented on the SHMT. Their involvement in the update process is described in the meeting agenda and discussion presented in the previous section.

- Department of Agriculture
- Department of Higher Education
- Department of Local Affairs

- Department of Natural Resources
- Department of Transportation
- Department of Personnel and Administration Department of Public Safety

D. Description of Plan Review and Analysis

The process utilized to review and analyze the 2004 NHMP involved an assessment of the 2004 NHMP and information pertinent to the document along with an examination of state hazard mitigation goals and objectives. The review and analysis of the 2004 NHMP initially focused on three items: (a) comments provided by FEMA following their review of the 2004 NHMP; (b) guidance provided in the Multi-Hazard Mitigation Planning Guidance, Part 1-Standard State Mitigation Plans (FEMA, November 2006) and Standard State Hazard Mitigation Plan Review Crosswalk (FEMA, November 2006); and (c) information and data compiled and utilized during the development of the 2004 NHMP. This initial step promoted an evaluation of the existing plan with the federal requirements and identified deficiencies in the plan as well as sections where updated information was necessary.

As discussed previously, the SHMT was reconvened and several tasks were identified, assigned and completed. These tasks included the following:

- Review and update roles and responsibilities of each state agency with respect to hazard mitigation
- Review and update agency policies and programs, and determine effectiveness
- Review and update legislative information
- Review general goals and priorities
- Review and update reported assets of each agency
- Review and update risk assessment
- Identify strategies for protecting existing and potential assets
- Identify general and specific projects associated with each agency with respect to hazard mitigation (protection of life and assets)
- Identify general and specific projects that depend on future funding and funding availability
- Identify projects completed by other agencies (including local and federal government)

- Update progress on mitigation projects identified in the existing plan

This work effort was facilitated by the development of a working table that mirrors the requirements identified in the State Hazard Mitigation Plan Review Crosswalk (FEMA, November 2006). The working table included the following information:

- Section or element required by the review crosswalk
- Location(s) in the current plan where information on this section/element is provided
- Identification of new or updated information and data needs and documents where new or updated data and information can be found
- List of additional data requirements not included in the current plan
- Identification of agency to contract for additional data
- FEMA review comments (by section/element) of current plan

This working table was utilized as the basis for compiling the information required to update the current plan.

E. Indication of Section Revisions

The following table (Table 2) displays those sections of the 2004 NHMP that were revised as part of this 2007 review and update process. The information in Table 2 corresponds to the required elements identified in the State Hazard Mitigation Plan Review Crosswalk (FEMA, November 2006).

COORDINATION AMONG AGENCIES

A. Involvement of Federal and State Agencies

Federal and state agencies were integrally involved in the development of the information provided in the update to the NHMP. The agencies are identified in the previous sections with specific contacts identified in Table 1. Both federal and state agencies were represented on the SHMT and participated in meetings previously listed. As indicated, these meetings served as a means to identify federal requirements, assign roles and responsibilities to obtain pertinent information, provide for the exchange or transmission

of the information, and specifically provide insight and data pertinent to the risk assessment and mitigation strategies. In addition, the SHMT provided a mechanism for federal and state agencies to review the draft plan and provide comments that were incorporated into the final document.

Table 2. Revisions to the 2004 NHMP	
Plan Element	**Section Updated/Revised?**
Prerequisite	
Adoption by the State	No
Planning Process	
Documentation of the Planning Process	Yes
Coordination Among Agencies	Yes
Risk Assessment	
Identifying Hazards	Yes
Profiling Hazards	Yes
Assessing Vulnerability by Jurisdiction	Yes
Assessing Vulnerability of State Facilities	Yes
Estimating Potential Losses by Jurisdiction	Yes
Estimating Potential Losses of State Facilities	Yes
Mitigation Strategy	
Hazard Mitigation Goals	Yes
State Capability Assessment	Yes
Local Capability Assessment	Yes
Mitigation Actions	Yes
Funding Sources	Yes
Coordination of Local Mitigation Planning	
Local Funding and Technical Assistance	Yes
Local Plan Integration	Yes
Prioritizing Local Assistance	Yes
Plan Maintenance Process	
Monitoring, Evaluating, and Updating the Plan	Yes
Monitoring Progress of Mitigation Activities	Yes

B. Involvement of Interested Groups

DEM has engaged several interested groups in the mitigation planning activities associated with the update to this flood annex as well as the NHMP umbrella document. These groups include the Colorado Emergency Manager's Association; Urban Drainage and Flood Control District; County Technical Services, Inc.; Rocky Mountain Insurance Information Association, and Colorado Association of Stormwater and Floodplain Managers. A complete list of participants in the mitigation planning activities associated with the update to the NHMP umbrella document is Appendix I of that document.

The mechanism for providing comments to the draft plan, including notification to all groups and the general public was presented in the previous section of this document ("Description of Planning Process").

C. Changes in Coordination

Recognizing the important aspect of the insurance industry in this business and that most of our disaster recovery is handled through the insurance and risk-sharing industry in Colorado, DEM has increasingly requested more participation and involvement from those entities.

PROGRAM INTEGRATION

A. Integration of Mitigation Planning with other State Planning Efforts

Mitigation planning has been closely integrated with the planning efforts related to the following programs:

- Flood Management Assistance (FMA) Program,
- Pre-Disaster Mitigation Program
- Flood Map Modernization Program

In addition, the CWCB recently completed and approved the "State of Colorado Floodplain and Stormwater Criteria Manual". This planning document provides guidance to local communities on issues related to flood and stormwater management within the state.

B. Integration of Mitigation Planning with FEMA Mitigation Programs and Initiatives

Mitigation planning associated with this document has strived to include the integration of other FEMA mitigation programs and initiatives. Specifically, the goals of the NFIP Repetitive Loss Program have been integrated into the evaluation of mitigation projects identified through this planning process. Repetitive loss properties will be included as a criteria during the evaluation process. Furthermore, a discussion of repetitive loss

properties is included in this document with specific information provided on the number of repetitive loss properties in Colorado on a county-by-county basis. Through the integration of this information into the planning activities, the capability of Colorado to be selected for the nationally competitive grant programs should be increased.

SECTION 3: RISK ASSESSMENT

IDENTIFYING FLOOD HAZARDS

A. Description of Flood Hazards Affecting State

The natural hazards affecting the state are described in detail in the NHMP 2001 umbrella document. This document focuses on a summary of the flood hazards that affect the State of Colorado.

A flood is a general and temporary condition of partial or complete inundation of normally dry land areas from: (1) the overflow of stream banks, (2) the unusual and rapid accumulation of runoff of surface waters from any source, or (3) mudflows or the sudden collapse of shoreline land. Flooding results when the flow of water is greater than the normal carrying capacity of the stream channel. Rate of rise, magnitude (or peak discharge), duration, and frequency of floods are a function of specific physiographic characteristics. Generally, the rise in water surface elevation is quite rapid on small (and steep gradient) streams and slow in large (and flat sloped) streams. The causes of floods relate directly to the accumulation of water from precipitation, rapid snowmelt, or the failure of manmade structures, such as dams or levees. Floods caused by precipitation are further classified as coming from:

- **Rain in a general storm system**
- **Rain in a localized intense thunderstorm**
- **Melting snow**
- **Rain on melting snow**
- **Ice jams**

Each of these causes results in floods that have distinct characteristics relative to flow rate, rate of rise, volume, duration, and flood season.

General Rain Floods

General rain floods can result from moderate to heavy rainfall occurring over a wide geographic area lasting several days. They are characterized by a slow steady rise in stream stage and a peak flood of long duration. As various minor streams empty into larger and larger channels, the peak discharge on the mainstream channel may progress upstream or downstream (or remain stationary) over a considerable length of river. General rain floods can result in considerably large volumes of water. The general rain flood season is historically from the beginning of May through October. Because the rate of rise is slow and the time available for warning is great, few lives are usually lost, but millions of dollars in valuable public and private property are at risk.

Thunderstorm Floods

Damaging thunderstorm floods are caused by intense rain over basins of relatively small area. They are characterized by a sudden rise in stream level, short duration, and a relatively small volume of runoff. Because there is little or no warning time, the term "flash flood" is often used to describe thunderstorm floods. The average number of thunderstorm days per year in Colorado varies from less than 40 near the western boundary to over 70 in the mountains along the Front Range. The thunderstorm flood season in Colorado is from the middle of July through October.

Snowmelt Floods

Snowmelt floods result from the melting of the winter snowpack in the high mountain areas. Snowmelt floods typically begin as spring runoff appears, after the first spring warming trend. If the trend continues up to 8 to 10 consecutive days in a basin where the snowpack has a water content more than about 150% of average, serious flooding can develop. The total duration of snowmelt floods is usually over a period of weeks rather than days. They yield a larger total volume in comparison to other types of floods in Colorado. Peak flows, however, are generally not as high as flows for the other types. A single cold day or cold front can interrupt a melting cycle causing the rising water to decline and stabilize until the cycle can begin again. Once snowmelt floods have peaked, the daily decreases are moderate, but fairly constant. Snowmelt flooding usually occurs in May, June, and early July.

Rain on Snowmelt Floods

Rain on snow flooding occurs most often in Colorado during the month of May. It is at this time of year that large general rainstorms occur over western Colorado. These rainstorms are most often caused when warm moist air from the Gulf of Mexico begins pushing far enough north that it begins to affect western weather. In combination with

this movement of air mass is the continued possibility of cold fronts moving into Colorado from the Pacific Northwest. When these weather phenomena collide, long lasting general rainstorms can often occur. Rain on snowmelt exacerbates an already tenuous situation as snowmelt waters rush down heavily incised stream channels. Any abnormal increase in flow from other sources usually causes streams to leave their banks.

During the summer months of May and June when rivers are running high, there is a potential for flooding due to rain falling on melting snow. Usually such rain is over a small part of a basin, and the resulting flood is of short duration and may often go unnoticed in the lower reaches of a large drainage basin. To some extent, the cloud cover associated with the rain system can slow the melting cycle and offset the compound effect. In some cases, however, rainfall may be heavy and widespread enough to noticeably affect peak flows throughout the basin.

Ice Jam Floods

Ice jam floods can occur by two phenomena. In the mountain floodplains during extended cold periods of 20 to 40 degrees below zero, the streams ice over. The channels are frozen solid and overbank flow occurs, which results in ice inundation in the floodplains. Ice jam floods can occur when frozen water in the upper reaches of a stream abruptly begins to melt due to warm Chinook winds. Blocks of ice floating downstream can become lodged at constrictions and form a jam. The jam can force water to be diverted from the stream channel causing a flood. An ice jam can also break up, suddenly causing a surge of water as the "reservoir" that was formed behind it is suddenly released. Ice jamming occurs in slow moving streams where prolonged periods of cold weather are experienced. Sometimes the ice jams are dynamited, allowing a controlled release of the backed up water to flow downstream.

Dam Failure Floods

Dam failure floods are primarily a result of hydrologic or structural deficiencies. The operation of a reservoir can also influence the safety of the structure. Dam failure by hydrologic deficiency is a result of inadequate spillway capacity, which can cause a dam to be overtopped during large flows into the reservoir. Dam failure by hydrologic deficiency occurs from excessive runoff after unusually heavy precipitation in the basin. Large waves generated from landslides into a reservoir, or the sudden inflow from upstream dam failures, are other causes of dam failure by overtopping. Overtopping is especially dangerous for an earth dam because the down-rush of water over the crest will erode the dam face and, if continued long enough, will beach the dam embankment and release all the stored water suddenly in to the downstream floodplain.

Examples of structural deficiencies include seepage through the embankment, piping along internal conduits, erosion, cracking sliding, overturning, rodent tunneling, or other weakness in the structure. Old age is often at the root of structural deficiencies. Seismic activity in Colorado has recently been recognized as a potential source of structural problems due to liquefaction of sand layers in the embankment of a dam.

The mechanics of a structural failure depends on the type of dam and the mode of failure. Dam failure floods due to structural deficiencies are characterized by a sudden rise in stream level and relatively short duration similar to a thunderstorm flood. They can occur at any time, but earthen dams appear to be most susceptible to structural failure during the fall and spring freezing and thawing cycles.

PROFILING FLOOD HAZARDS

The relationship between flood hazards and population identifies patterns of risk. Such relationships are not new to Colorado. Flooding has occurred here long before people settled in high-risk areas. Risk grows from the increasingly close association between natural phenomena and a growing population.

People become vulnerable to hazards when they choose (knowingly or unknowingly) to live near the areas where these extreme events occur. Vulnerability is also related to preparedness. People who prepare for the occurrence of an extreme event are less vulnerable to it than those who do not. The vulnerability of Colorado's population is rooted in a relationship between the occurrences of extreme events, the proximity of people to these occurrences, and the degree to which these people are prepared to cope with these extremes of nature.

Presently, flood prone areas have been identified in 268 cities and towns and in all of the 64 counties in Colorado. Using information supplied from local units of government, there are estimated to be approximately 250,000 people now living in Colorado's floodplains. The CWCB estimates that approximately 65,000 homes and 15,000 commercial and industrial business structures are located in Colorado's floodplains. Designation of floodplains in Colorado for floodplain management activities is related to the 100-year flood event. Cumulative flood losses from the turn of the century to 2006 from the state's most damaging floods are over $5.5 billion (2007 dollars).

A. Location of Flood Hazards in Colorado

Colorado has a long history of tragic flooding events. As mentioned previously, flood prone areas have been identified in 268 cities and towns and in all of the 64 counties in Colorado. The earliest known floods are reported to have occurred in 1826 in the Arkansas River and Republican River basins. Between 20 and 30 large magnitude floods (in terms of peak discharge) occur somewhere in Colorado every year.

The most notable flood events in Colorado from 1864 to 2006 are presented in Table 3. As indicated in the table, the greatest loss of life occurred during the Big Thompson flood event of 1976. The most damaging flood in Colorado occurred in June 1965 on the South Platte River when almost $2.6 billion in damages (2007 dollars) was sustained in the Denver metro area.

Table 3. Notable Flood Events In Colorado: 1864-2006

Year	Location	Deaths	Damages (2007 $ Millions)
1864	Cherry Creek (Denver)	0	7
1896	Bear Creek (Morrison)	27	8
1911	San Juan River (by Pagosa Springs)	2	7
1912	Cherry Creek (Denver)	2	156
1921	Arkansas River (Pueblo)	78	988
1935	Monument Creek (Col. Springs)	18	68
1935	Kiowa Creek near Kiowa	9	20
1942	South Platte River Basin	?	10.8
1955	Purgatorie River (Trinidad)	2	47
1957	Western Colorado	0	23
1965	South Platte River (Denver)	8	2,600
1965	Arkansas River Basin	16	267
1969	South Platte River Basin	0	28
1970	Southwest Colorado	0	17
1973	South Platte River (Denver)	10	505
1976	Big Thompson River (Larimer)	144	110
1982	Fall River (Estes Park)	3	64
1983	North Central Counties	10	34
1984	West & Northwest Counties	2	61
1993	Western Slope	0	2.7
1995	Western Slope & South Platte	21	68
1997	Fort Collins & 13 East Counties	6	220
1999	Col. Springs, 12 East Counties	0	130
2000-6	Statewide Various Events	5	111
Totals		**363**	**5.5 billion**

Source: Colorado Flood Hazard Mitigation Plan 2007

Table 4 presents a summary of the damage in Colorado due to floods. The period reflected in the table extends from January 1, 1978 through July 19, 2007. The information presented in Table 4 reflects the geographic distribution of flooding within the state.

Table 4. Summary Of Damage Losses and Payments from NFIP due to Floods in Colorado: 1/1/1978-07/19/2007

Community	Losses	Payments	Community	Losses	Payments	Community	Losses	Payments
Adams Co*	20	38,541	Estes Park	35	660,606	Mineral Co.*	1	268
Alamosa Co.*	3	1,215	Federal Heights	2	12,773	Minturn, Town of	1	6,035
Alamosa, City of	14	9,226	Florence	3	17,366	Montezuma Co.*	1	0
Arapahoe Co.*	11	19,929	Fort Collins	41	351,915	Montrose Co.*	1	21,759
Archuleta Co.*	4	1,863	Fort Morgan	1	0	Montrose, City of	2	681
Arvada	48	38,288	Fountain	12	655	Morgan Co.*	5	22,112
Aspen	9	168,271	Frederick	5	10,349	Morrison	2	1,232
Aurora	34	1,010	Fremont Co.*	7	22,040	Northglenn	2	2,785
Basalt	1	3,816	Frisco	5	921	Otero Co.*	85	1,194,844
Bent Co.*	2	2,689	Garfield Co.*	8	5,728	Ouray, City of	6	33,045
Black Hawk	4	8,332	Georgetown	7	11,886	Paonia	9	51,261
Boone	2	26,147	Gilpin Co.*	3	1,432	Park County	1	343
Boulder Co.*	54	122,136	Glenwood Spgs.	9	26,591	Pierce	1	312
Boulder, City of	82	147,603	Golden	13	5,694	Pitkin Co.*	13	36,019
Breckenridge	2	28,060	Grand Junction	6	6,125	Prowers Co.*	7	2,783
Brighton	3	3,292	Greeley	6	63,895	Pueblo Co.*	23	67,945
Broomfield	8	416	Green Mtn Falls	4	0	Pueblo, City of	47	34,634
Brush	18	3,261	Greenwood Vill.	12	21,142	Rangely	5	2,693
Buena Vista	2	1,007	Gunnison Co.*	27	126,836	Rifle	6	44,686
Calhan	1	0	Gunnison, City of	3	6,331	Rio Blanco Co.*	3	21,259
Canon City	42	54,369	Gypsum	1	0	Rio Grande Co.*	3	1,305
Central City	1	0	Hayden	2	1,236	Rocky Ford	8	25,803
Chaffee Co.*	2	0	Hinsdale Co.*	1	0	Routt Co.*	3	49,996
Clear Creek Co.*	8	14,595	Holyoke	1	2,,244	Salida	1	1,310
Collbran	3	0	Hotchkiss	1	1,566	San Miguel Co.*	2	23,037
Colorado Springs	172	276,645	Huefano Co.*	1	769	Silver Plume	2	1,460
Cortez	1	2,487	Idaho Springs	3	369	Silverton	1	1,144
Crested Butte	2	197	Jamestown	4	696	Steamboat Sprgs	14	4,749
Del Norte	2	1,346	Jefferson Co.*	74	176,959	Sterling	34	67,815
Delta Co.*	7	34,247	La Junta	28	457,113	Summit Co.*	11	8,623
Delta, City of	2	5,223	La Plata Co.*	22	425,103	Teller Co.*	4	680
Denver, City/Co.	120	404,400	Lakewood	110	369,724	Telluride	4	0
Dolores Co.*	1	270	Lamar	12	6,746	Thornton	6	7,453
Dolores, Town of	1	0	Larimer Co.*	95	552,394	Trinidad	3	10,992
Douglas Co.*	7	52,530	Limon	5	4,362	Vail	10	98,980
Durango	5	31,827	Littleton	19	16,465	Walsenburg	4	1,116
Eagle Co.*	11	18,860	Logan Co.*	18	131,814	Weld Co.*	26	61,684
Eaton	1	0	Longmont	9	2,260	Wellington	7	4,209
Edgewater	23	51,637	Loveland	7	12,909	Westminster	31	253,793
El Paso Co.*	86	236,645	Lyons	10	6,793	Wheat Ridge	34	82,659
Englewood	5	78	Manitou Springs	23	85,096	Wiley	1	6,705
Erie	2	986	Mesa Co.*	30	246,486	Winter Park	1	5,960
						Woodland Park	2	1,749
* Unincorporated areas.						Total	1,959	7,930,782
Source: FEMA, Community Information System 2007								

B. Information on Previous Floods

In addition to the information presented in Tables 3 and 4, the information summarized below documents historic flooding in Colorado due to the types of flooding previously discussed.

General Rain Floods

The October 5, 1911 floods in Pagosa Springs and Durango were a result of a general rain system over tributaries of the San Juan River Basin in southwestern Colorado.

This flood event resulted in two deaths and damages of approximately $7.4 million (2007 dollars). The damaging floods of June 1965 in the Denver metro area were a result of heavy to torrential rainfall over large portions of the South Platte River Basin that lasted several days.

Thunderstorm Floods

The widely publicized Big Thompson Canyon flood disaster of July 31, 1976 was a result of an intense thunderstorm cell that dropped up to 10 inches of rain in a few hours over the basin.

On May 15 and 16, 1993, a thunderstorm-induced flood event occurred at Rifle on Rifle and Government Creeks. As is usually the case, the highest flows in the shortest period of time occurred when an estimated 125-year flood discharge impacted Rifle. Structures and vehicles in harm's way suffered damages in excess of $200,000.

On June 17, 1993, a flash flood occurred on Shooks Run in Colorado Springs. Damages were confined to a mobile home park on the creek's edge with losses estimated at $1 million.

In July 1993, the Town of Otis and the unincorporated area of Cope in Washington County and the City of Yuma in Yuma County experienced a weekend flood event as a result of three consecutive days of thunderstorms. Several homes suffered damages and roadways were inundated with loss in excess of $650,000. In Otis, a flood control and storm drainage project protected the northern half of town.

On August 10, 1993 flash floods occurred on several creeks in Delta County. Two roads were washed out and a flood fight was conducted with sandbags on Robideaux Creek near the Department of Corrections Detention Facility.

On August 26 to 29, 1993 general rainstorms caused flooding in Archuleta and La Plata counties. A subdivision in Archuleta County was threatened and roads damaged as the Rio Blanco overflowed its banks south of Pagosa Springs. In Durango, the Fire Department had their emergency operations plan in effect and came very close to evacuating residents of a mobile home park on the Animas River.

In the spring and early summer of 1995, the lower South Platte River, the lower Arkansas River and the Roaring Fork River were impacted by significant flooding. Most damages were experienced by agricultural landowners.

On July 24 to 28, 1997, the City of Fort Collins and most of eastern Colorado received soaking and/or drenching rains, adding to soil moisture in some locations. As the cold front arrived in the late afternoon of July 27, strong thunderstorms developed just north and west of Fort Collins. Later that night, steady rains developed along the eastern base of the foothills in Larimer County and continued until about noon on July 28. Several inches of new rain were reported just west and northwest of Fort Collins totally saturating the ground, producing major flooding in Laporte, and setting the stage for the evening flood event. On the evening of July 28, 1997, intense rains began around 6:30 p.m. in the foothills west of Fort Collins. Winds from the east and southeast continued to pump moisture into the storm system throughout the evening. The core of the storm was very small but remained nearly stationary over the headwaters of Spring Creek, the Fairbrooke Channel, Clearview Channel, the CSU Drainage Basin, and the West Vine Drainage Basin. Rainfall intensity increased and reached a maximum between 8:30 p.m. and 10:00 p.m. before ending abruptly. A subsequent analysis of rainfall conducted by CSU showed a maximum of 10.2 inches of rainfall in less than five hours near the intersection of Drake Road and Overland Trail.

On July 29, 1997, slow-moving thunderstorms dumped large amounts of rainfall over the Pawnee Creek Basin in Weld and Logan counties and over the Schaefer Draw Basin in Morgan County north of Weldona. Floodwaters from Schaefer Draw entered the unincorporated Town of Weldona on the evening of July 29 while similar damaging floodwaters from Pawnee Creek entered the unincorporated Town of Atwood early on July 30 (west of Sterling and north of U.S. Hwy 6). Additionally, floodwaters flowing east from Atwood entered the City of Sterling.

During the Presidential Declaration incident period (July 28 to August 12, 1997) storm systems drenched other areas in northeastern Colorado, as well as several counties in southeastern Colorado. In addition, the Denver metro area received flooding rains as did the Clear Creek County area to the west of Denver.

A three-day rainfall event occurred on April 29 to May 1, 1999. Heavy rain and saturated soil caused flooding in two major areas along the Front Range; specifically in Northeastern Colorado along the South Platte River and some of its tributaries; and Southeastern Colorado along the Arkansas River and some of its tributaries. Rainfall totals of up to 13 inches were recorded in the Cheyenne Mountain region of Colorado Springs. The La Junta region recorded approximately 8 inches over the same three-day period. The Arkansas River broke the dikes near North La Junta, flooding approximately 200 residences and businesses. The stormwater runoff from the three-day general rain resulted in large flood inundation and erosion in the Arkansas River and Fountain Creek watersheds.

These rainfall totals are large, but not extreme in comparison to the largest storms experienced in Colorado. What made this storm so different was that most of the affected basins were receiving heavy rainfall throughout the basin. This is not the "norm" for Colorado. Also, rain on snow is generally not a great problem in Colorado, but sizeable areas of the Front Range foothills did receive heavy rain on top of several inches of saturated snowpack. The melt rate of this snowpack was low, but additional water was added to the runoff.

The flooding that occurred along Fountain Creek and the Arkansas River was significant and will likely be considered the worst flooding event since 1965. In total, the storm affected Bent, Crowley, Custer, Elbert, El Paso, Fremont, Kiowa, Larimer, Las Animas, Otero, Pueblo, and Weld Counties. These counties sustained damage to roads, bridges, culverts, homes, and business from overtopping, dike breaches, erosion, mudslides, and rockslides.

Snowmelt Floods

Floods in June 1983, along the Cache la Poudre River in Fort Collins and Greeley, along Clear Creek and its tributaries in Silver Plume and Georgetown, and along the Arkansas River in Fremont and Chaffee counties were principally due to melting snow. The 1984 floods on the western slope were primarily snowmelt flooding.

Rain on Snowmelt Floods

Flooding along the Colorado River in Grand Junction in July 1884, along Clear Creek at Georgetown in June 1965, and along the Gunnison and Colorado Rivers at Grand Junction in June 1983, are examples of flooding from rain on melting snow. The effect of rain on melting snow in the Colorado River Basin in 1983 was felt as far downstream as Mexico. In 1984, rain or melting snow caused severe flooding conditions at Paonia.

On May 28, 1993, rain on snowmelt flooding occurred at Paonia on the North Fork of the Gunnison River. The rainfall occurred over a five-hour period during the evening. This caused the North Fork of the Gunnison River to reach its highest level since the 1984 flood season. Many miles of agriculture land experienced severe bank erosion in unincorporated Delta County.

Ice Jam Floods

In 1955, 1962, and 1983, flooding in Rangely resulted from ice jams. In addition, flooding in Meeker in 1973 and in Gunnison in 1980 resulted from ice jams.

Dam Failure Floods

Although few lives have been lost from dam failures, property damage has been high. There have been at least 130 known dam failures and incidents in Colorado since 1890. The failure of the Lower Latham Reservoir Dam in 1973 and subsequent flooding in the Town of Kersey, Weld County, Colorado, resulted in a Presidential Major Disaster Declaration.

The earliest recorded dam failure flood in the Estes Park region occurred on May 25, 1951, when Lilly Lake Dam failed, sending flood waters down Fish Creek and into Lake Estes.

In June 1965, a flood occurred on Clay Creek in Prowers County, which overtopped an earthen dam being constructed by the Colorado Game, Fish, and Parks Commission. Although the dam did not fail, it did divert floodwater into an adjacent drainage. The subsequent damage and death from this flood resulted in an important legal controversy known as the Barr Case. This case was finally decided in 1972 by the Colorado Supreme Court, which recognized the concept of probable maximum flood as a predictable and foreseeable standard for spillway design purposes.

The Lawn Lake Disaster of 1982 resulted from the failure of a privately owned dam on Forest Service property, and $31 million of damage was sustained in Larimer County and Estes Park. A lawsuit awarded $480,000 to one of the four persons killed in the disaster.

The most unusual flood from the failure of a manmade structure in Colorado is probably the complete draining of Lake Emma, a natural lake located high in the San Juan Mountains above Silverton, Colorado. On June 4, 1979, floodwater flowed through a network of tunnels in an abandoned mine that extended under the lake.

The Carl Smith Reservoir failed on the evening of May 2, 1998. Carl Smith Dam is an 850 acre-foot, Class 1 off-channel reservoir in Leroux Creek Basin north of Hotchkiss, Colorado. The failure was a result of a large slide on the downstream slope that extended across the crest and into the upstream slope. The releasing water swiftly eroded down through the top half of the remaining embankment and quickly released about 500 acre-feet of storage. The peak discharge just below the dam was determined to be around 3,300 cfs. Several residences were evacuated. The only loss of life was livestock. The high water washed out numerous bridges, and diversion structures were quickly rebuilt to restore water to irrigators.

C. Probability of Future Floods

Flooding will continue to occur in Colorado. As mentioned previously, between 20 and 30 large magnitude floods (in terms of peak discharge) occur somewhere in Colorado every year. Furthermore, between 1965 and 1999, Colorado experienced nine major flood disasters as indicated below:

- 1965: 33 Front Range communities
- 1969: 15 Front Range communities
- 1970: Southwestern Colorado
- 1973: 13 Front Range communities
- 1976: 2 Front Range communities
- 1982: Larimer County (dam failure)
- 1984: 15 Western Slope counties
- 1997: 13 Eastern Colorado counties
- 1999: 12 counties

In the 2004 update to the NHMP 2001 umbrella document, the probability of future flooding was represented by Q3 Flood Data Product which is a digital representation of certain features in the FEMA Flood Insurance Rate Map that can be used in spatial evaluations. At that time, flood data were only available for nine counties: Adams, Arapahoe, Boulder, Denver, El Paso, Jefferson, Larimer, Morgan and Pueblo. The flood hazard indicators were categorized using FEMA's flood zone designations. Zones A and AE represented areas that were in a 100-year floodplain or have a 1% chance of flooding. Zone X500 represented areas that were in a 500-year floodplain or have a 0.2% chance of

flooding. The Q3 flood data was merged into a single comprehensive data layer that provides shapefiles of both the 100- and 500-year flood hazard zones. Although only 9 of 64 counties were represented in the existing Q3 layer, these nine counties represented those with the largest populations that are most likely to be impacted by floods.

Presently, the information provided by the Q3 Flood Data Product is being supplemented by the data provided through FEMA's national Multi-hazard Map Modernization Program. Upon FEMA request, the CWCB prepared an implementation plan for the Map Modernization of Colorado communities. One of the objectives of this program is to compile digital data into a statewide base map database for use as a scoping and assessment tool, and to facilitate flood hazard mapping activities. Most of the 64 counties in Colorado have been identified for flood hazard mapping activities in the Colorado Flood Map Modernization Business Case Plan-Final Draft, Fiscal Years 2004-2008. To date, flood hazard mapping activities have been completed and effective mapping produced for the following counties: Denver, Jefferson, Adams, Douglas, Broomfield, Routt, Pitkin, and Clear Creek. Preliminary mapping has been produced for Arapahoe, Boulder, Larimer, Weld, Eagle, and Grand counties. Flood hazard mapping activities are presently on-going in Pueblo, Mesa, Fremont, Garfield, La Plata, Montezuma, Teller, and Archuleta counties. The present status of the Map Modernization Program in Colorado is depicted in Table 5.

ASSESSING VULNERABILITY BY JURISDICTION

A. Vulnerability Based on Local and State Risk Assessments

The 2004 update to the NHMP 2001 umbrella document contains information on the risk evaluation that was conducted in 2003 and 2004. Risk Assessment Forms were sent out to various entities throughout the state. Responses to the survey were received from the local emergency managers and contain references to other local/regional documents that identify flood risk for the area (e.g., county hazard mitigation plans, emergency operations plans, etc.). It was noted that several counties did not respond to the initial survey and have not yet completed a local hazard mitigation plan. It is recommended that the completion of these local hazard mitigation plans be made a priority during the next update cycle, and that this information be incorporated into the next update. CWCB will also strongly encourage local entities to include this information in a flood hazard mitigation plan.

Table 5. Present Status of the Map Modernization Program in Colorado					
COUNTY	**STATUS**	**RANK**	**COUNTY**	**STATUS**	**RANK**
Denver	Effective	2	Rio Grande		102
Jefferson	Effective	3	Elbert		103
El Paso		4	Lake		110
Arapahoe	Preliminary	5	Park		112
Adams	Effective	6	Clear Creek	Effective	119
Boulder	Preliminary	9	Archuleta	In production	121
Larimer	Preliminary	10	Huerfano		122
Pueblo	In production	13	Saguache		131
Weld	Preliminary	15	Yuma		144
Douglas	Effective	18	Kit Carson		148
Mesa	In production	20	Lincoln		149
Fremont	In production	31	Grand	Preliminary	158
Garfield	In production	36	Bent		160
Broomfield	Effective	37	San Miguel		162
La Plata	In production	38	Gilpin		174
Logan		42	Ouray		175
Morgan		43	Rio Blanco		176
Routt	Effective	46	Conejos		179
Otero		57	Phillips		192
Delta		59	Custer		194
Montrose		60	Costilla	No study	197
Montezuma	In production	68	Crowley		214
Summit		69	Dolores		216
Alamosa		70	Hinsdale		248
Eagle	Preliminary	73	Mineral	No study	250
Moffat		75	Sedgwick	No study	251
Gunnison		76	Washington	No study	254
Prowers		81	Jackson	No study	267
Las Animas		83	Baca	No study	274
Chaffee		84	San Juan	No study	278
Pitkin	Effective	86	Kiowa	No study	283
Teller	In production	88	Cheyenne	No study	288
Source: Colorado Water Conservation Board 2007					

Information provided by the local emergency managers was compiled by emergency management region; the data for flood hazards presented below was extracted from the summary table provided in Appendix E of the 2004 update to the NHMP umbrella document.

	SUMMARY OF HAZARDS BY REGION AND TYPE								
	COLORADO ALL HAZARDS EMERGENCY MANAGEMENT REGIONS								
TYPE OF HAZARD	WEST	SOUTH WEST	SOUTH EAST	SOUTH	SOUTH CENTRAL	SAN LUIS	NORTH EAST	NORTH CENTRAL	NORTH WEST
Flood	**High**	**High**	**High**	**High**	**High**		**High**	**High**	**High**
LOCAL EMERGENCY MANAGERS SURVEY, 2003									

B. Jurisdictions Most Threatened and Most Vulnerable to Damage or Loss

The jurisdictions most threatened and most vulnerable to damage or loss is presented in Figure 1. This information in Figure 1 is based on the county data for flood hazards extracted from the summary table provided in Appendix E of the 2004 update to the NHMP umbrella document.

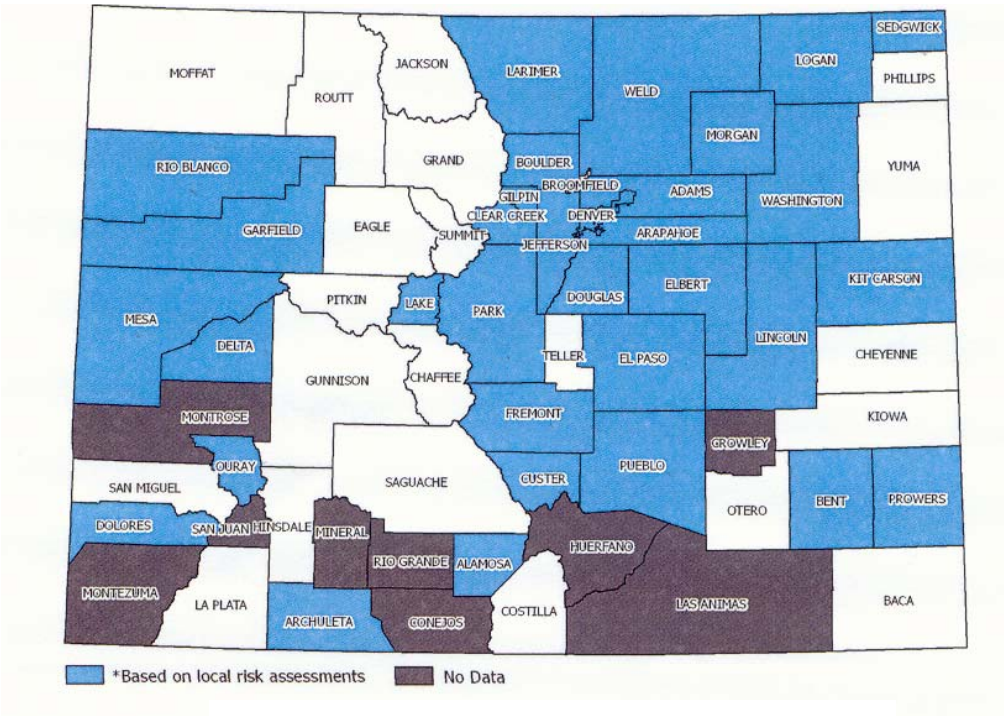


Figure 1. High Risk Counties for Flooding

Information presented in Table 4 provides a profile of the damages and losses in Colorado communities from January 1978 through July 2007. According to FEMA NFIP information, the State of Colorado has 40 repetitive loss structures. Structures are located in 18 counties as indicated in Table 6.

The data presented in Table 7 was developed from information in the Community Information System, which is part of the FEMA database for the NFIP. Communities and unincorporated areas of counties participating in the program are asked to report on population and structures at risk and other items of interest. Some communities have not determined the population or structures at risk in their area. These are represented by zeroes. CWCB will strongly encourage all communities to provide information related to population or structures at risk and to include this information in the development of local flood hazard mitigation plans.

Table 6. Repetitive Loss Communities/Number	
Arapahoe County 1	Larimer County 1
Boulder County 1	Littleton 1
Canon City 1	Logan County 1
Colorado Springs 5	Manitou Springs 2
Delta County 1	Mesa County 1
Denver 1	Pueblo (City of) 1
Durango 1	Rio Blanco County 1
El Paso County 4	Steamboat Springs 1
Gunnison County 1	Sterling 1
Jefferson County 1	Weld County 1
La Junta 3	Westminster 1
Lakewood 8	
Source: CIS database 2007	

C. Process Used to Analyze Information from Local Risk Assessments

The 2004 update to the NHMP 2001 umbrella document contains information describing the process used to analyze information from local risk assessments. The process is summarized below.

Counties most at risk were determined following an evaluation of: (1) population in the flood risk area, (2) number of structures identified in the flood risk area, (3) number of repetitive loss structures in each county, and (4) number of Class I and II dams in each county. Values for each factor were assigned as follows:

Population in Flood Risk Area	Value
1,001 +	3
501 – 1000	2
1 – 500	1
0	0

Number of Structures	Value
75 +	3
50 – 74	2
22 – 49	1
1 – 21	0.1
0	0

Table 7. Population and Structures in Flood Hazard Area							
County	**Population**	**1-4 Family Structures**	**Other Structures**	**County**	**Population**	**1-4 Family Structures**	**Other Structures**
Adams	7,432	1,449	192	Kit Carson	0		
Alamosa	9,380	1,071	463	La Plata	2,062	437	138
Arapahoe	6,089	726	245	Lake	0		
Archuleta	802	300	212	Larimer	5,413	1,864	298
Baca	0			Las Animas	380	170	112
Bent	0	0	0	Lincoln	279		
Boulder	12,270	1,735	905	Logan	4,273	3,143	1,445
Broomfield	75			Mesa	2,717	248	22
Chaffee	856	145	0	Mineral	180	40	35
Cheyenne	55			Moffat	360	111	64
Clear Creek	2,545	501	82	Montezuma	947	767	67
Conejos	901	30	0	Montrose	1,249	42	7
Costilla	98	55	0	Morgan	2,384	225	7
Crowley	53			Otero	1,150	355	399
Custer				Ouray	285	0	0
Delta	335	183	42	Park	72	0	0
Denver	2,079			Phillips	332	120	15
Dolores	94	43	2	Pitkin	446	97	11
Douglas	315	100	32	Prowers	2,213	1,008	261
Eagle	858	122	9	Pueblo	877	350	0
El Paso	9,869	3,244	551	Rio Blanco	1,255	526	90
Elbert	65	0	3	Rio Grande	1,201	3,418	23
Fremont	9,586	329	367	Routt	1,294	380	282
Garfield	1,746	538	17	Saguache	0		
Gilpin	147	42	0	San Juan	14		
Grand	192	56	3	San Miguel	628	230	64
Gunnison	1,071	879	26	Sedgwick	7		0
Hinsdale	19	36	16	Summit	500	220	102
Huerfano	767	293	164	Teller	173	25	28
Jackson	0	0	0	Washington	38	14	2
Jefferson	12,705	2,454	1,499	Weld	3,485	144	28
Kiowa	0			Yuma	715		
Source: FEMA, Community Information System 2007							

Repetitive Loss Structures	Value
7 – 10	3
4 – 6	2
1 – 3	1
0	0

Number of Class I and II Dams	Value
10 +	3
6 – 9	2
1 – 5	1
0	0

The values of the four factors were computed and each value ranked in accordance with the procedure below.

Value	Risk Assessment
10 +	High
6 – 9	Moderate
1 – 5	Low
0	Very Low

The results of the risk assessment are presented on Figure 1.

D. Changes in Development Patterns

Information in this section of the document is intended to reflect changes in development for jurisdictions in flood hazard prone areas. Changes in development patterns can generally be related to changes in population. Consequently, census data was utilized to identify the potential changes. The 2004 update to the NHMP 2001 umbrella document contained population data, based on the 2000 census, and the percent change in population since 1990. The Department of Local Affairs (DOLA) updated this information in 2007 as shown on the following page.

ASSESSING VULNERABILITY OF STATE FACILITIES

A. Types of State Owned/Operated Facilities

The 2004 update to the NHMP 2001 umbrella document specifically identified the types of State owned or operated critical facilities located in flood hazard areas. The

Colorado Office of Risk Management and the Colorado DEM updated this information in 2007. State assets located in floodplain areas are presented on Figure 2 and in Table 8 along with the value of the assets. In addition, bridges that were determined to be at risk from scour during flooding events were also identified. A summary of the state critical assets at risk from a 100-year flooding event is presented in Table 9.

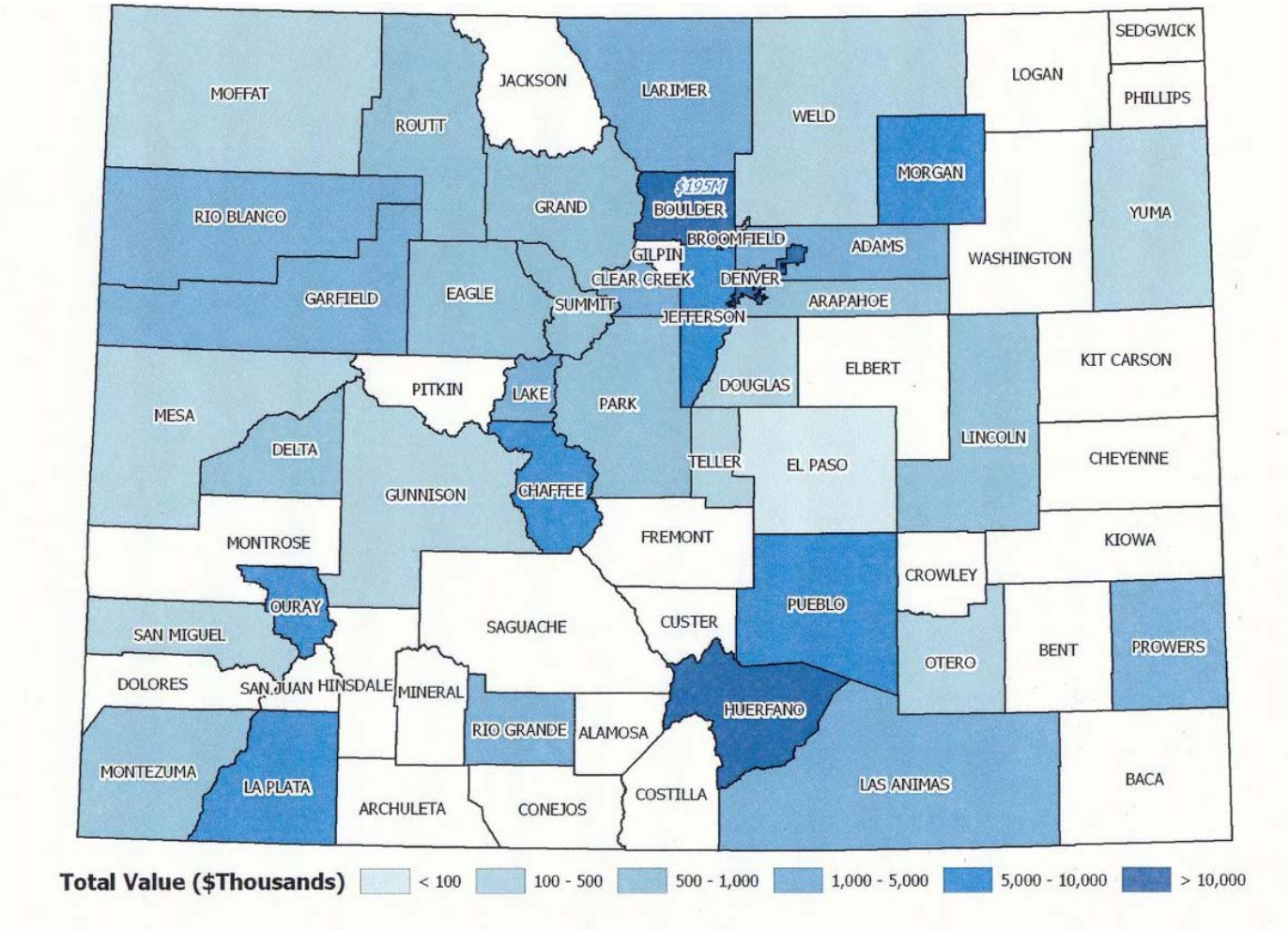


Figure 2. Value of State Assets in Floodplains by County

Table 8. State Assets In The Floodplain						
# Of Assets	Occupancy	Owned	Basement	Total Value ($)	1-Story	2+Stories
43	Storage/storage sheds/warehouses	39	0	$ 13,705,354	42	1
10	Sand sheds	10	0	$ 1,049,034	10	0
2	Walk-in coolers/storage	2	0	$ 52,867	2	0
4	Office/storage	4	0	$ 1,343,757	3	1
4	Shop/office	4	0	$ 615,063	4	0
44	Office buildings*	29	9	$ 35,429,746	21	17
10	Shelter/public/offices/visitor centers	7	0	$ 5,256,536	9	1
6	Offices/garages	3	0	$ 3,368,418	6	0
66	Maintenance/repairs/storage	66	1	$ 16,560,712	59	7
10	Vehicle storage garages/parking*	10	0	$ 711,814	0	0
1	Warehouse/garage	1	0	$ 3,039,132	1	0
8	Garages	6	0	$ 1,044,447	7	1
2	Traffic Shops	2	0	$ 301,840	2	0
2	Mobile port of entry vehicles	2	na	$ 92,173	na	na
3	Ports of entry	3	2	$ 1,224,664	3	0
11	Hatchery Buildings	11	0	$ 12,108,076	9	2
2	Bird Farm Buildings	2	0	$ 99,368	2	0
7	Pump Buildings, Controls, Filters	7	1	$ 1,397,323	7	0
2	Wastewater Treatment Plant	2	1	$ 1,696,656	2	0
28	Residences/Housing*	27	5	$ 98,811,678	7	5
1	Nursing Home	1	1	$ 18,811,484	0	1
7	Yurts/Cabins	7	0	$ 300,946	7	0
2	Railroad Loading Platforms	2	0	$ 347,108	2	0
3	Museums	3	0	$ 4,496,625	2	1
1	Meat Packing Plant	1	0	$ 633,759	0	1
1	Printing/Distribution Center	1	0	$ 2,050,655	1	0
2	Hangar and Simulator Lab	1	0	$ 622,995	2	0
6	Radio Towers/Equipment/Offices	3	na	$ 1,961,207	3	0
3	Air Sampling Equipment/Station	2	na	$ 150,121	1	0
12	Classrooms/Labs/Research*	12	0	$ 97,532,963	3	0
1	Leased Equipment	0	na	$ 4,472,987	na	na
5	Utilities*	5	na	$ 5,922,800	na	0
309	Total	275	20	$ 332,212,307	219	na

Note: Not every location is a separate building. Multiple assets from different agencies may be in one building. *Includes assets from the University of Colorado DRU Plan. BASEMENT, 1-STORY, and 2- STORY may not be reflected. Colorado Office of Risk Management 2003-2007

Table 9. Summary of the State Critical Assets at Risk from a 100-Year Flooding Event

State Assets At Risk Buildings, Contents, Vehicles, Equipment, Etc.	Impacts	Approximate Value of Assets
At-risk critical assets:		
Long-Term Housing	Loss of life, injuries, property loss, economic loss	$23 million
Nursing home, employee residences, patient care, correctional facility		
Recreation/Temporary Housing	Loss of life, injuries, property loss, economic/revenue loss	$10 million
Campgrounds, cabins, rentals, shelters, visitor centers/offices, museums		
Support Buildings	Property loss, economic loss	
Pump buildings, controls, filters, wastewater treatment plant		$3 million
Equipment/towers/monitoring sites	Property loss	$7 million
Air sampling equipment and stations, radio towers and equipment, leased equipment		
Ports of Entry	Property loss, economic loss	$1 million
Hatcheries, Bird Farm, Etc.	Property loss, economic loss	$12 million
Storage/Etc.	Property loss	$16 million
Storage sheds, warehouses, coolers		
Offices/Etc.	Loss of life, injuries, property loss, economic loss	$44 million
Office buildings, shop/office/storage/garage, labs, printing and distribution center, meat packing plant		
Transportation-Related	Loss of life, injuries, property loss, economic loss	$22 million
Warehouse/garage, traffic shops, maintenance and repairs and storage, hangar and lab, RR platforms		
Bridges: Scour Critical	Loss of life, injuries, property loss, economic loss	$237 million
State owned and other		
Highways and culverts	Loss of life, injuries, property loss, economic loss	unknown
University buildings	Loss of life, injuries, property loss, economic loss	unknown

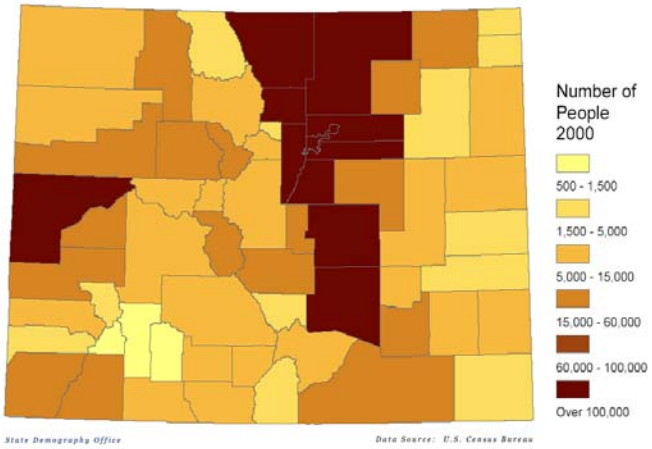
ESTIMATING POTENTIAL LOSSES BY JURISDICTION

A. Overview and Analysis of Potential Losses

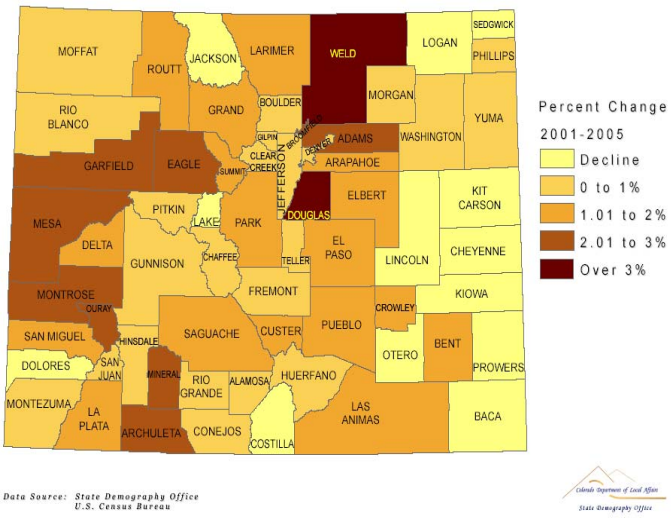
Estimates of potential vulnerability and losses associated with flood hazards reflect both the population and structures within the 100-year floodplain. Methods utilized to develop the estimates were presented previously in this document and are summarized below.

On a countywide basis, pertinent information was requested and obtained from local and state floodplain/emergency managers through a survey of risk assessment. Additional information was obtained from FEMA's Community Information System and was supplemented with data obtained from FEMA's national Multi-hazard Map Modernization Program. The Map Modernization Program compiled digital data into a statewide base map database for use as a scoping and assessment tool, and to facilitate flood hazard mapping activities.

COLORADO
NUMBER OF PEOPLE, 2000



COLORADO POPULATION GROWTH
ANNUAL AVERAGE PERCENT CHANGE
2001-2005



REGIONS	SDOEst. July, 2001	SDO Est. July, 2005	Change 2001-2005	Percent Change
COLORADO	**4,446,934**	**4,722,755**	**275,821**	**6.2%**
Adams	361,262	405,561	44,299	12.3%
Alamosa	15,282	15,765	483	3.2%
Arapahoe	503,465	534,252	30,787	6.1%
Archuleta	10,548	11,716	1,168	11.1%
Baca	4,514	4,263	-251	-5.6%
Bent	5,865	6,314	449	7.7%
Boulder	280,965	285,880	4,915	1.7%
Broomfield	40,621	45,755	5,134	12.6%
Chaffee	16,485	16,889	404	2.5%
Cheyenne	2,228	2,120	-108	-4.8%
Clear Creek	9,485	9,510	25	0.3%
Conejos	8,401	8,586	185	2.2%
Costilla	3,723	3,628	-95	-2.6%
Crowley	5,491	5,740	249	4.5%
Custer	3,686	3,964	278	7.5%
Delta	28,709	30,257	1,548	5.4%
Denver	560,365	571,848	11,483	2.0%
Dolores	1,844	1,846	2	0.1%
Douglas	200,385	251,418	51,033	25.5%
Eagle	44,824	49,375	4,551	10.2%
Elbert	21,453	22,786	1,333	6.2%
El Paso	533,534	565,350	31,816	6.0%
Fremont	47,209	47,727	518	1.1%
Garfield	46,173	50,673	4,500	9.7%
Gilpin	4,845	4,976	131	2.7%
Grand	13,253	13,906	653	4.9%
Gunnison	14,012	14,264	252	1.8%
Hinsdale	794	821	27	3.4%
Huerfano	7,857	7,932	75	1.0%
Jackson	1,620	1,531	-89	-5.5%
Jefferson	530,111	532,608	2,497	0.5%
Kiowa	1,598	1,533	-65	-4.1%
Kit Carson	8,007	7,882	-125	-1.6%
Lake	7,981	7,949	-32	-0.4%
La Plata	45,614	48,019	2,405	5.3%
Larimer	260,221	271,951	11,730	4.5%
Las Animas	15,550	16,271	721	4.6%
Lincoln	6,117	5,905	-212	-3.5%
Logan	21,920	21,605	-315	-1.4%
Mesa	120,128	130,662	10,534	8.8%
Mineral	843	946	103	12.2%
Moffat	13,246	13,426	180	1.4%
Montezuma	23,999	24,862	863	3.6%
Montrose	34,601	37,880	3,279	9.5%
Morgan	27,623	28,348	725	2.6%
Otero	19,976	19,569	-407	-2.0%
Ouray	3,894	4,303	409	10.5%
Park	15,327	16,595	1,268	8.3%
Phillips	4,511	4,631	120	2.7%
Pitkin	16,197	16,420	223	1.4%
Prowers	14,240	13,973	-267	-1.9%
Pueblo	144,383	151,104	6,721	4.7%
Rio Blanco	5,986	6,073	87	1.5%
Rio Grande	12,518	13,043	525	4.2%
Routt	20,551	21,905	1,354	6.6%
Saguache	6,100	6,538	438	7.2%
San Juan	560	576	16	2.9%
San Miguel	6,956	7,310	354	5.1%
Sedgwick	2,722	2,667	-55	-2.0%
Summit	26,355	27,507	1,152	4.4%
Teller	21,827	22,346	519	2.4%
Washington	4,898	4,936	38	0.8%
Weld	193,576	228,781	35,205	18.2%
Yuma	9,900	9,978	78	0.8%

With respect to State owned or operated critical facilities located in flood hazard areas, the Colorado Office of Risk Management and the Colorado DEM updated the potential vulnerability and loss data presented in the 2004 update to the NHMP 2001 umbrella document. State critical assets were specifically identified through the development of a digital risk layer.

In 1994, there were 9,893 flood insurance policies. In September 2007, there were 17,788 flood insurance policies statewide with an insured value of $3,626,858,400.

B. Potential Losses Based on Estimates in Local and State Risk Assessments

The information obtained from local emergency managers, through either the state-sponsored survey or local hazard mitigation plans, was supplemented with information in the FEMA Community Information System. Communities and unincorporated areas of counties participating in the NFIP reported on population and structures at risk. As indicated in Table 4, losses associated with the flood hazard for 2006 exceeded $8.2 million. The potential loss based on the local risk assessment assumed a worst-case scenario, in which all structures covered by flood insurance incurred the maximum loss. Under this assumption, the potential loss was estimated to be approximately $3.6 billion.

The value of state assets located in the floodplain is presented in Table 6. Approximately $122 million in assets (buildings, vehicles, contents) were identified as being at risk. Assuming a worst-case scenario, in which all assets were assumed to be at risk during a 100-year flood event, the total potential loss to assets becomes $122 million. In addition, the potential losses associated with bridges that were determined to be at risk from scour during flooding events were estimated. Statewide, 358 bridges were determined to be scour critical with a total replacement cost of $237 million. Table 9 presents a summary of the potential losses associated with state critical assets at risk from a 100-year flooding event.

C. Impacts on Losses from Changes in Development

Information reflecting changes in development for jurisdictions in flood hazard prone areas was provided in previous sections to this report. There is a close correlation

between development patterns, population growth, and the cost of disasters. As growth occurs within a community, less land is available for development. This tendency promotes the development of land that is more prone to flood hazards. As the population grows, it is anticipated that the losses from future floods will likely increase without additional flood mitigation measures. Mitigation, through processes that guide development, reduces damage caused by flooding events and generates a monetary benefit by reducing funds allocated to disaster response and recovery.

D. Estimating Potential Losses of State Facilities

The value of state assets located in the floodplain is presented in Table 8. Approximately $122 million in assets (buildings, vehicles, contents) were identified as being at risk. Assuming a worst-case scenario, in which all assets were assumed to be at risk during a 100-year flood event, the total potential loss to assets becomes $122 million. In addition, the potential losses associated with bridges that were determined to be at risk from scour during flooding events were estimated. Statewide, 358 bridges were determined to be at risk, due to scour, with a total replacement cost of $237 million. Table 9 presents a summary of the potential losses associated with state critical assets at risk from a 100-year flooding event.

SECTION 4: MITIGATION STRATEGY

HAZARD MITIGATION GOALS

A. Description of State Mitigation Goals

The mitigation goals presented in the 2004 update to the NHMP 2001 umbrella document are summarized below.

- **Reduce the loss of life and personal injuries from natural hazard events.**
- **Reduce damage to state critical, essential, and necessary assets.**
- **Reduce damage to local government assets.**
- **Reduce state and local costs of disaster response and recovery.**
- **Minimize economic losses**.
- **Reduce damage to personal property**.

The goals and their associated objectives form the basis for the development of the mitigation action plan and specific mitigation projects to be considered. The action plan contains recommended mitigation projects and initiatives.

Strategies, goals, objectives, and actions were also identified through hazard specific annexes. All annexes are incorporated by reference and the actions fall into the goals of the umbrella document the same as the actions identified from the local hazard mitigation plans. The goals of the flood hazard mitigation plan, presented below, were reviewed by the CWCB and are intended to promote the reduction of future damages from flood hazards.

- **Encourage the use of public funds by state and local governments for housing and public buildings in non-hazardous areas.**
- **Promote appropriate land use decisions to minimize the vulnerability of development to floods.**
- **Educate the public and government officials and their staffs about flood hazards and mitigation.**
- **Identify adverse impacts to public health and the environment and encourage the mitigation of these impacts when considering the expenditure of public funds.**
- **Encourage the design and engineering of infrastructure to take into consideration the mitigation of potential natural hazard impacts.**
- **Promote the adoption of model codes and standards (such as UBC and IBC) that emphasize hazard mitigation and reduced use of hazardous areas for development.**
- **Promote the development of flood mitigation plans**.
- **Publish flood documentation report**.
- **Modernize current floodplain maps**.

B. Reassessment of Goals for Validity or Need for Revision

As indicated previously, the SHMT was reconvened in April 2007 to provide information necessary to update the 2004 version of the NHMP 2001 umbrella document. The objectives of the SHMT meetings included reviewing NHMP goals and priorities, identifying strategies for protecting assets, and updating progress on mitigation projects already listed in the plan. No revisions to the goals were identified. Recommendations were provided to realize a reduction in loss of life and property damage associated with flood hazards. Actions for each of the recommendations have been updated. No revisions to the flood goals were identified by the Colorado Water Conservation Board.

STATE CAPABILITY ASSESSMENT

A. Pre-disaster Hazard Management Policies, Programs, Capabilities

State departments are responsible, within their statutory authorities, to provide assistance and support to local jurisdictions when they are unable to cope with a disaster emergency situation. Assistance and support is provided both prior to and following the disaster emergency. The state laws, regulations, authorities, and policies especially pertinent to flood hazards within the State of Colorado are listed below.

State Engineer's Reports on High Hazard Dams, C.R.S. 37-87-123. The State Engineer develops and distributes reports on high hazard dams. Each report contains the State Engineer's evaluation of the structural integrity and state of repair as of October 1983.

1977 – Executive Order 8504. Requirements and criteria for State participation in the National Flood Insurance Program.

1977 – Executive Order 8491. Evaluation of flood hazard in locating State buildings, roads, and other facilities, and in reviewing and approving sewage and water facilities, and subdivisions.

1977 – Senate Bill 126 – C.R.S. § 24.65.1-403(1), 1973, as amended. An Act authorizing the Colorado Water Conservation Board to coordinate all activities relating to the designation of floodplains in the State in connection with land use planning.

1974 – House Bill 1041, Chapter 106, C.R.S. 1963, as amended. This Act involved comprehensive treatment of hazards and charged local governments with legal responsibility for designation and administration of hazardous areas of state interest.

106-7-201. Areas of State Interest-as determined by local governments. Natural hazard areas and mineral resource areas are two of the four areas of state interest.

106-7-202. Criteria for administration of areas of state interest. "Floodplains shall be administered so as to minimize significant hazards to public health and safety or to property….." The Colorado Water Conservation Board was to develop model hazard area control regulations.

106-7-302. Functions of other state agencies. (1) Pursuant to this article, it is the function of other state agencies to: (a) send recommendations to local governments and the Colorado Land Use Commission relating to designation

> of matters of state interest on the basis of current and developing information; and (b) provide technical assistance to local governments concerning designation of and guidelines for matters of state interest. (2) Primary responsibility for the recommendation and provision of technical assistance functions described in subsection (1) of this section is upon: (a) the Colorado Water Conservation Board, acting in cooperation with the Colorado Soil Conservation Board, with regard to floodplains; (b)……."

1974 – House Bill 1034, C.R. S. 29-20-201, et seq., 1974, is the "Local Government Land Use Control Enabling Act. The act gives authority to local governments to plan and regulate the use of land within their jurisdictions, including regulating development and activities in hazardous areas.

1970 – Colorado Land Use Act – C.R.S. § 24-65-101, 25-65-105. Model resolutions – subdivisions – improvement notices. (2)(a) The commission shall, after consultation with its advisory committee, develop model resolutions to serve as guidelines for boards of county commissioners, city councils, town boards, and special districts and authorities in developing land uses and construction controls within designated floodways. (b) The commission shall, in its progress report, due February 1, 1972, designate critical areas in the state where a one hundred-year (storm return frequency) floodway should be identified and shall aid the state agencies and local governments having jurisdiction over such critical areas in adopting a program for such identification. The purpose of identifying a floodway is to insure that life and property are protected, that the expenditure of public funds to clean up flood damage is kept to a minimum, that a high volume of water runoff can be accommodated, and that impediments to this flow are held to a minimum. The commission shall designate critical conservation and recreation areas and recommend state involvement in land use in such areas. (c) The commission shall include a report on land uses and construction within floodways in its interim and final land use planning programs.

1966 – House Bill 1007 – Flood Control – Planning and Zoning. State approval and designation of storm runoff channels and basins.

1963 – C.R.S. § 139-59-7. "The plan shall be made with the general purpose of guiding and accomplishing a coordinated, adjusted, and harmonious development of the municipality and its environs, which will, in accordance with present and future needs, best promote health, safety, …., and general welfare, as well as efficiency and economy

in the process of development, including among other things, …, the promotion of safety from fire, and other dangers, …"

1937 – The Colorado Water Conservation Board is created.

In the 2004 update to the NHMP 2001 umbrella document, an evaluation of the effectiveness of the state's capabilities was submitted. Several of the programs identified in the evaluation matrix were adopted into the state's mitigation strategy. Information in Table 10 specifically addresses the state programs and capabilities related to flood hazards.

B. Post-disaster Hazard Management Policies, Programs, Capabilities

The previous section includes pertinent information and an evaluation of both pre-disaster and post-disaster hazard management policies, programs and capabilities.

C. State Policies Related to Development in Flood Prone Areas

Policies and programs related to development in flood prone areas were presented and discussed in the previous sections of this document. In general, these policies and programs reflect regulatory requirements for construction in floodplains. In addition to zoning ordinances, regulations on construction in the floodplains are usually found in one or more of three locations: subdivision ordinance, building code, and/or a separate "stand alone" floodplain ordinance.

If the zoning for a site allows a structure to be built, then the applicable subdivision and building regulations will impose construction standards to protect buildings from flood damage and prevent the development from aggravating the flood problem.

Subdivision regulations govern how land will be subdivided into individual lots, often requiring that every lot have a buildable area above flood level. These regulations set construction and location standards for the infrastructure provided by the developer, including roads, sidewalks, utility lines, storm sewers and drainage-ways.

Table 10. State Programs and Capabilities Related to Flood Hazards

DEPARTMENT	PROGRAM/POLICY REGULATION/PRACTICE	EFFECT ON LOSS REDUCTION[1]	PROVIDES FUNDS OR ASSISTANCE
Local Affairs	**Community Development Block Grants**	**Support**	**Yes**

Local Government Services in Local Affairs coordinates the overall administration of the federally funded "Small Cities" Community Development Block Grant (CDBG) program. Funds are provided to the department through the U.S. Department of Housing and Urban Development (HUD) and are primarily intended to benefit low-to-moderate income persons through community development efforts. Eligible recipients are all municipalities and counties, except those larger jurisdictions that receive CDBG funding on an "entitlement" basis directly from HUD. These funds have been used for mitigation purposes. Example: After the floods in the Summer of 1999, $1 million was directed to buyouts of damaged properties in Otero County. HMGP and Unmet Needs funds were also used for buyouts.

Local Affairs	**Colorado Division of Emergency Management**	**Facilitate**	**Yes**

CDEM administers the following programs: DHS Hazard Mitigation Grant Program, DHS Pre-Disaster Mitigation Grant Program, DHS Disaster Resistance Universities, and the Emergency Management Performance Grant Mitigation Assistance Program. Funds are used for mitigation projects including plans, studies, construction projects, and mapping.

Natural Resources	**Dam Safety Program**	**Facilitate**	**Yes**

Funds for the update of local dam emergency preparedness plans comes from DHS' Dam Safety Program. All Class I dams have preparedness plans. Copies are at the State Engineer's Office and CDEM.

Natural Resources	**Map Modernization & Implementation Plan**	**Facilitate**	**Yes**

The Colorado Water Conservation Board administers the program. Funding sources are from DHS, the sate, and local funds. The Map Modernization Implementation Plan for Colorado and the Business Case Plan-Final Draft Fiscal Years 2004-2008 may be accessed on the state website at http://www.cwcb.state.co.us. The Urban Drainage and Flood Control District is one of the Cooperating Technical Partners in the program.

Natural Resources	**Flood Mitigation Assistance Program**	**Facilitate**	**Yes**

This program is administered by the Colorado Water Conservation Board. Two grants are available from the DHS Federal Emergency Management Agency (FEMA) for reducing flood risk in local communities. The Flood Mitigation Assistance Program (FMAP) offers grants for developing a local flood hazard mitigation plan and for completing flood mitigation projects to reduce flood risk in your community.

Natural Resources	**National Flood Insurance Program**	**Facilitate**	**TA**

Technical assistance on floodplain issues is provided through the Community Assistance Program (CAP), administered by the Colorado Water Conservation Board. Funding for the state to provide technical assistance is provided through DHS with match funds from the state. According to the FEMA Community Information System list, 236 communities participate in the NFIP; 19 communities with hazard areas identified are not in the program. One community has been suspended from the regular program.

[1] Support: Programs, plans, policies, regulations, funding, or practices that help implement mitigation measures
Facilitate: Programs, plans, policies, regulations, funding, or practices that make implementing mitigation measures easier
Hinder: Programs, plans, policies, regulations, funding, or practices that pose obstacles to implementing mitigation measures

The building code should establish flood protection standards for all construction. These should include criteria to ensure that the foundation will withstand flood forces and that all portions of the building subject to damage are above, or otherwise protected from, flooding.

Some Colorado communities have adopted the Building Officials and Code Administrators' (BOCA) National Building Code. The 1997 edition sets standards for protecting foundations against flood damage, including requirements for soil testing and prepared fill. It should be noted that one of the goals for flood hazard mitigation is the promotion and adoption of model codes and standards (such as the UBC and IBC).

Most communities with a flood problem in Colorado participate in the National Flood Insurance Program (NFIP). The NFIP sets minimum requirements for participating communities' subdivision regulations and building codes. Communities are encouraged to adopt local ordinances, which are more stringent than the state or federal criteria. This is especially important in areas with older maps that may not reflect the current hazard. These could include prohibiting damage-prone uses (such as garages, sheds, parking lots and roadways) from the floodway or requiring structures to be elevated one or more feet above the base flood elevation.

As with any regulatory program, property owners may not be aware of the need for permits, or may resist getting permits, especially after a flood. Because many existing floodplain maps are out of date, caution should be exercised when utilizing them for regulations. Conservative safety factors are highly recommended. Some of the requirements, such as floodway construction criteria or substantial improvement rules, can be technically complicated. However, assistance is available from FEMA, CWCB and OEM.

D. State Funding Capabilities for Flood Hazard Mitigation Projects

The state funding sources and capabilities for flood hazard mitigation projects were presented in previous sections of this document. The funding programs are summarized below:

Department of Local Affairs (DOLA):

Community Development Block Grants
Unmet Needs Program

Division of Emergency Management:

Hazard Mitigation Grant Program
Pre-Disaster Mitigation Grant Program
Disaster Resistance Universities
Emergency Management Performance Grant Mitigation Assistance Program

Colorado Water Conservation Board:

Map Modernization and Implementation Program
Flood Mitigation Assistance Program
Community Assistance Program (Technical Assistance)

Department of Natural Resources:

Dam Safety Program (local dam emergency preparedness plans)

E. Changes in Hazard Management Capabilities of the State

The state funding sources and capabilities for flood hazard mitigation projects were presented in previous sections of this document. Hazard management capabilities have been increased by the activities associated with the items listed below.

- Development and approval of a state-wide criteria manual for floodplain and stormwater management
- Implementation and progress associated with the Flood Map Modernization Program
- Training workshops and seminars developed and presented by the CWCB CAP Coordinator regarding floodplain management within the state
- Training workshops to local emergency managers developed and presented by the DEM
- Training provided to state and local emergency managers and local insurance agents to promote their certification as Certified Floodplain Managers (CFM)

LOCAL CAPABILITY ASSESSMENT

A. Local Mitigation Policies, Programs and Capabilities

Local mitigation policies, programs and capabilities have been described in the NHMP umbrella document. Much of this information has been provided in response to an initial survey that was sent to all local emergency managers of the counties and cities with populations over 100,000. Information from local flood mitigation plans was also utilized to update the risk assessments, mitigation strategies and potential mitigation projects. For those counties with local flood mitigation plans, worksheets were developed to solicit additional information related to capability including regulations, codes, emergency warning systems, evacuation plans, public information programs, GIS/mapping, master plans, and potential projects.

Those communities with local floodplain regulations are presented in Table 11. Table 12 illustrates the communities that have adopted codes according to the ICC. In Colorado, codes are adopted at the local level.

Information related to mitigation projects, evacuation plans, emergency warning systems, etc., can also be found in local flood mitigation plans. Local communities were originally encouraged by DEM to start their flood mitigation plans and have them completed for the original November 1, 2003 deadline associated with the umbrella document. New communities are being encouraged to start plans. Many communities that started the planning process last year and this year expect to have them completed and submitted to FEMA by the end of 2008. Several other communities expect to start the process this fall through funding sources administered by the state. Most of the population in the state will be addressed in counties with plans through 2008. A list of the communities that have flood hazard mitigation plans is presented in Table 13.

B. Effectiveness of Local Mitigation Policies, Programs and Capabilities

The effectiveness of the local mitigation policies, programs and capabilities can be reflected by the continued progress of the local communities in the development and administration of local floodplain regulations, reduction of population and structures in the floodplain, and the implementation of both planning and flood control projects. Since the 2004 update to the NHMP 2001 umbrella document, local floodplain regulations have

Table 11. Regulations Survey For Local Governments 2000-2001; Updated With Local Plans In 2007			
County	**Floodplain**	**County**	**Floodplain**
Adams	yes	Park	yes
Alamosa	yes	Phillips	yes
Arapahoe	yes	Pitkin	yes
Archuleta	yes	Prowers	yes
Baca	yes	Pueblo	yes
Bent	yes	Rio Blanco	yes
Boulder	yes	Rio Grande	yes
Chaffee	yes	Routt	yes
Cheyenne	no	Saguache	no
Clear Creek	yes	San Juan	yes
Conejos	yes	San Miguel	yes
Costilla	yes	Sedgwick	yes
Crowley	no	Summit	yes
Custer	no	Teller	yes
Delta	yes	Washington	yes
Denver	yes	Weld	yes
Delores	yes	Yuma	yes
Douglas	yes		
Eagle	yes	**Regulations Survey For Local Governments 2000-2001**	
Elbert	no	**City**	**Floodplain**
El Paso	yes	Arvada	yes
Fremont	yes	Aurora	yes
Garfield	yes	Boulder	yes
Gilpin	yes	Brighton	yes
Grand	yes	Broomfield	yes
Gunnison	yes	Canon City	yes
Hinsdale	yes	Castle Rock	yes
Huerfano	yes	Colorado Springs	yes
Jackson	yes	Commerce City	yes
Jefferson	yes	Englewood	yes
Kiowa	no	Fort Collins	yes
Kit Carson	no	Golden	yes
Lake	yes	Grand Junction	yes
La Plata	yes	Greeley	yes
Larimer	yes	Lafayette	yes
Las Animas	yes	Lakewood	yes
Lincoln	yes	Littleton	yes
Logan	yes	Longmont	yes
Mesa	yes	Louisville	yes
Mineral	no	Loveland	yes
Moffat	yes	Northglenn	yes
Montezuma	yes	Parker	yes
Montrose	yes	Pueblo	yes
Morgan	yes	Thornton	yes
Otero	yes	Westminster	yes
Ouray	yes	Wheatridge	yes
Source: Colorado Office of Emergency Management 2001			

Table 12. International Codes – Adoption by Jurisdiction

International Codes-Adoption by Jurisdiction

X = Effective Statewide A = Adopted, but may not yet be effective L = Adopted by Local Governments
S = Supplement 06 = 2006 Edition 04 = 2004 Edition 03 = 2003 Edition 00 = 2000 Edition

ST	Jurisdiction	IBC	IRC	IFC	IMC	IPC	IPSDC	IFGC	IECC	IPMC	IEBC	ICCPC	IWUIC*	IZC	ICCEC	Comments
CO	Colorado	L	L	L	L	L	L	L	L	L	L	L	L	L	L	IBC, IFC: Colorado Div. of Fire Safety
CO	Alamosa	L	L		L											
CO	Arapahoe County	L03	L03		L03	L03		L03	L03							
CO	Archuleta	L	L	L												
CO	Arvada	L03	L03	L03	L03	L03		L03	L03							
CO	Arvada Fire District			L												
CO	Aspen	L03	L03		L03	L03		L03		L03	L03					
CO	Aspen Fire Dept			L03												
CO	Ault	L	L		L	L		L								
CO	Aurora	L03	L03	L03	L03	L03		L03								
CO	Avon	L03	L03	L03	L03											
CO	Avondale	L	L		L					L						
CO	Basalt					L										
CO	Bayfield	L03	L03		L03			L03								
CO	Bennett	L	L		L	L		L								
CO	Black Hawk	L	L	L	L	L		L	L		L					
CO	Blue River		L												L	
CO	Boulder	L03	L03	L03	L03	L03		L03	L03		L03					
CO	Boulder County	L	L		L	L		L	L							
CO	Breckenridge	L	L		L	L		L							L	
CO	Brighton	L03	L03	L03	L03	L03										
CO	Broomfield, City/County	L	L	L	L	L		L	L							
CO	Brush	L03	L03	L03	L03	L03		L03	L03							
CO	Buena Vista	L	L													
CO	Canon City	L	L	L	L			L								
CO	Carbondale	L03	L03			L03		L03	L03							
CO	Castle Rock	L	L		L	L		L	L		L					
CO	Centennial	L03	L03	L03	L03	L03		L03								
CO	Central City	L03	L03	L03	L03	L03		L03	L03							
CO	Chaffee County	L	L													
CO	Cherry Hills Village	L	L	L	L	L		L	L							
CO	Clear Creek County	L03	L03		L03	L03										
CO	Clifton Fire Protection Dist			L												
CO	Coal Creek Canyon Fire Protection District			L03									L03			
CO	Collbran	L	L	L	L			L	L	L						
CO	Colorado Div. of Fire Safety	L		L												
CO	Colorado Div. of Housing	L03	L03		L03	L03		L03	L03							
CO	Colorado Div. Of Oil and Public Safety	L		L	L											All Public Schools
CO	Colorado Examing Brd of Plumbers and State Bldgs		X03		X03	X03		X03								
CO	Colorado Springs	L03	L03	L03	L03			L03	L03		L03					
CO	Colorado State Buildings	L03			L03				L03							
CO	Columbine Valley	L	L		L	L		L		L					L	
CO	Commerce City	L03	L03	L03	L03	L03		L03	L03	L03	L03	L03				
CO	Copper Mountain FPD			L												
CO	Cortez	L03	L03	L03	L03	L03		L03	L03	L03						
CO	Crested Butte	L03	L03		L03	L03		L03								
CO	Cripple Creek	L	L	L	L	L		L	L	L	L					
CO	Cunningham Fire Protec-tion District			L03												
CO	Dacono					L97										
CO	DeBeque	L	L	L	L			L	L	L						
CO	Del Norte	L03	L03		L03	L03										
CO	Delta	L03	L03	L03	L03	L03		L03	L03							
CO	Denver	L03	L03	L03	L03	L03		L03	L03							
CO	Dillion	L	L	L	L	L		L							L	
CO	Douglas County	L03	L03	L03	L03	L03		L03								
CO	Durango	L03	L03		L03	L03		L03	L03							
CO	Eagle	L03	L03		L03	L03		L03	L03						L03	
CO	Eagle County	L03	L03	L03	L03											
CO	Eaton	L03	L03		L03	L03		L03								
CO	Edgewater	L	L		L	L		L		L						
CO	El Paso County	L03	L03		L03			L03	L03		L03					
CO	Elk Creek FPD			L03									L03			
CO	Estes Park	L03	L03		L03	L03		L03	L03		L03					
CO	Evans	L03	L03	L03	L03	L03		L03		L03						
CO	Evergreen Fire Protection District			L03									L03			

Table 12. International Codes – Adoption by Jurisdiction (continued)

International Codes-Adoption by Jurisdiction

X = Effective Statewide A = Adopted, but may not yet be effective L = Adopted by Local Governments
S = Supplement 06 = 2006 Edition 04 = 2004 Edition 03 = 2003 Edition 00 = 2000 Edition

ST	Jurisdiction	IBC	IRC	IFC	IMC	IPC	IPSDC	IFGC	IECC	IPMC	IEBC	ICCPC	IWUIC*	IZC	ICCEC	Comments
CO	Fairmont Fire Protection District			L00												
CO	Federal Heights	L03	L03	L03	L03	L03		L03	L03	L03						
CO	Firestone	L	L		L	L		L								
CO	Florence	L	L	L	L											
CO	Foothills Fire and Rescue			L03									L03			
CO	Fort Collins		L03		L03	L03		L03								
CO	Fort Lupton					L										
CO	Fort Morgan	L03	L03	L03	L03	L03		L03	L03							
CO	Fraser	L	L		L	L		L								
CO	Frederick	L03	L03		L03	L03		L03								
CO	Fremont County	L03	L03													
CO	Frisco	L03	L03	L00	L03	L03		L03	L03							
CO	Fruita	L	L	L	L			L	L	L						
CO	Fruita Fire District			L												
CO	Garfield County	L03	L03		L03	L03		L03								
CO	Genessee FPD			L03									L03			
CO	Gilcrest	L	L		L	L		L								
CO	Glendale				L											
CO	Glenwood Springs	L03	L03	L03	L03	L03		L03		L03	L03					
CO	Glenwood Springs Fire District			L03												
CO	Golden Gate Fire			L03									L03			
CO	Granby	L	L		L	L		L								
CO	Grand County	L	L		L	L		L								
CO	Grand Jct Rural FPD			L												
CO	Grand Junction	L	L	L	L			L	L	L						
CO	Grand Junction Fire Dept			L												
CO	Grand Lake	L	L		L	L		L								
CO	Greeley	L03	L03	L03	L03	L03		L03		L03	L03					
CO	Greenwood Village	L03	L03	L03	L03	L03		L03								
CO	Gunnison	L03	L03	L03	L03	L03		L03	L03	L03	L03	L03				
CO	Gunnison County	L03	L03		L03			L03	L03							
CO	Gypsum	L03	L03	L03	L03			L03								
CO	Hayden					L										
CO	Hot Sulphur Springs	L	L		L	L		L								
CO	Hudson	L03	L03		L03	L03		L03								
CO	Huerfano County	L03	L03								L03					
CO	Ignacio	L03	L03		L03	L03		L03	L03							
CO	Indian Hills FPD			L												
CO	Inter-Canyon Fire Rescue			L03									L03			
CO	Jamestown	L03	L03		L03	L03		L03	L03							
CO	Jefferson County	L03	L03	L03	L03	L03		L03	L03							
CO	Johnstown	L03	L03	L03	L03	L03		L03	L03							
CO	Keenesburg				L	L										
CO	Kersey	L	L		L	L		L								
CO	Kremmling	L	L		L	L		L								
CO	La Plata County	L03	L03		L03	L03		L03	L03							
CO	Lafayette	L	L		L	L		L	L							
CO	Lake County	L03	L03		L03	L03		L03			L03				L03	
CO	Lake Dillon FPD			L												
CO	Lakewood	L	L	L	L	L		L	L							
CO	Lamar	L	L	L	L	L		L		L						
CO	Larimer County	L03	L03		L03	L03		L03	L03		L03					
CO	Littleton	L	L		L	L		L		L					L	
CO	Littleton FPD			L03												
CO	Lochbuie	L03	L03	L03	L03	L03		L03								
CO	Logan County	L	L		L	L00		L00								
CO	Lone Tree			L03												
CO	Longmont	L03	L03	L03	L03	L03		L03	L03	L03						
CO	Louisville	L	L	L	L	L		L	L							
CO	Loveland	L03	L03		L03	L03		L03		L03						
CO	Lower Valley Fire District			L												
CO	Lyons	L	L		L	L		L								
CO	Mancos	L	L						L	L						
CO	Mead	L	L		L	L		L								
CO	Meeker	L03	L03	L03	L03			L03								
CO	Mesa County Regional	L	L	L	L			L	L	L						Includes Palisade, Fruita, Collbran, DeBeque & City of Grand Junction
CO	Minturn	L	L		L	L										
CO	Moffat County	L03	L03		L03	L03		L03	L03	L03						
CO	Montezuma	L	L		L	L		L							L	
CO	Montrose	L03	L03	L03	L03	L03		L03		L03	L03	L03				
CO	Morgan County	L03	L03		L03											
CO	Mountain Village	L	L		L			L		L						
CO	Mt Crested Butte					L										

Table 12. International Codes – Adoption by Jurisdiction (continued)

International Codes-Adoption by Jurisdiction

X = Effective Statewide A = Adopted, but may not yet be effective L = Adopted by Local Governments
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ST	Jurisdiction	IBC	IRC	IFC	IMC	IPC	IPSDC	IFGC	IECC	IPMC	IEBC	ICCPC	IWUIC*	IZC	ICCEC	Comments
CO	Nederland	L	L		L	L		L	L							
CO	North Fork FPD			L03									L03			
CO	North Metro FPD			L03									L03			
CO	Northglenn	L03	L03		L03	L03		L03	L03							
CO	Nunn	L	L		L	L		L								
CO	Oak Creek					L										
CO	Orchard City	L	L		L	L		L	L							
CO	Palisade	L	L	L	L			L	L	L						
CO	Parachute	L03	L03	L03	L03	L03		L03								
CO	Parker	L03	L03	L03	L03	L03		L03	L03		L03					
CO	Parker Fire Protection District			L												
CO	Pierce	L	L		L	L		L								
CO	Pikes Peak Regional Building Dept.	L03	L03	L03	L03			L03	L03		L03					
CO	Pitkin County	L	L		L	L		L			L					
CO	Platteville	L	L		L	L		L								
CO	Pleasant View Fire Dept.			L03												
CO	Poncha Springs	L	L													
CO	Pueblo	L03	L						L							
CO	Pueblo County	L03	L03						L03							
CO	Rangely	L	L		L	L	L	L								
CO	Red Cliff	L	L		L	L										
CO	Red White & Blue Fire Rescue			L												
CO	Rifle	L03	L03		L03	L03		L03								
CO	Rio Blanco County	L	L		L	L										
CO	Rio Grande County	L03	L03		L03											
CO	Routt County	L03	L03	L03	L03	L03		L03			L03				L03	
CO	Routt County Regional					L										Includes Steamboat Springs
CO	Salida	L	L	L												
CO	San Miguel County	L03	L03		L03			L03	L03		L03					
CO	Severance	L	L		L	L		L								
CO	Sheridan	L03	L03	L03					L03	L03	L03					
CO	Silverthorne	L03	L03		L03	L03		L03								
CO	Snake River FPD			L												
CO	Snowmass Village	L	L	L	L	L		L	L		L					
CO	South Fork	L03	L03		L03											
CO	South Metro Fire District			L												
CO	South West Adams County Fire & Rescue			L06												
CO	Steamboat Springs					L										
CO	Sterling	L	L	L	L											
CO	Summit County	L	L		L	L		L							L	
CO	Superior	L03	L03	L03	L03	L03	L03	L03	L03	L03				L03		
CO	Thornton	L03	L03	L03	L03	L03		L03	L03							
CO	Timnath	L	L		L	L		L								
CO	Tri-Lakes Monument Fire Rescue	L03		L03	L03	L03		L03	L03				L03		L03	
CO	Trinidad	L03	L03	L03	L03				L04S							
CO	Vail				L	L										
CO	Weld County	L	L		L	L		L								
CO	Wellington	L	L		L	L		L								
CO	West Metro Fire Rescue			L03												
CO	Westminster	L	L	L	L	L		L	L							
CO	Wheat Ridge	L03	L03	L03	L03	L03		L03	L03	L03						
CO	Wheat Ridge Fire Protection District	L03		L03	L03	L03										
CO	Wiggins	L03	L03		L03											
CO	Windsor	L03	L03		L03	L03		L03								
CO	Winter Park	L	L	L	L	L		L								
CO	Yampa					L										

been adopted by two of the eight communities that were identified in need of these regulations.

Table 13. Local Government Flood Hazard Mitigation Plans

- City of Manitou Springs
- City of Colorado Springs
- Montrose County
- City of Boulder
- City of Arvada
- City of La Junta
- Otero County
- Prowers County
- Rio Blanco County
- Town of Basalt
- Town of Calhan
- Bent County
- Gunnison County
- Pitkin County
- Town of Wellington
- City of Delta
- San Luis Valley
- Town of Lyons
- Town of Jamestown
- City of Canon City
- City of Rifle
- City of Fort Collins
- City and County of Pueblo
- Town of Silver Plume
- Town of Rangely
- Town of Georgetown
- Town of DeBeque
- Town of Wattenburg
- Participants in Northeast Colo. Region Plan
- Participants in Northern Colo. Regional Plan
- Participants in Upper Arkansas Area Plan
- Participants in DRCOG Plan
- Participants in Pitkin/Eagle Counties Plan

(SOURCE: CWCB & DOLA WEBSITES)

With respect to a reduction of population and structures in the floodplain, a comparative evaluation of the information in Table 7 suggests a reduction since 2004 in the following counties: Arapahoe, Boulder, Chaffee, Conejos, Crowley, Delta, Dolores, Douglas, La Plata, Larimer, Lincoln, Otero, Phillips, San Miguel, Teller and Weld. This reduction likely resulted from several actions including, but not limited to, improvements in the floodplain delineation obtained from the Map Modernization Program, enforcement of local floodplain regulations, and implementation of flood mitigation projects.

Several local entities have also completed both planning and projects associated with flood mitigation. Fourteen Pre-Disaster Mitigation plans have been approved by FEMA as indicated below.

- DRCOG Regional Plan
- UAACOG Regional Plan
- Northeastern Colorado Regional Plan
- City of Colorado Springs PDM Plan
- Dolores County PDM Plan

- Gunnison County PDM Plan
- Hinsdale County PDM Plan
- Northern Colorado Regional Plan
- San Miguel County PDM Plan
- University of Colorado at Boulder
- Pitkin and Eagle Counties
- Mesa County PDM Plan
- Prowers County PDM Plan
- Rio Blanco County PDM Plan

Efforts to prepare additional plans are on-going. These entities consist of the following:

- Grand County
- Kiowa County
- Baca County
- Pueblo County
- El Paso County
- City of Boulder
- Bent County
- Routt County

Finally, funds available through the FMA program have been utilized for both planning and projects for flood mitigation. These funds are currently allocated to the following entities:

- City of Sterling project
- Town of Gilcrest project
- Costilla County plan
- Summit County plan
- Delta County plan
- Park County plan
- Teller County plan
- Ouray County plan
- Boulder County plan
- Huerfano County plan
- City of Fort Collins et al.

MITIGATION ACTIONS

A. Identification of Actions Under State Consideration

While similarities exist among the concepts of hazard mitigation, strong differences also exist among many of the strategies available to carry out these concepts. Warnings and land use application, such as floodplain regulations and acquisition of open space, are particularly cost-effective mitigation activities especially when compared to other available strategies, such as relief, insurance, and project measures. Effective land use, for example, can provide very high net benefits and can significantly lower future

catastrophic loss potentials in a given community. Other adjustments, except warnings, generally cost more and yield the possibility for repeated catastrophic loss. Although land use decisions are often controversial, when they are carefully planned and implemented, enormous savings in life and property can be realized in time. In Colorado, flood warning systems and effective land use decisions are implemented mainly by action at the local level. Therefore, this plan emphasizes mitigation activities that will essentially support local efforts.

The goals, recommendations and actions for this plan were derived from several sources in the planning process. Goals and objectives from the 2004 update to the NHMP 2001 umbrella document were reviewed. Additional goals were identified as needed. Finally, recommendations and actions were developed. The following recommendations represent the collaborative efforts of the SHMT and local emergency managers. Many of the recommendations can be implemented immediately; others must be viewed as long-term measures. The information below identifies the goals, recommendations related to for each goal, and the action associated with each recommendation.

GOAL 1: Encourage the Use Of Public Funds by State and Local Governments for Housing and Public Buildings in Non Hazardous Areas		
Recommendation	**Lead Agency/ Partner Agencies**	**Action**
Seek ratification of State Executive Orders 8504, 8491 and legislation such as H.B. 1041 and incorporate into the Colorado Flood Hazard Mitigation Plan. In addition promulgate rules and regulations to administer the legislation if necessary.	**CWCB**	Confirm governor's agreement Contact by Governor's office with responsible state agencies with legislative sponsor and begin drafting bill Perform updates to FHMP as warranted
Identify Long-Term Safe Affordable Housing Outside Hazard Areas Using Manufactured Housing Where Applicable and Volunteer Agency Construction	**DOLA**	Continue to contact local representatives to solicit involvement utilizing risk analysis Plan, identify flood-safe areas in Colorado's NFIP communities
When rehabilitating listed historic structures located in floodplains or other associated hazard areas, consider floodproofing, elevation, channelization or other techniques.	**CWCB** **FEMA**	Contact Colorado communities with historic districts and inform about mitigation grant programs and their opportunities
Work with the state Real Estate Services Division and State Buildings to ensure that facilities proposals and infrastructure take natural hazards into account when state projects are in the approval process.	**CWCB**	Review and comment on project proposals
Increase awareness of the designated 100-year floodplain in permitting new developments and structures	**CWCB**	Contact local managers and provide current information and technical data

GOAL 2: Promote Appropriate Land Use Decisions to Minimize the Vulnerability of Development to Floods		
Recommendation	**Lead Agency/ Partner Agencies**	**Action**
Provide technical comments and recommendations on proposed state and federal legislation related to growth management.	**CWCB** **DOLA**	In Progress
Develop guidance and criteria for mapping and Regulating mudflow/debris-flow areas.	**CWCB** **CGS and DEM**	In Progress Review CWCB guidance & criteria for traditional floodplain mapping Establish work schedule to undertake mudflow/debris-flow guidance & criteria Continue to improve mapping of mudflow/debris flow areas. Continue to identify areas of concern.
Research and support the use of conservation easements, transferable development rights, cluster development, recreational uses, wildlife areas and open space uses as tools when undertaking mitigation initiatives.	**DOW** **CWCB**	In Progress Gather information materials, solicit input from states with similar programs/initiatives Set schedule to develop guidance document
Optimize potential state and federal funding sources to support mitigation initiatives which are part of the Colorado Flood Hazard Mitigation Plan.	**DEM** **CWCB**	In Progress
Encourage use of watershed-based GIS maps in future land use planning and development review. Collaboration of storage space in existing reservoirs where appropriate.	**CWCB** **DWR**	Compile a current and sufficient volume of watershed-based GIS mapping information Work with USACE and local sponsors

GOAL 3: Educate the Public and Government Officials and Their Staffs About Flood Hazards and Mitigation		
Recommendation	**Lead Agency/ Partner Agencies**	**Action**
Enhance the natural and beneficial functions of floodplains by promoting an increased awareness of wetland and habitat resources and their benefits to flood hazard mitigation.	**DOW** **CWCB** **DWR**	Gather information materials Set schedule to develop guidance document Solicit input from states with similar initiatives
Provide flood hazard mitigation education for entities such as local water and wastewater management officials, local building officials, and road and bridge officials through state programs such as the FEMA-funded Community Assistance Program and other educational programs within state agencies such as the Division of Local Government (DLG) and the CWCB.	**CWCB** **DEM**	In progress annually Gather information materials Continue to set schedule and deliver workshops Promote the public awareness of appropriate web sites and information

GOAL 3: Continued		
Recommendation	**Lead Agency/ Partner Agencies**	**Action**
Promote regional intergovernmental cooperation concerning watershed-based planning and floodplain management using a strategic planning process with goals and recommendations.	**CWCB** **DEM** **DWR**	Contact local governments and determine level of interest Gather informational materials Set schedule to deliver strategic
Improve access to information regarding floodplain management, flood hazard mitigation and flood insurance through approaches such as the use of hyper-links between state agency websites, bibliographies of available materials, etc.	**CWCB** **DEM** **DWR**	Ongoing Post two public notices every March Establish webmaster duties Assign duties
Develop a hazard mitigation education program for public officials at annual conferences and workshops conducted by Colorado Association of Stormwater and Floodplain Managers (CASFM), Colorado Municipal League (CML), Colorado Counties Inc. (CCI), the Colorado Emergency Management Association (CEMA), the American Planning Association (APA), and the American Public Works Association (APWA)	**DNR** **COOT DEM**	Establish webmaster duties Assign duties Gather information materials Annual DEM training workshops for local officials and annual emergency management conference include hazard mitigation components
Through flood hazard reduction workshops, promote the use of a "hazard overlay" concept for GIS mapping using information developed by the Colorado Geological Survey (CGS) for Garfield County as a model.	**CGS** **CWCB** **OEM**	Conduct statewide workshops Conduct workshops on State Floodplain and Criteria Manual
Promote public education on wildfire mitigation to reduce flood hazard potential in post-burn areas.	**CWCB** **DEM, CSFS, local partners, RMIIA**	Gather informational materials Publish articles in newsletters and releases Annual wildfire and mitigation conference, partnership on public information brochures and campaigns, wildfire and lightning awareness weeks
Provide newsletter articles, other relevant information on flood hazard mitigation and other forms of information exchange to professional organizations and local governments.	**DEM** **CWCB**	Obtain agencies/entities PIO information, Preparedness newsletter articles from DEM
Develop a flood hazard awareness and education Program utilizing programs already in place.	**DEM** **CWCB**	Conduct workshops and provide educational materials
Promote the concept of people accepting fiscal responsibility for the consequences of living in floodprone areas.	**DEM, CWCB** **DNR** **DOLA**	Provide education materials to local governments and the public.

GOAL 4: Identify Adverse Impacts to Public Health and the Environment and Encourage the Mitigation of These Impacts When Considering the Expenditure of Public Funds		
Recommendation	**Lead Agency/ Partner Agencies**	**Action**
Promote: 1) the development of contingency plans for household hazardous materials, 2) anchoring/locating containers of hazardous materials, and 3) safely transporting these materials during flood events.	**CDPHE** **DEM**	Develop educational program for local emergency personnel Improve inventories of hazardous materials
Encourage small communities to develop centralized sewer and water systems in areas that will not be impacted by flooding and relocate or floodproof existing treatment plants and/or lagoons, where possible,	**CWCB** **DOLA** **DEM**	Develop educational outreach program, assist communities with development of projects and pursuit of funding

GOAL 5: Encourage the Design and Engineering of Infrastructure to Take Into Consideration the Mitigation of Potential Natural Hazard Impacts		
Recommendation	**Lead Agency/ Partner Agencies**	**Action**
Promote the design and operation of flood control systems and other related infrastructure to convey floodwaters safely,	**DWR** **CWCB**	Establish section in state criteria manual
Promote the sustainability and access of critical infrastructure during disaster events to the 100-year flood event.	**OEM** **CWCB** **DWR** **CDOT** **DOLA**	Develop educational outreach program,
Improve emergency warning systems and encourage the installation of additional sensors and reporting devices to improve high flow measurement capabilities along floodprone streams in high risk areas.	**DEM** **CWCB** **DWR**	Activities in progress, assist communities with development of projects and pursuit of funding
Work with local emergency planners and floodplain administrators to identify critical infrastructure, housing, businesses and all other structures in the floodplains in their communities. Incorporate the information into local emergency response plans.	**DEM** **CWCB**	Activities in progress
In floodplains that have already been urbanized, encourage and support a combination of structural and non-structural elements to reduce the risks from floods and other hazards.	**CWCB** **DEM**	Begin formulating workshops at which this message is delivered, assist communities with development of projects and pursuit of funding

GOAL 6: Promote the Adoption of Model Codes and Standards (Such as the UBC and IBC) That Emphasize Hazard Mitigation and Reduced Use of Hazardous Areas for Development		
Recommendation	**Lead Agency/ Partner Agencies**	**Action**
Support the concept of communities using land use or construction permitting processes consistent with hazard reduction principles.	**OEM** **CWCB** **DOLA**	In progress
Promote development of master drainage plans for state properties.	**CWCB** **OEM**	Survey state institutions to determine existing criteria. Encourage state departments to continue to develop plans for their critical assets.
Review the adequacy of existing stream gage networks and make recommendations for future maintenance and improvements.	**CWCB** **DWR**	Inventory existing stream gage network and produce report Annual improvements to selected stream gages

GOAL 7: Promote the Development of Flood Mitigation Plans		
Recommendation	**Lead Agency/ Partner Agencies**	**Action**
Promote the development of flood mitigation plans through the FMAP, PDM, and Flood Response programs.	**CWCB** **DEM**	Conduct statewide workshops Solicit applicants for planning grant funds Encourage adoption of plans by communities
Maintain database of communities with approved plans.	**CWC B**	Ongoing

GOAL 8: Publish Flood Documentation Report		
Recommendation	**Lead Agency/ Partner Agencies**	**Action**
Publish reports of major flood events that presents the flood hydraulics and hydrologic characteristics of the event and detail potential flood mitigation activities.	**CWCB** **USACOE** **USGS**	Prepare field report as needed
Publish annual report	**CWCB**	Prepare comprehensive report covering major flood events Document precipitation values, stream hydrology, inundation areas, and compilation of damages

GOAL 9: Modernize Current Floodplain Maps.		
Recommendation	**Lead Agency/ Partner Agencies**	**Action**
Digitize existing 100-year floodplain maps.	**CWCB**	In Progress with 8 completed counties
Promote compatibility of Federal, State, and Local GIS capabilities.,	**CWCB**	In Progress
Create user-friendly floodplain map system through website design,	**CWCB**	In Progress, website development for map mod program

Appendix B to this flood hazard mitigation plan provides pertinent information related to appropriate flood hazard mitigation strategies.

B. Evaluation of Actions and Activities

Under the guidance of the DEM, the plan will be reviewed every 3 years for consistency with the mitigation programs and updated and evaluated every 3 years, as required. A state team, chosen at the discretion of the emergency management director, will be convened to identify which objectives are still relevant, which actions have been completed and which actions should be carried over in the next revision. Mitigation reports will continue to be published in the DEM monthly reports to the director of DOLA as necessary. Quarterly reports for projects using FEMA funds are sent to FEMA. All applications for FEMA funds intending to be expended on mitigation projects include assurances that the state will comply with all applicable federal statutes and regulations. Specifically with respect to this flood hazard mitigation plan, accomplishments are monitored through the CWCB and the DWR and frequently published in reports, including, but not limited to "Flood Talk" and "The State Engineer's Annual Dam Safety Report". Many activities are covered by local media and can be accesses via websites or in local newspapers.

Actions in this plan will be specifically evaluated under the following process. If an activity is still deemed relevant and viable at the time of the update, it will remain in the plan. If the activity is deemed completed or outdated for cost or another reason, the review team/committee can review the value of the action and remove it. A very brief summary of significant actions taken during the three-year period can be included with each flood plan update. Draft plans will be put on the internet or some other public access method will be used to solicit review and comment. This flood plan was reviewed and adopted through the Colorado Water Conservation Board process.

C. Prioritization of Actions and Activities

Results of the prioritization efforts are summarized in Appendix J of the NHMP umbrella document. The implementation of actions, activities and projects related to the flood mitigation plan will be evaluated in accordance with the priorities established in Appendix J and presented in Table 14.

Other factors may be included to determine the priority associated with implementation of actions, activities and projects related to the flood mitigation plan. These factors include, but are not limited to, the following:

- Benefit-cost ratio
- Availability of matching funds
- Mitigation of repetitive loss structures

Table 14. Priority Schedule for Flood Mitigation Actions/Activities/Projects

Action/Activity/Project Associated with Mitigation of:	Priority
Loss of life/sustaining injuries	1
Damage to state critical infrastructure	2
Damage to local critical infrastructure	3
Economic loss at the state level	4
Economic loss at the local level	5
Damage to state non-critical infrastructure	6
Damage to local non-critical infrastructure	7
Damage to private property	8
Damage to private nonprofit property	9
Economic loss at the residential level	10

D. Contribution of Each Activity to Overall State Flood Mitigation Strategy

The overall state flood mitigation strategy was presented in the section entitled "Identification of Actions Under State Consideration". Recommended activities are listed in accordance with the goals established for the flood mitigation strategy. For each recommended activity, actions have been identified to achieve the recommendation.

E. Integration of Local Plans into Mitigation Strategy

Communities with local mitigation plans were identified in Table 13. As stated previously, local communities were originally encouraged by DEM to start their flood mitigation plans and have them completed for the original November 1, 2003 deadline associated with the umbrella document. New communities are presently being encouraged to start plans. Several local mitigation plans were completed between 2004 and 2006, providing a source of additional information for this update. Many communities that started the planning process last year and this year expect to have them completed and submitted to FEMA by the end of 2008. Several other communities expect to start the process this fall through funding sources (e.g., PDM, FMA) administered by the state. Most of the population in the state will be addressed in counties with plans through 2008.

Strategies and projects were also identified from local hazard mitigation plans, local emergency manager input and the county summaries provided in the umbrella document. The following strategies and projects related to flood hazard mitigation were identified (the number in parentheses indicates the number of times the item was identified).

- Conduct studies, new mapping and map improvements (50)
- Outreach and education projects: preparedness, flood insurance (32)
- Install or improve early warning systems (18)
- Encourage enrollment in existing programs: NFIP (3), StormReady (12)
- Adopt/revise building codes, design standards, land development regulations (10)
- Elevation/floodproofing (7)
- Property acquisition/relocation (6)
- Channel modifications/flood control/storm drainage improvements (31)
- Improve administration of FEMA flood hazard areas (4)
- Critical facilities protection (7)
- Storm shelters (11)
- Erosion and sediment control (3)

FUNDING SOURCES

A. Identification of Current Federal, State, Local Funding Sources

A discussion of current and potential funding sources available for flood hazard mitigation projects is included in Appendix G of the update to the NHMP umbrella document. Pertinent sections of Appendix G are summarized below.

Mitigation funding is available from the Federal Emergency Management Agency (FEMA) to support a few mitigation projects each year. Specifically, funding is available the Flood Mitigation Assistance (FMA) and Pre-Disaster Mitigation (PDM) grant programs. Currently, PDM is capped at $3 million. It is the role of the preparedness and mitigation staff of CDEM to help communities locate potential sources of available federal and state funding. As grants from different sources are posted, CDEM staff advertises to the communities and special districts. If a disaster occurs, the State will utilize Hazard Mitigation Grant Program (HMGP) and Public Assistance (PA) mitigation funds. PA mitigation funds will be used in accordance with program requirements and will be used for damaged facilities. HMGP funds may be used primarily in the affected area or may be used statewide at the Governor's and/or his representative's (GAR's) discretion. Local governments will continue to pursue grants from federal agencies to purchase equipment, training, and planning. Department of Homeland Security funds are part of the state strategy to fund interoperability and communications. FEMA and DWR provide funds to local dam owners to update and improve emergency preparedness plans. PDM, FMA, HMPG and other funds have been utilized for pre-disaster plans. Additional information regarding the funding available from both federal and state agencies is summarized in Table 10.

Large projects continue to be completed with federal and state funds and technical assistance from federal agencies other than FEMA. Examples include, but are not limited to, the U.S. Department of Transportation, the USDI Bureau of Land Management, USDI National Park Service, the USDA Forest Service, and the US Army Corps of Engineers. The USDA Natural Resource Conservation Service has programs for projects both exigent and not, including the Emergency Watershed Protection Program. The Small Business Administration has provided funding related to several Presidential, USDA, and SBA administrative declarations in recent years. U.S. ACE General Investigations and Continuing Authorities Programs provide opportunities for water resources projects, studies, design and engineering, and technical expertise.

The governor can move funds into the State Disaster Emergency Fund to fund emergency types of activities. The local agencies have the required TABOR (Taxpayers Bill of Rights) reserves for use during emergencies. Local districts have used taxing mechanisms, such as mill levies, to support prevention activities. Local entities also actively pursue grant opportunities through federal and state agencies.

Education projects, outreach programs, repeater sites, early detection and warning/notification systems, generators for backup power, are very popular flood mitigation methods in Colorado. Local communities are constantly seeking sources of funding to maintain programs and install or upgrade systems. Unfortunately, funds for these types of projects are limited and the need strongly outweighs the availability. Even if communities receive initial funding, continuation of programs creates new financial needs on already very tight budgets with competing demands. In spite of this, Colorado communities have made great strides and progress in prevention and preparedness activities and continue to do more each year by taking advantage of limited opportunities. For example, several communities benefited years ago from a grant program through USDA designed to fund repeater sites in remote locations, thereby serving communities with need but without means to get warnings pertinent to their immediate area. CDEM staff promoted the grant opportunity and worked with communities on grant applications.

The state has loan and grant programs for which prevention activities are eligible. Funding sources traditionally used have been energy impact funds, gaming funds, general funds, and severance tax. Many agencies have grant programs, including, but not limited to, the State Forest Service, Water Conservation Board, Division of Water Resources, Division of Emergency Management, and the Soil Conservation Service.

B. Identification of Potential Federal, State, Local Funding Sources

Other potential sources of funding have been identified, and have been included in the information presented in the section above.

C. Sources of Funding Used to Implement Previous Mitigation Activities

Since approval of the 2004 update to the NHMP, the sources listed below have been utilized to fund flood mitigation activities within the state.

Flood Management Assistance (FMA) Program

2005: Flood Mitigation Project, City of Sterling
Flood Mitigation Planning Project, Costilla County
State-wide Flood Mitigation Planning Projects

2006: Detention Pond Project, Town of Gilcrest
Flood Mitigation Planning Projects, Summit, Delta, Park, Teller, Ouray, and Boulder Counties

2007: Flood Mitigation Plan, Huerfano County
Flood Mitigation Plan, City of Fort Collins, et al.

SECTION 5: COORDINATION OF LOCAL MITIGATION PLANNING

LOCAL FUNDING AND TECHNICAL ASSISTANCE

A. Description of State Process to Support Local Plan Development

The state process to encourage and support the development of local flood mitigation plans is presented in Appendix G of the 2007 update to the NHMP and has been presented in previous sections of this document. Local plan development is required as a condition for receiving any Federal disaster grant funding (under the HMGP) to evaluate the impact of natural hazards within designated disaster areas, and to identify actions that will reduce the effects of such hazards. In general, the mitigation staff of the DEM is responsible to provide technical assistance and training to local governments to assist them in developing local mitigation plans and project applications. The mitigation staff is also responsible to review and submit all local mitigation plans to FEMA.

B. Funding/Technical Assistance Provided in Past Three Years

Since approval of the 2004 update to the NHMP, funding and technical assistance has been provided to several local entities. This work has culminated in the completion of several hazard plans between 2004 and 2007. Workshops and seminars have been presented through the Community Assistance Program (CAP) to assist communities with the development of flood mitigation planning documents. In addition, as indicated previously, funding available from the FMA Program has been accessed to develop flood mitigation planning documents. These funds have been utilized to address flood mitigation planning statewide (2005), and specifically in Costilla, Summit, Park, Teller, Ouray, Boulder, and Delta Counties (2005, 2006), the City of Fort Collins et al. (North Colorado HMP) (2007), and Huerfano County (2007).

LOCAL PLAN INTEGRATION

A. Process and Timeframe to Review Local Plans

A worksheet was developed and is utilized by the DEM to review each local mitigation plan. This worksheet can be found in Appendix B to the 2007 update to the NHMP and is included as Appendix C to this document. With respect to flood mitigation planning, the worksheet specifically reviews the following information:

- Population affected by flooding
- Number of structures affected by flooding
- Number of critical facilities affected by flooding
- Potential loss ($) associated with flooding

The projected vulnerability associated with future development is also identified and reviewed as it pertains to future population, future number of structures, and future potential loss ($). This includes additional information regarding population shifts, changes in land use, effects of mitigation projects, etc.

The capability of each local entity is identified and reviewed along with the effectiveness associated with each capability identified below:

- Floodplain regulations
- Zoning ordinances
- Building codes
- Emergency warning systems
- Evacuation plans
- Public information programs
- Environmental education programs
- GIS/Mapping
- Master plans

Included in the review of the local entity capability is the identification of potential flood mitigation projects.

As local plans are submitted to the State, the initial review is conducted by the CWCB CAP coordinator and the DEM mitigation planner. The CAP coordinator and the mitigation planner will utilize the worksheet to conduct the review along with the Plan Review Crosswalk. Comments are provided to the State Hazard Mitigation Officer (SHMO) for review and additional scrutiny. If revisions are necessary, the Plan Review Crosswalk will be returned to the local entity for corrections and re-submittal. Plan review by the State generally takes about 45 days, but is largely dependent on the density of the workload and the size and detail of the plans being reviewed.

B. Process and Timeframe to Coordinate and Link Local Plans to State Mitigation Plan

Information available from the local flood mitigation plans is compiled and utilized during the development of the state flood hazard mitigation plan. This information is supplemented by data available from other sources (such as FEMA's Community Information System and local emergency managers) to develop the state mitigation plan. The coordination and integration of the local plans into the state mitigation plan is a continuous process. Following the review and approval of the local mitigation plans, pertinent information is identified and compiled that would be necessary to update the state hazard mitigation plan. Local plans that have been approved are obtained in digital form and access is provided via the DEM website.

Flood mitigation projects are tracked, from submittal through approval and completion, by the CWCB CAP coordinator on a spreadsheet that provides the following information:

- Local jurisdiction
- Project type (planning, mitigation project, or technical assistance)

- Total project cost
- Non-federal share of the total project cost
- Federal share of total project cost (itemized by planning, mitigation project or technical assistance)
- Date of funding/award
- Performance period/completion date

PRIORITIZING LOCAL ASSISTANCE

A. Description of Criteria for Prioritizing Planning and Project Grants

The criteria and process used to prioritize funding assistance requests is described below. When a Notice of Interest (for receipt of financial assistance) is submitted to the state, it must meet certain minimum criteria. These include whether the project: complies with the state's hazard mitigation strategies; meets funding eligibility requirements; is an independent solution to the problem; does not duplicate other funding sources, has a beneficial impact on the declared area, and is cost-effective and environmentally sound. When projects are competing for limited funding, projects are scored and ranked. Under the direction of the State Hazard Mitigation Officer (SHMO) and the Governor's Authorized Representative (GAR), a subcommittee of the State Hazard Mitigation Team (SHMT) convenes to score and rank the projects. The ranking is to be based on criteria derived from 44 CFR 206.434(b), and may or may not be specific to the disaster.

Other considerations that will be weighed by the application review committee in awarding grants include, but are not limited to:

- relative need (risk) compared to other local entities requesting projects
- repetitive losses mitigated by project(s)
- benefit-cost analyses (may include b/c ratios greater than 1 for construction projects)
- future development patterns and development pressure
- availability/amount of grant funds along with commitment for matching funds

B. Cost-Benefit Review of Non-Planning Grants

As noted above and in Appendix D, one of the criteria used for eligibility of all projects is whether the project is cost-effective. This applies to projects funded by non-planning grants as well as planning grants.

C. Criteria Considers High Risk, Repetitive Loss, Intense Development Pressure

As noted above, as part of the criteria used to rank projects, points are given for the following:

- relative need (risk) compared to other local entities requesting projects
- repetitive losses mitigated by project(s)
- future development patterns and development pressure

SECTION 6: PLAN MAINTENANCE PROCESS

MONITORING, EVALUATING AND UPDATING THE PLAN

A. Method and Schedule for Monitoring Plan

Successful implementation of the flood hazard mitigation plan is the next step in the plan process. Both state and local involvement continue to be the foundation during the implementation and monitoring phases. The local emergency management offices and state level agencies will also play key roles in effective implementation and monitoring.

Division of Emergency Management (DEM) and Colorado Water Conservation Board (CWCB):

The DEM and the CWCB will be responsible for coordinating the implementation and monitoring activities developed through the planning process and detailed in this plan document. They will involve the SHMT, other state agencies, local/county emergency management coordinators (EMCs), and other state and local level organizations. In

addition to the coordinator role, DEM and CWCB will develop and conduct education and outreach activities to introduce the plan to the residents of the state. Activities will be targeted to specialized audiences: local level officials, state agencies, and policymakers. These audiences have been a part of the plan development and they will continue their participation through expanded awareness of their stake in its successful implementation. The purpose of this outreach is not to provide technical assistance, but rather to build a widespread understanding of the plan and the importance of mitigation.

The DEM State Hazard Mitigation Officer (SHMO) and the CWCB Community Assistance Program (CAP) Coordinator will conduct coordination activities that will result in the implementation and monitoring of this plan.

Role of State Hazard Mitigation Officer (SHMO) in Hazard Mitigation:

In addition to the previously mentioned roles, The SHMO will activate the State Hazard Mitigation Team and serve as the chair of the team. The SHMO coordinates with the CWCB in the implementation of mitigation recommendations and monitoring activities as determined in the plan. The SHMO is responsible for the review of local multi-hazard mitigation plans and submittal to FEMA for approval. Additionally, the SHMO is responsible for the development and utilization of some mitigation training materials.

Role of Colorado Water Conservation Board (CWCB) in Hazard Mitigation:

In addition to the above-mentioned activities, there are several duties and responsibilities of the CWCB which include:

- Continue to support the statewide association of local floodplain managers known as CASFM
- Work with other agencies in approving mitigation activities
- Assist in exploring a state funding pool exclusively for flood hazard mitigation
- Serve as communication liaison with regional FEMA personnel
- Assist in the implementation and monitoring of cost-effective and environmentally-acceptable flood mitigation
- Provide technical assistance to county EMCs
- Visit each of the 64 counties on a five-year cycle, monitoring local project progress, as well as monitoring annual maintenance activities

- Develop training materials about mitigation
- Select digital area mapping for recovery operations

Role of Local Government Emergency Managers and Floodplain Coordinators:

Local government emergency management and floodplain coordinators are frequently forced by multiple roles and job demands to deal with mitigation issues and projects. Throughout the mitigation planning process, the county EMCs and floodplain coordinators have played an important role. They are the local level contact and the coordinator of mitigation implementation and monitoring, programs and activities. In that role, the county EMC is the key communication point between the state and local level and between local community agencies and organizations.

Local government emergency management coordinators and floodplain managers will assist in implementing and monitoring this plan at the local level. Among suggested actions are:

- Working closely and communicating with the DEM staff and the SHMO to implement and monitor mitigation recommendations
- Conducting public awareness and education activities on mitigation, its importance and methods
- Conducting education/outreach activities for community organizations
- Developing, implementing and monitoring the mitigation recommendations appropriate for the county
- Working with other community organizations and agencies on local mitigation projects
- Participating in regional and statewide cooperative mitigation efforts
- Identifying critical facilities and infrastructure at risk from hazards
- Monitoring progress in recommendation implementation through participation on a regional team

As the link between the CAP Coordinator, SHMO, and other community agencies and organizations, the county emergency management coordinator and/or floodplain manager is/are the recognized focal point(s) for implementation and monitoring of mitigation activities at the local government level.

The plan will be reviewed every 3 years for consistency with the mitigation programs and updated and evaluated by the DEM every three years, as required. A state team, chosen at the discretion of the emergency management director, will be convened to identify which objectives are still relevant, which actions have been completed and which actions should be carried over in the next update.

Mitigation activities in this plan will be specifically evaluated under the following process. If an activity is still deemed relevant and viable at the time of the update, it will remain in the plan. If the activity is deemed completed or outdated for cost or another reason, the review team/committee can review the value of the action and remove it. A very brief one-page summary of significant actions taken during the three-year period will be included with each update.

Mitigation reports will continue to be published in the DEM monthly reports to the director of the Department of Local Affairs, as necessary. Quarterly reports for projects using FEMA funds will continue to be sent to FEMA. All applications for FEMA funds earmarked for mitigation projects include assurances that the state will comply with all applicable federal status and regulations. Mitigation accomplishments will be monitored by CWCB through the CAP Coordinator with pertinent information published in "Flood Talk" and "the State Engineer's Annual Dam Safety Report".

A simplified one-to-two page reporting form will be used by the CWCB to report to the DEM. DEM will monitor the implementation process as a whole at all levels to ensure that progress is being made. Representatives of the DEM and CWCB CAP Coordinator will participate in onsite visits with a goal of reaching each of the Colorado counties over a five-year period. Not only will this give the state a first-hand look at the progress of mitigation implementation in the counties, but it will provide an opportunity for local level officials and the county EMCs to address needs, barriers, problems, and successes in their local mitigation efforts. The visits will be structured so that county EMCs and floodplain administrators are able to demonstrate their mitigation progress. This may also involve meeting with other local mitigation participants, such as the local utilities, county highway officials, or community organizations.

B. Method and Schedule for Evaluating Plan

The methods and schedule for evaluating the state flood mitigation plan were presented in the previous section. The roles of various entities during the plan development and evaluation were also discussed.

The criteria utilized to evaluate the plan will be obtained from the Plan Review Crosswalk. Information received from FEMA during its review of the flood mitigation plan will be presented in the comment section of the Plan Review Crosswalk. Each section and element of the Plan Review Crosswalk will be reviewed and additional data requirements or information identified as indicated by the FEMA reviewer. Data requirements and information will be compiled and integrated into revisions associated with the next update to the plan.

C. Method and Schedule for Updating Plan

The methods and schedule for updating the state flood mitigation plan were presented in the previous sections. The roles of various entities during the plan development, evaluation and update process were also discussed.

D. Evaluation of Methods, Schedule, Elements and Processes Identified in Previous Plan

Refer to the previous sections of this element (Monitoring, Evaluating, and Updating the Plan) for a discussion related to the evaluation of the methods, schedule, elements and processes identified in the previous plan.

MONITORING PROGRESS OF MITIGATION ACTIVITIES

A. Monitoring Mitigation Measures and Project Closeouts

An agreed upon FEMA/state method will be utilized for monitoring all mitigation projects. Projects must be completed and reconciled within 3 years for those projects completed following a disaster declaration unless an extension is approved by FEMA.

For project completions, subgrantees shall submit a letter with all final project documentation and a final inspection report to DEM requesting closeout. The SHMO, mitigation staff, and financial officer are responsible to review all paperwork for completion and determine that all eligible work was completed within the performance period. Site visits and inspections are conducted when deemed necessary.

B. Reviewing Progress on Achieving Goals in Mitigation Strategy

The goals associated with the flood mitigation plan were presented in the table in a previous section ("MITIGATION ACTIONS, A. Identification of Actions Under State Consideration"). Mitigation recommendations were also identified in this table along with the actions taken to achieve the recommendations. This table will be utilized as a tool to review the progress on achieving the goals and recommendations related to the flood hazard mitigation plan. As actions are completed, the table will be updated to reflect the mitigation action and achievement of the recommendation.

The CWCB CAP Coordinator will be responsible for collecting the information necessary to update the progress of the goals and recommendations identified in the table. Much of this information will be provided by representatives of state agencies responsible for flood mitigation activities as well as local emergency managers and floodplain managers.

As mentioned previously, a simplified one-to-two page reporting form will be used by the CWCB to report to the DEM. DEM will monitor the implementation process as a whole at all levels to ensure that progress is being made. Representatives of the DEM and CWCB CAP Coordinator will participate in onsite visits with a goal of reaching each of the Colorado counties over a five-year period. These visits will provide the state with a first-hand look at the progress of mitigation implementation in the counties and will provide an opportunity for local level officials and the county EMCs to address needs, barriers, problems, and successes in their local mitigation efforts. The visits will be structured so that county EMCs and floodplain administrators are able to demonstrate their mitigation progress. This may also involve meeting with other local mitigation participants, such as the local utilities, county highway officials, or community organizations.

C. Changes in System for Tracking Mitigation Activities

For FEMA-funded projects, quarterly progress reports are required from subgrantees, which are to reflect project and cost status. These reports are reviewed by Mitigation staff and the State Hazard Mitigation Officer, and submitted to FEMA.

As previously discussed, flood mitigation activities (both planning and project activities) will be tracked, from submittal through approval and completion, by the CWCB CAP coordinator on a spreadsheet that provides the following information:

- Local jurisdiction
- Project type (planning, mitigation project, or technical assistance)
- Total project cost
- Non-federal share of the total project cost
- Federal share of total project cost (itemized by planning, mitigation project or technical assistance)
- Date of funding/award
- Performance period/completion date

D. System for Reviewing Progress on Implementing Activities and Projects of Mitigation Strategy

The procedures utilized for reviewing the progress associated with implementing activities and projects related to the mitigation strategy were discussed in the two previous sections. In summary, the system will include the utilization of the table presented in a previous section ("MITIGATION ACTIONS, A. Identification of Actions Under State Consideration") along with the tracking spreadsheet utilized by the CWCB CAP coordinator.

E. Implementation of Previously Planned Mitigation Actions

Several actions have been implemented since the 2004 update to the NHMP. Public outreach and training included workshops and seminars through the Community Assistance Program (CAP) to assist communities with the development of flood mitigation planning documents; training for local emergency managers conducted by the

DEM in February 2007. In addition, funding available from the FMA Program has been accessed to develop flood mitigation planning documents. These funds have been utilized to address flood mitigation planning statewide (2005), and specifically in Summit, Teller, Park, Ouray, Boulder, and Delta Counties (2006), the City of Fort Collins et al. (2007), and Huerfano County (2007). The CWCB has developed a criteria manual to guide local communities in their floodplain and stormwater planning and mitigation activities. Flood mitigation activities have also been completed and new projects include the City of Sterling (2005) and the Town of Gilcrest (2006).

APPENDIX A

DEFINITIONS AND ACRONYMS

APPENDIX A – DEFINITIONS, ACRONYMS, & REFERENCES

44-CFR PART 9: Floodplain Management and Protection of Wetlands; regulations to implement and enforce Executive Order 11988, Floodplain Management, and Executive Order 11990, Protection of Wetlands.

44-CFR PART 206: Federal Disaster Assistance for Disasters Declared On or After November 23, 1988; regulations for implementing the Stafford Act.

100-Year Discharge: is the volume rate of streamflow (usually expressed in cubic feet per second) having a 100-year frequency of recurrence. This discharge magnitude is based on statistical analysis of stream flow records and analysis of rainfall and runoff characteristics in a particular watershed.

100-Year Flood: (also called the Base Flood) is the flood having a one- percent chance of being equaled or exceeded in magnitude in any given year. Contrary to popular belief, it is not a flood occurring once every 100 years.

100-Year Floodplain: The area adjoining a river, stream, or watercourse covered by water in the event of a 100-year flood. (see 100-year Floodplain Schematic)

100-Year Frequency: means a recurrence interval averaging 100 years. It can also be stated as having a one- percent probability of occurring in any given year.

Assistance: Any form of Federal grant under section 404 to implement cost effective mitigation measures that will reduce the risk of future damage, hardship, loss, or suffering as a result of major disasters.

Base Flood: shall mean the flood having a one-percent chance of being equaled or exceeded in magnitude in any given year. (Also knows as the 100-Year Flood). This is the flooding event that is used to calculate flood risk for the National Flood Insurance Program (NFIP) and the Federal Emergency Management Agency (FEMA).

Base Flood Elevation: means the height (above sea level) that flood waters will reach at a given location in the event of the Base (100-year) flooding event.

Dam Safety - A program to inventory, classify and inspect dams to identify hazardous conditions and insure proper maintenance through corrective orders for the purpose of protecting human life and property. A dam (including the waters impounded by such dam) constitutes a threat to human life or property if it might be endangered by overtopping, seepage, settlement, erosion, sediment, cracking, earth movement, earthquakes, failure of bulkheads, flashboards, gates on conduits, or other conditions.

Emergency: - Any occasion or instance which, in the determination of the President, Federal assistance is needed to supplement state and local efforts and capabilities to save lives and protect property and public health and safety, or to lessen or avert the threat of a catastrophe in any part of the United States.

Executive Orders 11988 and 11990: The requirements to avoid direct or indirect support of floodplain development and to minimize harm to floodplains and wetlands. Federal decision-makers are obligated to comply with these orders, accomplished through an eight-step decision-making process.

Flood: means a general and temporary condition of partial or complete inundation of normally dry land areas from: (1) The overflow of inland or tidal waters. (2) The unusual and rapid accumulation of runoff of surface water from any source.

Flood Insurance Study (FIS): is an engineering study performed by FEMA to identify flood hazard areas, flood insurance risk zones, and other flood data in a community.

Flood Mitigation Assistance Program: A program created under the National Flood Insurance Reform Act of 1994 to provide mitigation planning and project grants to states and communities. The program is funded through flood insurance policy fees. A maximum of $20 million in grant money is available annually.

Floodplain: The lowland and relatively flat areas adjoining inland or coastal waters including, at a minimum, that area subject to a one percent or greater chance of flooding in any given year.

Floodplain Management: - A comprehensive approach "to reduce the damaging effects of floods, preserve and enhance natural values and provide for optimal use of land and water resources within the floodplain. Its goal is to strike a balance between the values obtainable from the use of floodplains and the potential losses to individuals and society arising from such use". The operation of an overall program of corrective and preventive measures for reducing flood damage, including but not limited to, emergency preparedness plans, flood control work, and floodplain management regulations.

Flood-proofing: Permanent or contingent measures applied to a structure and/or its contents that automatically prevent or provide resistance to damage from flooding by intentionally allowing water to enter the structure. Examples: Move all electrical outlets above expected flood levels; install floodwalls and protection closets around equipment, and secure furnace and water heater that cannot be relocated.

Floodway: means the channel of a river or watercourse and the adjacent land areas that must be reserved in order to discharge the 100-year flood without cumulatively increasing the water surface elevation more than one foot. Federal Hazard Mitigation Officer (FHMO): The FEMA employee responsible for representing the agency for each declaration in carrying out the overall responsibilities

for hazard mitigation and for Subpart M, including coordinating post-disaster hazard mitigation actions with other agencies of government at all levels.

Gauging Station: is a particular site on a stream, river, canal, lake or reservoir where systematic observations of gage height or discharge are collected.

Hazard Mitigation - A plan "to alleviate by softening and making less severe the effects of a major disaster or emergency and of future disasters in the affected areas, including reduction or avoidance". "Hazard mitigation can reduce the severity of the effects of flood emergency on people and property by reducing the cause or occurrence of the hazard; reducing exposure to the hazard; or reducing the effects through preparedness, response and recovery measures. Hazard mitigation is a management strategy in which current actions and expenditures to reduce the occurrence or severity of potential flood disasters are balanced with potential losses from future floods".

Hazard Mitigation Grant Program: A program authorized under Section 404 of the Stafford Act that provides funding for hazard mitigation projects that are cost effective and complement existing post-disaster mitigation programs and activities by providing funding for beneficial mitigation measures that are not funded through other programs.

Hazard Mitigation Plan: The plan resulting from a systematic evaluation of the nature and extent of vulnerability to the effects of natural hazards in a given area, that includes the actions needed to minimize future vulnerability to hazards. Section 409 of the Stafford Act requires that a hazard mitigation plan be developed (or an existing plan be updated) as a condition of receiving Federal disaster assistance.

Hazard Mitigation State Administrative Plan: The plan developed by the State to describe the procedures for administration of the Hazard Mitigation Grant Program.

Local Emergency Management Coordinator: The person appointed to coordinate emergency management activities for a county or municipal emergency management program.

Major Disaster: Any natural catastrophe (including any hurricane, tornado, storm, high-water, wind-driven water, tidal wave, tsunami, earthquake, volcanic eruption, landslide, mudslide, snowstorm, or drought), or, regardless of cause, any flood, fire, or explosion, in any part of the United States which in the determination of the President cause damage of sufficient severity and magnitude to warrant major disaster assistance under the Stafford Act to supplement the efforts and available resources of states, local governments, and disaster relief organizations in alleviating the damage, loss, hardship, or suffering caused thereby.

National Flood Insurance Program (NFIP): The program established in 1968 under the National Flood Insurance Act to provide property owners in floodplains with Federally subsidized flood insurance in those communities that implement ordinances to reduce future flood losses. The National Flood Insurance Reform Act of 1994 revised and strengthened many aspects of the program.

State Hazard Mitigation Officer (SHMO): The representative of state government who serves on the Hazard Mitigation Survey Team and/or Interagency Hazard Mitigation Team, and who is the primary point of contact with FEMA, other Federal agencies, and local units of government in the planning and implementation of post-disaster mitigation activities.

State Hazard Mitigation Team: The team composed of key state agency representatives and, as appropriate, local units of government and other public or private sector agencies, which is responsible for evaluating hazards, identifying strategies, coordinating resources, and implementing measures that will reduce the vulnerability of people and property to damage from hazards.

Zone A (Unnumbered): are Special Flood Hazard Areas subject to inundation from the 100-Year flood. Because detailed hydraulic analyses have not been performed, no base flood elevation or depths are shown. Mandatory flood insurance purchase requirements apply.

Zone AE and A1-30: are Special Flood Hazard Areas subject to inundation by the 100-Year flood determined in a Flood Insurance Study by detailed methods. Base flood elevations are shown within these zones. Mandatory flood insurance purchase requirements apply. (Zone AE is used on new and revised maps in place of Zones A1-30.)

Zone AH: are Special Flood Hazard Areas subject to inundation by 100-Year shallow flooding (usually areas of ponding) where average depths are between one and three feet. Base flood elevations derived from detailed hydraulic analyses are shown in this zone. Mandatory flood insurance purchase requirements apply.

Zone AO: are Special Flood Hazard Areas subject to inundation by 100-Year shallow flooding (usually sheet flow on sloping terrain) where average depths are between one and three feet. Average flood depths derived from detailed hydraulic analyses are shown within this zone. Mandatory flood insurance purchase requirements apply.

Zone B, C, and X: are areas that have been identified in the community flood insurance study as areas of moderate or minimal hazard from principal source flood in the area. However, buildings in these zones could be flooded by severe, concentrated rainfall coupled with inadequate local drainage systems. Flood Insurance is available in participating communities but is not required by regulation in these zones. (Zone X is used on new and revised maps in place of Zones B and C.)

Zone D: are unstudied areas where flood hazards are undetermined by flooding is possible. No mandatory flood insurance purchase requirements apply, but coverage is available in participating communities.

ACRONYMS

APA American Planning Association
ASCS Agricultural Stabilization and Conservation Service
BFE Base Flood Elevation
BLM Bureau of Land Management
BOR Bureau of Reclamation
CAP Community Assistance Program
CAV Community Assessment Visit
CCA Comprehensive Cooperative Agreement
CDBG Community Development Block Grants
CERCLA Comprehensive Environmental Response, Compensation, and
Liability Act
CFR Code of Federal Regulations
cfs Cubic feet per second
COE Corps of Engineers (Same as USACE)
CRS Community Rating System
DFO Disaster Field Office
DFS Department of Family Services
DH Department of Health
DOT Department of Transportation
DSR Damage Survey Reports
EDA Economic Development Administration
E.O. Executive Order
EOC Emergency Operations Center
EOP Emergency Operations Plan
EPA Environmental Protection Agency
FBFM Flood Boundary and Floodway Map
FCO Federal Coordinating Officer
FCIC Federal Crop Insurance Corporation
FEMA Federal Emergency Management Agency
FHBM Flood Hazard Boundary Map
FHWA Federal Highway Administration
FIA Flood Insurance Administration
FIRM Flood Insurance Rate Map
FIS Flood Insurance Study
FLB Farm Loan Board
FPM Floodplain Management
FSA Farm Service Agency
HAZMAT Hazardous Materials
HMA Hazard Mitigation Assistance
MCSAP Motor Carrier Safety Assistance Program MM Modified Mercalli
NAD North American Datum
NFIP National Flood Insurance Program
NIIMS National Interagency Incident Management System
NOAA National Oceanic and Atmospheric Administration
NRCS Natural Resources Conservation Service
NWS National Weather Service
OCE Office, Corps of Engineer's
OSC On-scene Coordinator
P.L. Public Law
PEA Public Education and Awareness
PSC Public Service Commission
RCRA Resource Conservation and Recovery Act
SALEC State Law Enforcement Communications System
SAP State Assistance Program
SBA Small Business Administration
SCS Soil Conservation Service
SELS Severe Local Storms
SFHA Special Flood Hazard Areas
sq. ml. square miles
SHMO State Hazard Mitigation Officer
SHPO State Historic Preservation Officer
TSD Treatment, storage and disposal
USACE United States Army Corps of Engineers
USDA United States Department of Agriculture
USF&WS United States Fish & Wildlife Service
USGS United States Geological Survey, U.S. Department of Interior
WAPA Western Area Power Authority
WRDS Water Resources Data System
WSFO Weather Service Forecast Office
WYO Write Your Own

APPENDIX B

FLOOD HAZARD MITIGATION STRATEGIES

APPENDIX B - MITIGATION STRATEGIES

Introduction
There are basic strategies that may be applied to mitigate flood hazards. Each strategy has different measures that are appropriate for different conditions. In many communities, a different person may be responsible for each strategy. The strategies are described briefly below (see ***figure B-2)***.

Planning:
Through prevention, flood problems are kept from getting worse. The use and development of floodprone areas is limited through planning, land acquisition, or regulation. Building, zoning, planning, and/or code enforcement offices usually administer preventive measures.

Property protection:
Property owners on a building-by-building or parcel basis usually undertake property protection. Government agencies can provide information and technical or financial assistance to owners who want to elevate, floodproof, insure, or otherwise protect their property.

Emergency services:
Emergency measures are taken during a flood to minimize its impact These measures are the responsibility of city or county emergency management staff and the owners or operators of critical facilities.

Flood protection:
Keeping floodwaters away from an area with a levee, reservoir or other structural project is the goal of flood control. Flood control activities are usually designed by engineers and managed or maintained by public works staff.

Prevention
Prevention measures are designed to keep the problem from occurring or getting worse. They ensure that future development does not increase flood damage or they maintain the drainage system's capacity to carry away floodwaters.

Planning
Comprehensive plans and land use plans identify how a community should be developed. Generally, a plan has limited authority. It reflects what the community would like to see happen. Its utility is that it guides other local measures, such as capital improvement programs, zoning ordinances, and subdivision ordinances. The ordinances are covered in later sections.

A community's capital improvement program identifies where major public expenditures will be made over the next 5 to 20 years. Capital expenditures may include acquisition of land for public uses, such as parkland, and extension or improvement of roads and utilities.

If the community's long range plan calls for preserving the floodplain as open space, then the capital improvement program should support the plan by acquiring floodprone areas for parks and by not improving or extending roads into the floodplain.

Where appropriate: All communities that expect growth and are willing to guide it are prime candidates for developing land use plans.

Limitations: Plans are only as strong as the local authorities want them to be. To be effective, they must be implemented, which may require additional legal measures, such as a zoning ordinance.

For more information: Technical advice can be found at the county planning agencies.

Zoning
A zoning ordinance regulates development by dividing the community into zones or districts and setting development criteria for each district: There are two approaches that can prevent inappropriate floodprone development: separate districts and overlay zoning.

Separate districts: The floodplain can be designated as one or more separate zoning districts that only allow development that is not susceptible to damage by flooding. Appropriate districts include public use, conservation, agriculture, and cluster or planned unit developments that keep buildings out of the floodplain, wetlands, and other areas that are not appropriate for intensive development.

Overlay zoning adds special requirements in areas subject to flooding. The areas can be developed in accordance with the underlying zone, provided the flood protection requirements are met. As illustrated on the next page, there may also be setbacks or buffers to protect stream banks and shorelines or to preserve the natural functions of the channels and adjacent areas.

Where appropriate: Communities that expect development or redevelopment should adopt zoning ordinances.

Limitations: Some zoning regulations have been nullified because they placed too many restrictions on the use of private property and those restrictions could not be justified as needed for public health, safety or welfare. Some zoning requirements have been nullified when the community did not develop the technical data to support them.

Open Space Preservation

Keeping the floodplain open - free from development - is the best approach to preventing flood damage. Preserving open space is beneficial to the public in several ways. By preserving floodplains and natural sites for water storage, such as wetlands and low-lying areas, important recreational areas are secured while habitats for local flora and fauna are similarly protected.

Floodplains are excellent sites for scenic recreation areas and greenways. Local governments have prevented millions of dollars in flood damage through their open space preservation programs of floodprone areas. Open space preservation should not be limited to floodplains, as some sites in the watershed may be key to controlling runoff that adds to the flood problem.

Land use and capital improvement plans should identify areas to be preserved by acquisition and other means. Purchasing property with an easement, enables the land owner freedom to develop and use private property in the floodplain. If the owner agrees to not build on the floodprone parcel taxes are reduced. In some cases, the owner is allowed to develop the area for low hazard uses or to transfer the right to develop other flood-free parcels (known as **"TDR"** or transfer of development rights).

Easements do not always have to be purchased. Flood flow, drainage, or maintenance easements can be required of developers as a condition for approving the development. These are usually linear parcels along property lines or channels. Streamside property owners in return for a community channel maintenance program also can provide maintenance easements.

Where appropriate: Open space preservation is encouraged in undeveloped areas in floodplains, wetlands, other watershed storage areas, natural areas, and along streams and drainageways.

Limitations: Reaching agreement on an easement can be complicated. Enforcing it requires vigilance by the community.

For more information: Technical advice can be found at the county planning agencies and OEM. There may be funding programs to help acquire open space for recreational use or to preserve natural areas.

Floodplain Regulations

In addition to zoning ordinances, regulations on construction in floodplains are usually found in one or more of three locations: subdivision ordinance, building code, and/or a separate ***"stand alone"*** floodplain ordinance.

If the zoning for a site allows a structure to be built, then the applicable subdivision and building regulations will impose construction standards to protect buildings from flood damage and prevent the development from aggravating the flood problem.

Subdivision regulations: Subdivision regulations govern how land will be subdivided into individual lots, often requiring that every lot have a buildable area above flood level. These regulations set construction and location standards for the infrastructure provided by the developer, including roads, sidewalks, utility lines, storm sewers and drainage-ways. *(Storm sewer and drainage standards are discussed* in the *section on Stormwater management)*

Building codes: The building code should establish flood protection standards for all construction. These should include criteria to ensure that the foundation will withstand flood forces and that all portions of the building subject to damage are above, or otherwise protected from, flooding.

Some Colorado communities have adopted the Building Officials and Code Administrators' (BOCA) National Building Code. The 1997 edition sets standards for protecting foundations against flood damage, including requirements for soil testing and prepared fill.

Minimum regulatory requirements: Most communities with a flood problem in Colorado participate in the National Flood Insurance Program (NHP). The NFIP sets minimum requirements for participating communities' subdivision regulations and building codes. Communities are encouraged to adopt local ordinances, which are more stringent than the state or federal criteria. This is especially important in areas with older maps that may not reflect the current hazard. These could include prohibiting damage-prone uses (such as garages, sheds, parking lots and roadways) from the floodway or requiring structures to be elevated one or more feet above the base flood elevation.

Where appropriate: Any area with surface flooding is appropriate for floodplain regulations.

Limitations: As with any regulatory program, property owners may not be aware of the need for permits, or may resist getting permits, especially after a flood.

Because many existing floodplain maps are out of date, caution should be exercised when utilizing them for regulations. Conservative safety factors are highly recommended. Some of the requirements, such as floodway construction criteria or substantial improvement rules, can be technically complicated. However, assistance is available from FEMA, CWCB and OEM.

Flood Hazard Mitigation Measures *Figure B-2*	
Prevention	***Property Protection***
Planning	Building relocation
Zoning	Acquisition
Open space preservation	Building elevation
Floodplain regulations	Barriers
Wetland regulations	Dry floodproofing
Stormwater management	Wet floodproofing
Watershed measures	Sewer backup protection
Soil erosion and sediment control	Insurance
Channel maintenance	Community programs
Drainage protection	
Real estate disclosure	
Emergency Services	***Flood Control***
Flood threat recognition	Reservoirs
Flood warning Levees	Levees and floodwalls
Flood response	Diversions
Critical facilities	Conveyance improvements
Health and safety maintenance	Drainage/sewer improvements

Minimum Floodplain Regulation Requirements

Figure B-3

The National Flood Insurance Program (NFIP) is administered by the Federal Emergency Management Agency (FEMA). As a condition of making flood insurance available for their residents, Colorado communities agree to regulate new construction in the 100-year floodplain. To reduce confusion, the 100-year floodplain is called the "base floodplain" and the elevation of the 100-year flood is known as the base flood elevation."

The base floodplain is shown as the 'Special Flood Hazard Area" on the Flood Insurance Rate Map (FIRM) provided by FEMA. The base floodplain is designated as an "A" Zone. The 500-year floodplain is shown as a "B" Zone and areas above the 500-year flood level are shown as "C" Zones. On newer maps, the B and C zones are called 'X' zones. The designation as B, C, or X Zone does not mean that the area is not subject to local drainage problems or overbank flooding from streams or ditches smaller than the FEMA mapping criteria.

Additional floodplain regulatory requirements are set by state law. These are the minimum floodplain requirements. Cities and counties often have additional or more restrictive regulations.

1. All development must have a permit from the community. Development is defined as any man-made change to the land, including new buildings, improvements to buildings, filling, grading, mining, dredging, etc.

2. Only "appropriate uses" are allowed in the floodway. The floodway is the channel and central portion of floodplain that is needed to convey the base flood. Appropriate uses include flood control structures, recreational facilities, detached garages and accessory structures, floodproofing activities, and other minor alterations. They do not include buildings, building additions, fences, or storage of materials. The result of this requirement is that vacant floodways will essentially remain as open space, free of insurable buildings or other obstructions.

3. New buildings are allowed outside the floodway, but they must be protected from damage by the base flood. Residences must be elevated above the base flood elevation. Nonresidential buildings must be elevated or floodproofed.

4. When an addition, improvement or repair to an existing building is valued at more than 50% of the value of the original building, then it is considered a substantial improvement. A substantial improvement is treated as a new building.

5. Any filling, building or other obstruction placed in the floodplain reduces the amount of floodwater that can be stored. Developers must remove an equal or greater volume of fill to compensate for the loss of storage.

Wetland Protection Regulations

Wetlands are usually found in floodplains or depressional areas. They provide numerous natural and beneficial functions that warrant protection. Many wetlands in Colorado are subject to the Corps of Engineers' Section 404 regulations. Corps permits are required for projects that will place fill or dredged materials in a wetland. Before a permit is issued, the plans are reviewed by several agencies, including the US Fish and Wildlife Service and the US Environmental Protection Agency. Some communities also have their own wetland protection programs. Local programs are important for addressing gaps in the federal regulations, particularly for smaller wetlands and unregulated activities.

Where appropriate: Any community that seeks to preserve the natural and beneficial functions of wetlands should consider instituting wetland regulations.

Limitations: In many areas, smaller wetlands are not mapped, so projects may be built by owners who don't know the area should be protected. The Corps' authority is generally limited to filling wetlands. They can be impounded or otherwise damaged without a 404 permit being required. Therefore, communities should consider their own more comprehensive regulations.

For more Information: Technical advice can be found at the county stormwater planning agencies, the US Army Corps of Engineers, the US Fish and Wildlife Service, and the US Environmental Protection Agency.

Stormwater Management

Development outside a floodplain can contribute significantly to flooding problems. Runoff is increased when natural ground cover is replaced by urban development.

Unconstrained watershed development often will aggravate downstream flooding and overload tile community's drainage system. Effective stormwater management policies require developers to build detention basins and utilize other "best management practices" ("BMPs") to minimize increases in runoff rates and volumes in comparison to pre-development conditions.

Many developments utilize wet basins as landscaping amenities and for water quality BMPs. In some cases, watershed planners identify the most effective location for a basin. Communities then require developers to contribute funds for a regional basin in lieu of constructing on-site detention. Since detention only controls runoff rates, and not runoff volumes, there is a need for other BMPs to enhance the infiltration of stormwater. Swales, infiltration trenches, vegetative filter strips, and permeable paving blocks are recommended additions to the standard detention requirements. Stormwater management requirements are generally found in subdivision ordinances.

Where appropriate: Stormwater management requirements are encouraged for all new developments.

Limitations: The community must bear the cost of maintaining detention features after the developer leaves. Even with the best BMPs, development will increase runoff volumes.

For more information: Technical advice can be found at the county planning agencies, CWCB, OEM, and the Association of Flood and Stormwater Managers.

Watershed Measures

Agricultural practices also can cause stormwater problems. Subsurface drainage and row cropping can speed the runoff onto downstream properties. Because farmland is usually bare, stormwater runoff can carry large amounts of sediment that can fill in downstream drainage facilities.

Wetlands

- **Store large amounts of floodwaters**
- **Reduce flood velocities and erosion**
- **Filter water, making it cleaner for those downstream**
- **Provide habitat for species that cannot live or breed anywhere else**

Figure B-4

Ultimately, flood prevention must be viewed from a watershed perspective. Watershed measures should emphasize approaches that reduce runoff volumes and storing surface runoff naturally.

The runoff can be slowed down by watershed measures, such as vegetation, terraces, contour plowing and no-till farm practices. Slowing runoff on the way to a drainage channel increases infiltration into the soil and controls the loss of topsoil from erosion and the resulting sedimentation.

Protecting areas that naturally hold water is another effective type of watershed measure. Most watersheds have wetlands, depressions and other natural storage areas, which, if preserved from development, help reduce the impact of urbanization.

Where appropriate: Modifications to farming practices and urban development are most effective on steeper slopes where the most runoff and erosion occurs. Preserving storage areas is most effective in flat areas with natural depressions.

Limitations: These measures are usually implemented in areas beyond a municipality's jurisdiction. It can be hard to convince owners of property who are not near the flood problem to modify their drainage practices at their own expense.

For more information: Soil and Water Conservation Districts and their Natural Resources Conservation Service staff have both the expertise in watershed measures and the contacts with watershed landowners.

Soil Erosion and Sediment Control

As rain hits the ground - especially where there is bare dirt, as on farm fields and at construction sites - soil is picked up and washed downstream. This erosion of soil produces sedimentation in waterways that may be far from the eroded area. Sediment tends to settle where the river slows down and will gradually fill in the channel. Erosion and sediment control has two principal components: minimize erosion with vegetation and capture sediment before it leaves the site. Specific measures can be taken on farms and construction sites.

Farm practices such as contour plowing, terracing and no-till help reduce agricultural erosion and keep topsoil where it is needed. Soil loss can be cut at construction sites with techniques such as mulching, seeding, and erosion blankets. Silt fences and sediment traps slow runoff so sediment is dropped on-site before it gets to a watercourse. The key is to get these measures used, particularly on construction sites or at the downstream end of plowed fields.

Where appropriate: All watersheds are candidates for erosion and sediment control measures.

Limitations: As with any regulatory program, the community must have trained staff to educate developers and property owners, to monitor compliance, and to enforce the requirements.

For more information: Soil and Water Conservation Districts and their Natural Resources Conservation Service staff have both the expertise in watershed measures and the contacts with watershed landowners.

Channel Maintenance

Channel maintenance is an ongoing program to clean out blockages caused by overgrowth or debris. Public works or drainage districts crew usually does this work. Channel maintenance addresses vegetative growth and debris that can block flows. Channel maintenance activities normally do not affect the shape of the channel, but they do affect how well the channel can do its job.

Where appropriate: Smaller streams in all watersheds should be the targets of channel maintenance programs. Annual cleanup campaigns should be conducted in late fall through winter, before spring flows and when there are no leaves restricting visibility.

Limitations: If done improperly, channel clearing can allow bank erosion and destroy natural habitats. Channel inspection and maintenance must be conducted year-round. Property owners must consent to the maintenance program, in many cases, which may require legal negotiations to obtain maintenance easements.

For more information: Soil and Water Conservation Districts and their Natural Resources Conservation Service staff have both the expertise in watershed measures and the contacts with watershed landowners.

Drainage Protection

Small amounts of debris can accumulate or be accidentally or intentionally dumped into channels and detention basins. They obstruct low flows or accumulate to become major blockages. Stream dumping regulations are one approach to preventing intentional placement of trash or debris in watercourses.

Many communities have nuisance regulations that prohibit dumping garbage or other "objectionable waste" on public or private property. Some prohibit the discharge of polluted waters into natural outlets or storm sewers. Waterway dumping regulations need to also apply to "non-objectionable" materials, such as grass clippings or tree branches, which can kill ground cover or cause obstructions.

Many people do not realize the consequences of their actions. They may, for example, fill in the ditch in their front yard not realizing that it is needed to drain street runoff. Similarly, they may not understand how regrading their yard, or discarding leaves or branches in a watercourse can cause a problem.

Therefore, a drainage protection program should include public information materials that explain the reasons for the rules as well as the penalties. Regular inspections to catch violations also should be scheduled.

Where appropriate: All waterways, including street ditches, should be placed under stream dumping regulations. Obstructions have their greatest impact in smaller streams and ditches, so an anti-dumping program has its greatest effect there.

Limitations: Finding dumped materials is easy; locating the source of the refuse is hard. Usually the owner of property adjacent to a stream is responsible for keeping the stream clean. This may not be fair for sites near bridges and other public access points

For more Information: Example dumping ordinance language can be found in the NFIP Community Rating System - ***CRS Credit for Drainage System Maintenance***. Public information examples are in ***CRS Credit for Outreach Projects.***

Real Estate Disclosure

Many times after a flood, people say they would have taken steps to protect them-selves if only they had known they had purchased a floodprone property. Federal law requires that a potential purchaser of a parcel be told of any flood hazard.

Federal Law: Federally regulated lending institutions must advise applicants for a mortgage or other loan that is to be secured by an insurable building that the property is in a floodplain as shown on the Flood Insurance Rate Map. Because this requirement has to be met only five days before closing, often the applicant is already committed to purchasing the property when he or she first learns of the flood hazard.

This requirement does not affect renters or instances where properties are purchased without mortgages from federally regulated lenders. Enforcement of this law is up to the federal agencies that regulate lending institutions, such as the FDIC.

Where appropriate: Real estate disclosure can help everywhere.

Limitations: Enforcement of these regulations can be difficult. Compliance with the federal lending requirements has been spotty, but has been improving in recent years. The best approach for a community is to work with the local real estate agencies to encourage them to use the latest maps and provide assistance to them as needed.

For more Information: Information on the federal lending requirements can be obtained from the FEMA Region 8 Mitigation Division. The basic reference is ***Mandatory Purchase of Flood Insurance Guidelines.***

Property Protection

Property protection measures are used to modify buildings subject to flood damage rather than to keep floodwaters away. A community may find these to be inexpensive measures because often they are implemented by or cost shared with property owners. Many of the measures do not affect the buildings' appearance or use, making them particularly appropriates for historical sites and landmarks.

Building Relocation

Moving a building to higher ground is the surest and safest way to protect it from flooding. While almost any building can be moved, the cost goes up for heavier structures, such as those made of brick, and for large or irregularly shaped buildings. There are many experienced house movers in Colorado who know how to handle any job.

Where appropriate: Communities with areas subject to flash flooding, deep waters or other high hazard where the only safe approach is to remove the building should consider a relocation program.

Smaller, wood frame buildings on crawlspaces or basements are easier to move because they are lighter and it is easier to place jacking and moving equipment underneath the floor.

Relocation is also preferred for large lots with portions outside the floodplain or where the owner has a new flood-free lot available.

Limitations: Relocation can be expensive. The cost can average $25,000 and exceed *$50,000* depending on the type, weight and size of the house, whether it has to be cut and moved in parts, and the cost of a new lot. However, there are some government loans or grants available. Buildings that have suffered frequent flooding may be contaminated or structurally weakened and should be demolished.

For more Information: The following information is available from The Hazards Center in Boulder: ***Elevating or Relocating a House to Reduce Flood Damage, Design Manual for Retrofitting Flood-prone Residential Structures,*** **and** ***Protect Your Home from Flood Damage.***

Acquisition

Like relocation, acquisition ensures that buildings in a floodprone area will cease to be subject to damage. The major difference is that acquisition is undertaken by a government agency, so the cost is not borne by the property owner, and the land is converted to public use, such as a park.

Acquiring and clearing buildings from the floodplain is not only the best flood protection measure available, it is also a way to convert a problem area into a community asset and obtain environmental benefits.

Occasionally acquisition and relocation projects are undertaken jointly. The purchasing agency sells the building for salvage and the new owner relocates the structure rather than demolishes it.

Sometimes arrangements are made to allow the previous owner to buy back the building at the salvage value. This way, the owner gets to keep the house but have enough money from the sale to pay for a new lot and moving expenses.

Where appropriate: While acquisition works against any type of flood hazard, it is more cost-effective in areas subject to flash flooding, deep

waters, or other severe flood hazards where other property protection measures are not feasible.

Communities that want to clear floodprone areas, or redevelop them for other uses, such as recreation or riparian habitat, will find acquisition to be necessary. Acquisition, followed by demolition, is most appropriate for buildings that are too expensive to move -- such as larger, slab foundation, or masonry structures -- and for dilapidated structures that are not worth protecting.

Limitations: Cost is the number one concern with acquisition. An acquisition budget should be based on the median price of similar properties in the community, plus $10,000 to $20,000 for appraisals, abstracts, title opinions, relocation benefits and demolition.
Cost may be lower following a flood. For example, the community may have to pay only the difference between the full price of a property and the amount of the flood insurance claim received by the owner.

Communities should avoid creating a ***"checkerboard"*** acquisition pattern in which nonadjacent properties are acquired. This can occur when some owners, especially those who have and prefer a waterfront location, prove reluctant to leave. Creation of a checkerboard in a community simply adds to maintenance costs that taxpayers must support.

Smaller towns may be concerned if a large area is affected, for they may risk losing residents, businesses and/or revenue from property taxes and utility fees.

For more Information: The following information is available from The Hazards Center in Boulder: ***Elevating or Relocating a House to Reduce Flood Damage, Design Manual for Retrofitting Flood-prone Residential Structures,*** **and** ***Protect Your Home from Flood Damage.***

Building Elevation

Raising a house above the flood level is the best way to protect a structure that cannot be removed from the floodplain. Water flows under the building, causing no damage to the structure or its contents.

Raising a building above the flood level is cheaper than moving it, and can be less disruptive to a neighborhood. Commonly practiced in flood-prone areas nationwide, this protection technique is required by law for new and substantially damaged residences located in a floodplain. House moving contractors know the techniques to elevate a building.

Elevating a structure will change its appearance. If the needed degree of flood protection is low, the result is similar to putting a house on a two or three foot crawlspace. If the house is raised two feet, the front door would be three steps higher than before. If the house is raised eight feet, the lower area can be wet floodproofed for use as a garage and for storage of items not subject to flood damage.

Where appropriate: Smaller, wood frame buildings on crawlspaces are the cheapest to elevate. Use of this technique is safest where flood depths do not exceed six feet and velocities are slow.

Limitations: Elevation can be expensive. The price to raise a wood frame building on a crawlspace has run as low as $5,000 when the owner does much of the work. Otherwise, the cost averages $15,000 to $25,000. Raising a structure with brick walls resting on a slab foundation can cost *$25,000* to *$50,000.*

During flooding, the building may be isolated and without utilities, and therefore unusable. Newly created lower stories may be occupied or used for storage, putting household goods at risk for flood damage.

Some owners object to the change in appearance and are concerned that their home will stand out and affect property values.

For more Information: The following information is available from The Hazards Center in Boulder: ***Elevating or Relocating a House to Reduce Flood Damage, Design Manual for Retrofitting Flood-prone Residential Structures,*** **and** ***Protect Your Home from Flood Damage.***

Barriers

Barriers - levees, floodwalls and berms - keep floodwaters from reaching a building. Plans for using these structures must include ways to handle leaks, water seepage under the barrier and rainwater that accumulates inside the barrier. Therefore, they need a sump and/or drain tile to collect the internal ground and surface water, a pump to remove the water, and a pipe to send it over the barrier. Berms are commonly used in areas subject to shallow flooding. Not considered engineered structures, berms are made by regrading or filling an area.

Low floodwalls may be built around stairwells to protect the basement and lower floor of a split-level home. By keeping water away from the building walls, the problems of seepage and hydrostatic pressure are reduced.

The cost can range from practically nothing, when the homeowner re-grades the yard or builds a berm with local fill, to $10,000 for a concrete floodwall with drain tiles and sump pump.

Where appropriate: Barriers are recommended where the depth of flooding is three feet or less. Barriers may be used to protect any type of building, although buildings with basements wall be more

susceptible to underseepage. Floodwalls are more appropriate on small lots where there is little room for a levee. Care must be taken in locating barriers. They must be placed so as not to create flooding and/or drainage problems on neighboring properties. All barriers must be kept out of regulatory floodways.

Limitations: Private levees, floodwalls and berms are more susceptible to deterioration than publicly-held structures, as maintaining them falls to the property owner, not a public agency.

Private barriers do not eliminate the need for flood insurance, as they normally address only smaller, more frequent floods. They often have to rely on human intervention to close openings or operate pumps. Insurance is needed for those times when there is no one present who knows what to do when the flood arrives.

For more Information: The following information is available from The Hazards Center in Boulder: ***Design Manual for Retrofitting Flood-prone Residential Structures,*** **and** ***Protect Your Home from Flood Damage.***

Dry Floodproofing

Through dry floodproofing, a building is sealed against floodwaters. Buildings with crawlspaces generally are not dry floodproofed because water can seep under walls into the crawlspace. However, two kinds of structures can benefit from dry floodproofing.

Buildings on slab: All areas below the flood protection level are made watertight. Walls are coated with waterproofing compounds or plastic sheeting. Openings, such as doors, windows, sewer lines and vents, are closed either permanently, with removable shields, or with sandbags. Many dry floodproofed buildings cannot be distinguished from those that have not been modified.

Where appropriate: Dry floodproofing should be used only where the flood depth is less than three feet, and floodwaters will have little velocity. Most building walls and floors are not strong enough to withstand the hydrostatic pressure from more than three feet of water.

Buildings with basements: Houses with basements or other floors below grade can be protected with a backfill approach. A waterproofing compound is applied to the walls and fill is placed against the side of the house. The goal is to protect the house against contact with surface water or saturated ground. Such contact will greatly increase the amount of pressure against the basement walls, which may result in structural failure. Therefore, installation of a subsurface drain tile and one or two sump pumps is a must. Properly sized drains and pumps can handle any water that will naturally seep through the fill to reach the house.

Where appropriate: Buildings with basements or floors below grade may be dry floodproofed only with the waterproofing berm approach shown above and only where the flood protection level is lower than the first floor. In such a situation, the basement area should not be used as a bedroom where the occupants could be caught by surprise if water comes in.

Limitations: Dry floodproofing may involve closing openings and turning on pumps. These actions are dependent on adequate warning and the presence of someone who knows what to do.

As with barriers, flood insurance is highly recommended for those occasions when the protection level is overtopped or when there is no one available to take the proper steps.

An owner may be tempted to try to keep out floodwaters deeper than the design flood protection level. This can result in collapsed walls, buckled floors and danger to the occupants. It should be noted that floodplain management regulations do not allow new buildings to be dry floodproofed.

For more Information: The following information is available from The Hazards Center in Boulder: ***Design Manual for Retrofitting Flood-prone Residential Structures, and Protect Your Home from Flood Damage.*** Also, the Stormwater Floodplain Managers Association, CWCB, and OEM can offer technical assistance.

Wet Floodproofing

"Wet floodproofing" includes protection measures that deal with floodwaters in the building. Wet floodproofing approaches range from moving a few valuable items to rebuilding the flood prone area (see ***Figure B-9***).

Water standing on the ground outside a basement will quickly build up pressure against the basement walls, putting the equivalent pressure of six to seven feet of water on the walls and floor. Most wails and floors are not built to withstand hydrostatic pressure of more than three feet of water. As a result, sometimes basement walls and floors that have been waterproofed may be cracked, buckled or broken by the pressure of floodwater.
Wet floodproofing has one advantage over the other approaches: No matter how little is done, flood damage will be reduced. Simply moving furniture and electrical appliances out of the floodprone area can prevent thousands of dollars in damage.

Where appropriate: Wet floodproofing will work wherever there is an area above the flood protection level to which items can be relocated or temporarily stored.

Wet floodproofing works best in buildings with unfinished basements, garages, sheds, commercial and industrial facilities, and buildings with contents that are either water-resistant or easily moved. One-story houses are not appropriate for wet floodproofing because the likely flooded zone comprises living areas.

Many wet floodproofing techniques can be incorporated during repairs, reconstruction or remodeling. For example, damaged wallboard in a basement can be removed and the concrete wails can be covered with waterresistant paint. Wet floodproofing is sometimes the only way to protect a historic building that cannot be moved or elevated.

Limitations: Owners are often reluctant to "abandon" large areas of their buildings in anticipation of a flood. A plan to move contents relies on adequate warning and the presence of someone who knows what to do. Flood insurance is highly recommended for those occasions when the protection level is overtopped or when there is no one available to take the proper steps. There will still be a need for clean up, with its accompanying potential for health problems.

For more Information: The following information is available from The Hazards Center in Boulder: ***Design Manual for Retrofitting Flood-prone Residential Structures, and Protect Your Home from Flood Damage.*** Also, **CWCB and OEM can offer technical assistance.**

Sewer Backup Protection

In areas where sanitary and storm sewers are combined, basement flooding can be caused by stormwater overloading the system and backing up into the basement through the sanitary sewer line.

In areas where sanitary and storm waters are carried in separate pipes, the same thing can happen when there are cross connections between the storm and sanitary sewers or infiltration or inflow problems in the lines.

Houses which have downspouts, footing drain tile, and/or the sump pump connected to the sanitary sewer service may be inundated when heavy rains overload the system. If allowed by the local code, these should be disconnected. Rain and ground water should be directed out onto the ground, away from the building.

Four other approaches may be used to protect a structure against sewer backup: floor drain plug, floor drain standpipe, overhead sewer, and backup valve.

The first two devices keep water from flowing out of the lowest opening in the house, which is the floor drain. They cost less than $25. However, if the water gets deep enough in the sewer system, it can flow out of the next lowest opening in the basement, such as a toilet or laundry tub.

The latter two devices are more secure, but more expensive ($3,000 to $4,000). An overhead sewer, as illustrated on the next page, keeps water in the sewer line during a backup. A backup valve allows sewage to flow out while preventing backups from flowing into the house.

Where appropriate: All four approaches are appropriate for split levels, basements, and other locations where water in the sewer lines can back up into a building. Plugs and standpipes are only useful where the backup causes shallow flooding (lower than the next lower opening).

Limitations: Plugs and standpipes need to be carefully installed, as a little debris may prevent a good seal. In older houses, sewer lines under a basement floor may be clay tiles; a buildup of pressure may break them. Sewer lines in newer houses usually are cast iron, making breakage unlikely.

For more Information: The following information is available from The Hazards Center in Boulder: ***Design Manual for Retrofitting Flood-prone Residential Structures, and Protect Your Home from Flood Damage.*** Also, **OEM can offer technical assistance.**

In one city when flooding is imminent, firemen knock on the residents doors and say: "It is time to fill your basement" - The firemen lower the fire hose through the basement window and the homeowner turns on the nozzle and fills the basement with water to prevent hydrostatic pressure from collapsing the walls. Similar situations can occur in Colorado.
Figure D-8

Community Programs

Property owners usually implement their own property protection measures. Therefore, a community mitigation program should include measures to encourage and assist owners. A community's plan may provide three kinds of help: pertinent information, technical advice and financial assistance.

Information: A community has passive and active ways to inform residents about flood hazards and damage mitigation.

Passive ways to provide information, such as through references in the public library may not bring immediate reductions in flood damage.

However, they can have a long-term effect when people make construction or land use decisions later.

In addition to the library, many elementary and high schools have geography or science classes that are appropriate for sessions on flooding, natural hazards, and preserving the natural functions of floodplains and wetlands. The ***"Internet"*** is another source of information.

Active approaches include outreach projects, such as notices to floodprone property owners, to introduce the idea of property protection and identify sources of assistance. Other approaches, such as cable television shows, notices in public buildings, or booths at shopping centers, help but are not as effective as notices specifically directed to the owners of properties that should be protected.

More intensive efforts include distribution of handbooks and videos on property protection, public meetings with neighborhood groups, and "open houses." The last is a variation on the public meeting that includes exhibits by local contractors, insurance agents, building officials, the Red Cross, and others expert in flood protection who display their wares and answer questions.

Technical Assistance: In one-on-one sessions with property owners, community officials can provide advice and information on matters such as identifying flood hazards at the site, correcting local drainage problems, floodproofing, dealing with contractors, and funding.

Technical assistance can be given in telephone conversations, as complimentary critiques of the owner's plans or ideas, and in visits to the building. A more intensive effort is a written "flood audit," which provides the owner with a written description of the flood hazard at the site and specific recommendations to protect the site or building.

Where appropriate: Providing information and technical assistance can help every property owner, and is one of the least expensive measures a community can undertake. Every step taken by a property owner can reduce flood damages.

Limitations: Some community staff members are hesitant to provide advice due to a lack of knowledge about property protection measures or concern about liability should a recommended measure fail. Both of these concerns can be overcome through training using manuals, technical assistance, and courses available from FEMA and the Corps of Engineers.

For more information: Guidance on establishing a community program to provide information and technical assistance to property owners can be found in: *Flood Proofing Techniques, Programs* and *References, Local Flood Proofing Programs,* and *CRS* ***Credit for Public Information Programs.***

Low Cost Steps to Wet Floodproof a Structure

- Sewer openings, such as floor drains, must be plugged.
- Everything subject to damage by water or sediment must be moved to a higher level or out of the building. For example, the electrical panel and the furnace could be relocated to an upper floor.
- Where flooding is not expected to be deep, items needing protection may be placed on platforms or blocks.
- Owners should be prepared to move lighter items, such as lawn furniture or bicycles, after a flood warning is issued.

Figure B-9

APPENDIX C

MITIGATION PLAN WORKSHEET

STATE OF COLORADO

NATURAL HAZARDS MITIGATION PLAN UPDATE - 2007

Local Plan Review for Integration into State Plan

County: [] COUNTY

Significant Historical Occurrences Not Yet Addressed:

-

Vulnerability/Risk:

Hazard	Avalanche	Drought	Fire	Flood	Geologic	Thunderstorm	Winter Storm	Extreme Heat	Dam Failure
Risk									

Comments:

-

Hazard	Population Affected*	# of Structures Affected**	# of Critical Facilities Affected***	Potential $ (000s) Loss****
COUNTY-WIDE HAZARD				
Avalanche				
Earthquake				
Flood				
Landslide/Rockfall				
Wildfire				

*Source []
**Source []
***Source []
****Source []

Additional Comments on Vulnerability:

-

Projected Vulnerability from Future Development (If Available):

Hazard	*Future Population Affected**	*Future # of Structures Affected***	*Future Potential $ Loss****
COUNTY-WIDE HAZARD			
Avalanche			
Earthquake			
Flood			
Landslide/Rockfall			
Wildfire			

*Source []
**Source []
***Source []

Additional Comments on Future Development (e.g. Population shifts, changes in land use, effects from mitigation, etc.):

-

Capability:

Capability	*Yes or No*	*Effectiveness*	*Yes or No*
Floodplain Regulations			
Zoning Ordinance			
Building Code			
Stormwater Management			
Emergency Warning System			
Evacuation Plan			
Public Information Program			
Environmental Education Program			
Wildfire Safety Program			
GIS/Mapping			
Master Plan			

Additional Comments on Capability:

Potential Projects:

1. PROJECT –
2. PROJECT –
3. PROJECT –
4. PROJECT –
5. PROJECT –

…

Additional Comments on Potential Projects:

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