South Dakota Multi-Hazard Mitigation Plan

March 2005

Introduction

Hazard Mitigation: defined as any action taken to reduce or eliminate the long-term risk to human life and property from hazards. The term is sometimes used in a stricter sense to mean cost-effective measures to reduce the potential for damage to a facility or facilities from a disaster event (FEMA definition).

Mitigation: defined as measures taken to reduce the harmful effects of a disaster by attempting to limit the disaster's impact on human health and economic infrastructure

In order to understand the "big picture" of South Dakota's mitigation and planning efforts, it is important to understand how this plan was written and organized. The Plan was written to address the purposes as discussed below and to further meet the criteria of FEMA's Standard State Plan Hazard Mitigation Plan Review Document. The State of South Dakota Multi-Hazard Mitigation Plan is organized into a Table of Contents, the Basic Plan, Appendices to the Basic Plan, Attachments to the Basic Plan and separate Hazard Specific Annexes. The Basic Plan is not a stand alone document. The Basic Plan is an analyses and overview of information detailed and provided in the Appendices, Attachments and Annexes, along with three notebooks of reference material on file in the South Dakota Office of Emergency Management (SDOEM). For clarity and understanding, it is important to cross-reference between the Table of Contents, the Basic Plan and Appendices, and the referenced Attachments and Annexes. The planning process used to produce this plan is addressed in Section 2.0 of the plan.

South Dakota is remarkable and progressive in the sense that as early as the late 1800's mitigation efforts were pursued and implemented.

The first effort was after the 1881 flood of the Vermillion and Missouri Rivers that wiped out the town of Vermillion. The town was relocated on the bluffs behind the former town to prevent another recurrence - thus marking the first recorded hazard mitigation effort by a government entity in South Dakota and possibly the Nation.

The second effort followed the 1972 Black Hills/Rapid City flood. This flood stands out in South Dakota history as the deadliest and most expensive in terms of damage. Because of this flood, Rapid City engaged in the second recorded hazard mitigation effort in South Dakota by refusing to allow rebuilding in the floodway.

This program effectively launched Federal government efforts to create a Hazard Mitigation Program.

The third example of South Dakota mitigation efforts involves mitigation of landslides. Since 1969, the South Dakota Department of Transportation (SDDOT) has created and implemented engineering and construction methods/procedures for mitigation of landslides. Over time, these measures were copied by other states and are still in use today. South Dakota has received national notoriety for their work in this area.

As indicated by the examples provided, mitigating effects of potential disasters is not a new concept in South Dakota. This plan picks up where previous mitigation efforts have left off and identifies the direction mitigation efforts can be pursued in the future. This plan can be compared to reading a road map with a general destination in mind and how the road map shows more than one route that can be taken to arrive there.

Purpose

The purpose of the State of South Dakota Multi-Hazard Mitigation Plan is:

1. To guide South Dakota's mitigation program to reduce the impact of or eliminate destructive effects of significant hazards to the state e.g., threats to life and property.

2. To serve as a public and private sector reference document and management tool for mitigation activities throughout South Dakota.

3. To meet the state planning requirements of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as amended by Public Law 106-390, October 30,2000 UNITED STATES CODE Title 42. THE PUBLIC HEALTH AND WELFARE CHAPTER 68. DISASTER RELIEF [As amended by Pub. L. 103-181, Pub. L. 103-337, and Pub. L. 106-390] (Pub. L. 106-390, October 30, 2000, 114 Stat. 15521575) hereafter referred to as the Disaster Mitigation Act of 2000 (DMA 2000), Appendix B of this plan.

Scope

The scope of this plan is Statewide. All known federal, State, and local hazard mitigation laws, regulations, programs and policies are discussed. Local mitigation strategies and identification of potential projects were culled from 31 local jurisdiction plans submitted to the State of South Dakota Office of Emergency Management (SDOEM) as of April 1, 2004. After April 1, 2004 local jurisdiction plans submitted to the SDOEM will be incorporated into the next revision of the South Dakota Multi-Hazard Mitigation Plan. The State mitigation strategies, goals, objectives, and priorities for mitigation (including projects) are based on past disaster events, current risks and events and potential future disaster events. Local priorities, as identified in the 31 local jurisdiction plans submitted have determined that local mitigation priorities are in line with and support the State priorities. See Attachments 5-1, 5-2, and 5-3 to this plan.

Federal, State and Local Authorities and Responsibilities

1. Federal
   - Robert T. Stafford Disaster Relief and Emergency Assistance Act, as amended by Public Law 106-390, October 30,2000 UNITED STATES CODE Title 42. THE PUBLIC HEALTH AND WELFARE CHAPTER 68. DISASTER RELIEF [As amended by Pub. L. 103-181, Pub. L. 103-337, and Pub. L. 106-390] (Pub. L. 106-390, October 30, 2000, 114 Stat. 1552 - 1575) hereafter referred to as the Disaster Mitigation Act of 2000 (DMA 2000). See Appendix B.
   - Presidential Executive Order dated November 6, 2000 regarding: Consultation and Coordination with Indian Tribal Governments; effective date for implementation January 6,2001
   - Presidential Executive Order 11988, Floodplain Management
   - Presidential Executive Order 11990, Protection of Wetlands
   - FEMA Regulation, 44 CFR, Part 7, Non-Discrimination
   - FEMA Regulation, 44 CFR, Part 13, Administrative Requirements
   - FEMA Regulation, 44 CFR, Part 17, Subpart F, Drug-Free Workplace
   - FEMA Regulation, 44 CFR, Parts 201 and 206, Subparts M & N
   - See Attachments 2-1, 2-2, and 2-3 to this plan which are tables identifying federal hazard mitigation programs, points of contact, assistance and eligibility (not all inclusive).

Federal Responsibilities

The Federal Emergency Management Agency (FEMA) is the key federal agency in coordinating hazard mitigation actions. This agency assists States in developing pre-disaster and post-disaster mitigation plans, procedures and projects.

For purposes of implementing Section 322 of the Stafford Act, 42 U.S.C. 5165 and as stated specifically in Part III, 44 CFR Parts 201 and 206 Hazard Mitigation Planning and Hazard Mitigation Grant Program; Interim Final Rule, FEMA's responsibilities include:

General:

- Oversee all FEMA related pre- and post disaster hazard mitigation programs and activities
- Provide technical assistance and training to State, local, and Indian Tribal governments regarding the mitigation planning process
- Review and approve all Standard and Enhanced State Mitigation Plans

- Review and approve all local mitigation plans, unless that authority has been delegated to the State in accordance with § 201.6 (d)
- Conduct reviews, at least once every three years, of State mitigation activities, plans, and programs to ensure that mitigation commitments are fulfilled, and when necessary, take action, including recovery of funds or denial of future funds, if mitigation commitments are not fulfilled.

Post-disaster responsibilities include:

- Participating in the preliminary damage assessment process to evaluate the magnitude and severity of the disaster, evaluating initial mitigation possibilities, and determining the composition of the federal mitigation teams [e.g., Hazard Mitigation Survey Team (HMST) and Interagency Hazard Mitigation Team (IHMT)]
- Conducting on-site evaluations with an interagency team comprised of federal, State, and local government personnel
- Assisting the State with briefing potential applicants on the purpose and intent of mitigation and available funding opportunities through the Hazard Mitigation Grant Program (HMGP)
- Coordinating the development of an interagency team report on proposed actions to mitigate future losses; and
- Assisting the South Dakota Hazard Mitigation Team (SDHMT) with updating the South Dakota Multi-Hazard Mitigation Plan based upon the recommendations of the HMST or IHMT.

2. State

- South Dakota Codified Law (SDCL) Chapter 15 titled Emergency Management, Sections 33-15-1 through 33-15-48 defines the State emergency management function as having primary responsibility to prevent, minimize, and repair damage from natural and manmade causes. The Governor has the leadership role in providing this directive to all State agencies.
- Presidentially declared disasters trigger State post-disaster mitigation opportunities, requirements and activities. Specific mitigation activities are stated in a FEMA-State Agreement. The Governor, through his executive power, directs specific agencies to participate in post-disaster mitigation activities.
- Additional authority is derived from the following sources:
    - Executive Order 97-14 - October 21, 1997
    - South Dakota Emergency Operations Plan
    - South Dakota Hazard Mitigation Grant Program Administrative Plan – 2002
    - South Dakota Multi-Hazard Mitigation Plan Winter/Ice Storm Annex – 2001

  - South Dakota Multi-Hazard Mitigation Plan Flood Annex – 2002
  - South Dakota Multi-Hazard Mitigation Plan Wildfire Annex – 2001
  - South Dakota Multi-Hazard Mitigation Plan Tornado Annex – 2001
- Other State documents used to develop this plan:
  - Final Report of the Interagency Floodplain Management Review Committee - July 1994
  - FEMA-I031-DR-SD Hazard Mitigation Strategy Report - July 1994
  - FEMA-2109-FSA-SD Hazard Mitigation Survey Team Fire Suppression Report - February 1995
  - FEMA-1045-DR-SD Hazard Mitigation Survey Team Report - March 1995
  - FEMA-1052-DR-SD Interagency Hazard Mitigation Team Report - June 1995
  - FEMA-I075-DR-SD Hazard Mitigation Report - April 1996
  - FEMA-1161-DR-SD Hazard Mitigation Team Report - February 1997
  - FEMA-1173-DR-SD Hazard Mitigation Report - April 1997
  - FEMA-1218-DR-SD Hazard Mitigation Team Report - June 1998
  - FEMA-1280-DR-SD Strategy Paper - June 1999
  - See Attachment 2-7 to this plan which is a table that identifies South Dakota State Agencies and their Programs

State Responsibilities

SDOEM is responsible for guiding the development of the South Dakota Multi-Hazard Mitigation Plan, creating the Hazard Mitigation Grant Program Administrative Plan, and: coordinating, monitoring, and assisting in the implementation of these plans. OEM also provides mitigation training to SDHMT members, which is a key component in the process of completing past recommendations and identifying future opportunities. In addition, OEM prepares an annual progress report on previous mitigation recommendations.

For purposes of implementing Section 322 of the Stafford Act, 42 U.S.C. 5165 and as stated specifically in Part III, 44 CFR Parts 201 and 206 Hazard Mitigation Planning and Hazard Mitigation Grant Program; Interim Final Rule, the State's responsibilities include:

General:

- Coordinate all State and local activities relating to hazard evaluation and mitigation
- Prepare and submit to FEMA a Standard State Mitigation Plan following the criteria as established in § 201.4 as a condition of receiving Stafford Act assistance (HMGP, PDM, Permanent Restorative

Measures under Public Assistance (only emergency measures will be funded if there is no approved state plan), and Fire Management Assistance Grants
- If the state determines that they want to be considered for the 20 percent HMGP funding, prepare and submit an Enhanced State Mitigation Plan in accordance with §201.5, which must be reviewed and updated, if necessary, every three years from the date of the approval of the previous plan
- At a minimum, review and, if necessary, update the Standard State Mitigation Plan by November 1, 2004 and every three years from the date of the approval of the previous plan in order to continue program eligibility
- Make available the use of up to the 7 percent of HMGP funding for planning in accordance with § 206.434
- Provide technical assistance and training to local governments to assist them in applying for HMGP planning grants, and in developing local mitigation plans
- For Managing States that have been approved under the criteria established by FEMA pursuant to 42 D.S.C. 5170 c (c), review and approve local mitigation plans in accordance with §201.6 (d).

Post-disaster action requires OEM and the State to take on expanded responsibilities in addressing disaster response, recovery, and mitigation. The governor of South Dakota is responsible for designating a South Dakota Hazard Mitigation Officer (SD HM 0) in accordance with the provision of the FEMA-State Agreement. The SDHMO (via the Governors Authorized Representative) activates the SDHMT to participate in the evaluation and planning process.

The SDHMT members will:
- Coordinate all State and local responsibilities regarding hazard mitigation for their specific agency
- Participate in the HMST and IHMT evaluation and planning activities
- Coordinate with local government to ensure local issues are addressed
- Prepare or review and update the South Dakota Multi-Hazard Mitigation Plan for the recent Presidential disaster declaration
- Set hazard mitigation strategies, goals, objectives, and priorities via the South Dakota Multi-Hazard Mitigation Plan
- Annually update the existing hazard mitigation plan and projects as recommended actions are completed
- Assist State and local agencies in preparing and completing hazard mitigation grant proposals, to include seeking appropriate funding solutions.

3. Local and/or Indian tribal governments
- Local Authority varies by jurisdiction. State and local

hazard mitigation laws, regulations programs, and policies, etc. are discussed in Section 4.2 and 4.3 of this plan.

Local Jurisdiction and/or Indian Tribal Government Responsibility

Local governments should initiate hazard mitigation as a means of reducing their vulnerability to natural and technological disasters. County emergency management agencies should analyze their hazards annually and evaluate their capabilities to address those hazards.

Indian tribal governments will be given the option to apply directly to FEMA for Hazard Mitigation Grant Program funding or they may choose to apply through the State. If they apply directly to FEMA, they will assume the responsibilities of the State, or grantee and if they apply to the State (vs. FEMA), they will assume the responsibilities of the local government or sub grantee.

For purposes of implementing Section 322 of the Stafford Act, 42 U.S.C. 5165 and as stated specifically in Part III, 44 CFR Parts 201 and 206 Hazard Mitigation Planning and Hazard Mitigation Grant Program; Interim Final Rule local governments' and Indian tribes' responsibilities include:

- Prepare and adopt a jurisdiction-wide natural hazard mitigation plan as a condition of receiving project grant funds under the HMGP, in accordance with § 201.6.
- Prepare and submit to the State a Local Mitigation Plan following the established criteria as a condition of receiving Stafford Act assistance (HMGP, PDM, Permanent Restorative Measures under Public Assistance and Fire Management Assistance Grants).
- At a minimum, review and, if necessary, update the local mitigation plan every five years from date approval to continue program eligibility.

Local governments or Indian Tribes receiving a federal hazard mitigation grant through SDOEM are expected to support hazard mitigation activities by:

- Designating a local official to function as the local hazard mitigation officer, as appropriate
- Participating in the HMST and IHMT process, as necessary or requested
- Participating in: the process of evaluating hazards, the adoption of appropriate hazard mitigation measures (including land use and construction standards), and the development of mitigation plans, recommendations, and updates, as appropriate
- Coordinating and implementing mitigation measures as agreed
- As appropriate and necessary, participate in mitigation funding activities and progress reporting.

Other Private Resources

- American Red Cross
- Association of Floodplain Mangers: Floodplain Management Resource Center
- Churches
- Community Transportation Association of America Federal Home Loan Bank Board: Affordable Housing Program
- Financial Assistance (Banks)
- Housing Assistance Council
- Low Interest Loans & Technical Assistance (Individuals)
- Water/Waste Water Loan Fund (Rural Communities)
- Insurance Companies (Basement Flooding Insurance)
- South Dakota State Bar Association

1.0 Prerequisites

1.1 Adoption by the State

Once the South Dakota Multi-Hazard Mitigation Plan is finalized, submitted and initially approved by FEMA, the Governor of South Dakota will promulgate the plan via letter for final submission to FEMA. Copy of letter is located in Attachment 1-1.

The State 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 § 13.11 (c). The State will amend its plan whenever necessary to reflect changes in State or Federal laws and statues as required in §13.11 (d).

2.0 Planning Process

2.1 Documentation of the Planning Process – See Attachments 2-5 and 2- 6 and Annexes A-D

2.2 Coordination among Agencies - See Annexes A-D

2.3 Integration with Other Planning Efforts - See Annexes A-D

There are several components to the planning process used in developing the South Dakota Multi-Hazard Mitigation Plan.

Since 1993, a strategy and interagency Mitigation Team herein referred to as the State Hazard Mitigation Team (SHMT), has participated in the following discussion process to identify, categorize, and prioritize issues pertinent to each disaster event in SD and the review meetings to ensure the SD Multi-Hazard Mitigation Plan is a current and workable document.

South Dakota has determined four potential disaster categories that were focused on due to recurrence. These categories were then documented in our planning and mitigating planning strategies as priorities. With the daily input of the Office of Emergency Management and the SHMT working together, we have compiled that information into our State Multi-Hazard Mitigation Plan in order to better mitigate the four categories identified as being repetitive loss/recurring incidents in South Dakota. These categories are Flood, Tornado, Wind Storm, and Wild Fire. Since 1993, we have had six (6) major Flood disasters, two (2) Tornado disasters, five (5) Winter Storm disasters, and six (6) Wild Fire disasters. Due to this information, South Dakota feels that these four categories provide the basis for program priorities and have been incorporated into the State Multi-Hazard Mitigation Plan for this reason.

- The SD Administrative Plan 2004 cites each SHMT member and agency that participates in this review process.

- The SHMT members are contacted via face-to-face meetings, telephone and email on a daily basis.

- The State of South Dakota's Plan was submitted via the OEM Website, along with an accompanying email to each County Emergency Manager, inviting them to review the plan and submit comments and suggestions which would be incorporated into the Plan. The Plan was also made available to the entire public population via the OEM Website for the encouragement of public comment.

- A Letter of Intent, regarding the review and comment participation process of the SD Multi-Hazard Mitigation Plan, was sent to each SHMT member with an accompanying CD. Each member was encouraged to review the CD and submit comments/input to the Plan within designated deadline. Each comment submitted by the SHMT member, was then incorporated into the Plan.

- A schedule for the review and update to the Plan within OEM and the SHMT members, will take place six months prior to the three-year required review process and after each disaster event in the form of a Team Report. This Team Report will then be incorporated into the existing Plan to ensure all information is documented and current.

- The responsibility of all review timeframes will be monitored by the Office of Emergency Management and the State Hazard Mitigation Officer.

3.0 Risk Assessment

The South Dakota Multi- Hazard Mitigation Plan Risk Assessment is a foundation piece of the plan. The Risk Assessment sets the stage for identifying mitigation goals and activities to assist the State in becoming disaster resistant and for keeping South Dakota citizens safe.

Disaster, Risk Assessment and Risk are defined in many different ways. Following are some examples of these definitions as found from various sources:

Disaster: 1: The ultimate emergency - one that exceeds the available resources to deal with it, and which involves multiple jurisdictions, triage and casualty distribution, access restriction, ambiguity of authority and responsibility, and an inability to use routine response procedures and resources. 2: World Health Organization: an occurrence that causes damage, ecological disruption, loss of human life, deterioration of health and health services on a scale sufficient to warrant an extraordinary response from outside the affected community area. 3: Federal Emergency Management Agency: An occurrence of a natural catastrophe, technological accident, or human-caused event that has resulted in severe property damage, deaths, and/or multiple injuries. As used in [this FEMA guide], a "large-scale disaster" is one that exceeds the response capability of the local jurisdiction and requires State, and potentially Federal, involvement. As used in the Stafford Act, a "major disaster" is "any natural catastrophe [...] or, regardless of cause, any fire, flood, or explosion, in any part of the United States, which in the determination of the President causes damage of sufficient severity and magnitude to warrant major disaster assistance under [the] Act to supplement the efforts and available resources or States, local governments, and disaster relief organizations in alleviating the damage, loss, hardship, or suffering caused thereby." 4: Illinois Emergency Management Agency: An occurrence or threat of widespread or severe damage, injury or loss of life or property resulting from any natural or technological cause, including, but not limited to, fire, flood, earthquake, wind, storm, hazardous materials spill or other water contamination requiring emergency action to avert danger or damage, epidemic, air contamination, blight, extended periods of severe and inclement weather, drought, infestation, critical shortages of essential fuels and energy, explosion, riot, hostile military or paramilitary action, or acts of domestic terrorism.

5: "Many people trying to do quickly what they do not ordinarily do, in an environment with which they are not familiar." (Tierney, 1985) See also emergency; Federal Emergency Management Agency.

Risk Assessment: is defined as a systematic process that determines the likelihood of adverse health effects to a population after exposure to a hazard. Health consequences may depend on the type of hazard and damage to infrastructure, loss of economic value, loss of function, loss of natural resources, loss of ecological systems, and environmental impacts and deterioration of health, mortality, and morbidity. The major components of a risk assessment include a hazard identification/analysis and a vulnerability analysis that answer the following questions: What are the hazards that could affect a community? What can happen as a result of those hazards? How likely is each of the possible outcomes? When the possible outcomes occur, what are the likely consequences and losses? Risk assessment is a fundamental planning tool for disaster management, especially during prevention and mitigation activities.

Risk is defined as a function of hazard and vulnerability and is a relationship that is frequently illustrated with the following formula, although the association is not strictly arithmetic: Risk = Hazard x Vulnerability.

Based on the guidance and parameters from the definitions above, the South Dakota Risk Assessment Section unfolds as follows:

- General Discussion and scope of the Risk Assessment including identification of information sources
- Identifies 19 hazards that may potentially impact the state or already have impacted the State
- Identifies in Attachment 3-1:
    - South Dakotas 66 Counties and estimated population as indicated
    - Potential estimated dollar losses organized by county boundary vulnerable to the most historically prevalent hazards. These estimates include:
        - General building stock by square feet and number of buildings categorized into residential, commercial, industrial, agricultural, religious, and governmental facilities
        - Essential/critical facilities including dams, hospitals, police departments, fire stations, and Emergency Operations Centers
        - Utilities including power, water and sewer
        - Transportation resources including highway segments, bridges, rail segments, airports and runways
        - Lists, addresses and other pertinent information organized by County FIPs Code (Attachment 3-2) of the following: (Source: HAZUS-MH)
            - South Dakota Airport Runways--

    Attachment 3-3
    - South Dakota Airports-Attachment 3-4
    - South Dakota Bus Facilities-Attachment 3-5
    - South Dakota Care Facilities--Attachment 3-6
    - South Dakota Communication Facilities-Attachment 3
    - South Dakota Dams-Attachment 3-8
    - South Dakota Electric Facilities--Attachment 3-9
    - South Dakota Emergency Operations Centers-Attachment 3-10
    - South Dakota Fire Stations-Attachment 3-11
    - South Dakota Hazardous Material Sites-Attachment 3-12
    - South Dakota Highway Bridges-Attachment 3-13
    - South Dakota Highway Segments--Attachment 3-14
    - South Dakota Natural Gas Facilities-Attachment 3-15
    - South Dakota Police Stations-Attachment 3-16
    - South Dakota Potable Water Facilities-Attachment 3-17
    - South Dakota Railway Segments--Attachment 3-18
    - South Dakota Schools-Attachment 3-19 and Reference Notebook 1
    - South Dakota Waste Water Facilities – Attachment 3-20
- Discussion on South Dakota Jurisdictions' Vulnerabilities and the Vulnerability of South Dakota State Facilities
- Estimated Losses by Jurisdiction
- Discussion on Estimated Losses of State owned and operated facilities
- Discussion on Probability of Future Events
- Flood Hazard Profile
  - Missouri River Basin – Geographic Description
  - Big Sioux River Basin – Geographic Description
  - Waubay Lakes Chain and Adjoining Closed Basins
  - James River Basin - Geographic Description
  - Vermillion River Basin – Geographic Description
  - Black Hills Region – Geographic Description
  - Flood Hazard Events for FEMA-1375-DR-SD,

    - FEMA-1173-DR-SD and the 1972 Black Hills - Rapid City Flood
- Winter Storm Profile
    - Winter Storm Events for FEMA-1330-DR-SD, FEMA-I045-DR-SD, FEMA-I052-DR-SD, FEMA-I075-DR-SD
- Tornado Profile
    - Tornadoes FEMA-1280-DR-SD and FEMA 1218-DR-SD
- Wildfire Hazard Profile
    - Wildfires FEMA-FSA-2319-SD, FEMA-FSA-2324-SD, FEMA-FSA-2369-SD, FEMA-FSA-2434-SD, FEMA-FSA-2458-SD, FEMA-FSA-2513-SD
- Landslide Hazard Profile
- Earthquake Hazard Profile

At this time, the South Dakota Risk Assessment includes data extrapolated from 31 local jurisdiction hazard mitigation plans submitted to the state for review and approval as of April 1 , 2004. The submitted local jurisdiction mitigation plans Profiles and Risk Assessments reveal that the hazards and risks identified are similar in manner and were similarly consistent with those found in the state plan's Risk Assessment. Attachments 5-1 through 5-3 reflect this.

Information for the Hazard Profiles and at-risk facilities came from a variety of sources, including but not limited to the following:

- Federal Emergency Management Agency
- Multi-Hazard Identification and Risk Assessment published by FEMA in 1997
- HAZUS-MH and HAZUS97
- SHELDUS (Spatial Hazard Events and Losses Database for the U.S. (1960-2000) from the USC Hazards Research Lab
- Historical disaster records and documents, including but not limited to Hazard Mitigation Survey Team reports, Interagency Hazard Mitigation Team reports, State and federal disaster declarations
- Literature developed by state and national hazard experts containing best available science and most current knowledge of hazards
- Written and oral communication from state and national hazard experts
- Current hazard zone maps, if available
- State of South Dakota Hazard Mitigation Plan, November 2001
- Facilities databases developed by state agencies participating in the development of this plan
- Reference materials located in Notebooks 1, 2 and 3

on file with SDOEM

Information used in the Hazard Profiles came from a variety of organizations including:

- South Dakota Office of Emergency Management
- Federal Emergency Management Agency, U.S. Department of Homeland Security
- National Oceanic and Atmospheric Administration, and its agencies/programs:
- National Climactic Data Center
- National Weather Service
- Tornado Project website, www.tornadoproject.com
- Northern State University, Aberdeen, SD
- United States Army Corps of Engineers
- United States Geological Survey
- South Dakota State University, Brookings, SD
- South Dakota Department of Environment and Natural Resources
- South Dakota Department of Agriculture
- South Dakota Department of Health
- South Dakota Homeland Security

3.1 Hazard Identification, Vulnerability Assessment And Estimated Potential Losses

The following steps were pursued to identify hazards that may affect the State of South Dakota:

- Review of past State and federal disaster designations (Annexes A- D of this Plan and all Attachments to Section 3.)
- Review and extrapolation of data in the 31 local jurisdiction hazard mitigation plans submitted to the State as of April 1, 2004 (Attachments 4-9, 5-1, 5-2, and 5-3)
- Review of the 1997 FEMA publication Multi Hazard Identification and Risk Assessment (page "xix" in Introduction)
- Extrapolated information from HAZUS99 and HAZUS MH

Information from the previously mentioned sources indicate the following natural and man-made hazards have either already occurred in South Dakota or have the potential to occur sometime in the future.

- Floods including:
  - Flash floods
  - Long-rain floods
  - Snowmelt floods
  - Dam failure floods
- Severe Winter Storms

- Tornadoes including:
  Hailstorm
  Straightline wind
  Thunder
  Lightning
- Wildfires
- Landslide
- Earthquake
- *Drought
- *Extreme Heat
- *Expansive Soils
- *Terrorism
- *Epidemic*
- *Hazardous Materials
- *Nuclear Event
- *Transportation Incident
- *Civil Disturbance

In general, the previously *annotated risks fall into the following categories so they are not considered "natural disasters" therefore not included in this plan. They are considered to be technological, terrorism or man-made disasters and are addressed in other departments agencies' and offices' programs and plans.

For better understanding of the different types of disasters, the following definitions are provided:

- **Technological disaster:** defined as technological events caused by humans and occur in human settlements. Examples of technological disasters are fire, chemical spills and explosions, and armed conflict. Synonym: manmade disaster. See also manmade disaster.
- **Terrorism:** defined as threat of--or threatened use of--criminal violence against civilians or civilian infrastructure to achieve political ends through fear and intimidation, rather than direct confrontation. Emergency management is typically concerned with the consequences of terrorist acts directed against large numbers of people (as opposed to political assassination or hijacking, which may also be considered "terrorism") (FEMA definition).
- **Manmade disaster:** is defined as a disaster that man clearly causes, such as wars, armed conflicts or civil strife. All other disasters, with the exception of technological disasters (e.g., industrial accidents, railway crashes) are labeled natural. All avalanches, floods, landslides, droughts, crop failures, ete., are thus given the same quality of naturalness as earthquakes, tropical cyclones and volcanic eruptions. See also Disaster (definition is located on Page 31 & 32)
- **Natural Disaster:** is defined as an acute onset and profound effects, caused by the forces of nature, e.g., earthquake, volcanic eruption, tropical cyclone, inland storms (tornado), heavy rainfall, heavy

snowfall, absence of rain, heat wave, cold wave.

Source: http://www.ben.edu/semp/htmlpages/ glossarysource.html

Based on past disaster history, population and property potentially at risk (numbers and dollars) the following natural hazard threats have emerged as the greatest concern statewide and are profiled in detail in this plan:

- Floods including:
  - Flash floods
  - Long-rain floods
  - Snowmelt floods
  - Dam failure floods
- Severe Winter Storms
- Tornadoes including:
  - Hailstorm
  - Straight-line wind
  - Thunder
  - Lightning
- Wildfires
- Landslide and Mudflow
- Earthquake

Each profile of the above-specified threats provides a discussion and description of the hazard and how it has affected the state, and further identifies jurisdictions most vulnerable to future hazard events based on best available data.

Assessing Vulnerability by Jurisdiction

To assist in addressing this section, the following cross section of definitions is provided.

High-hazard areas: Geographic locations that for planning purposes have been determined through historical experience and vulnerability analysis to be likely to experience the effects of a specific hazard (e.g., hurricane, earthquake, hazardous materials accident, etc.) resulting in vast property damage and loss of life (FEMA definition).

Disaster vulnerability: is a measure of the ability of a community to absorb the effects of a severe disaster and to recover. Vulnerability varies with each disaster, depending on the disaster's impact on the affected population or group.

Vulnerability: defined as the susceptibility of a population to a specific type of event. Vulnerability is also associated with the degree of possible or potential loss from a risk that results from a hazard at a given intensity. The factors that influence vulnerability include demographics, the age and resilience of the environment, technology, social differentiation and diversity, as well as regional and global economics and politics.

Vulnerability Analysis: defined as the assessment of an exposed populations' susceptibility to the adverse health effects of a particular hazard. See also hazard; vulnerability.

www.ben.edu/semp/htmlpages/glossaryv1.html

Vulnerability: Another definition is a condition wherein human settlements or buildings are threatened by virtue of their proximity to a hazard, the quality of their construction, or both.

www.cdmha.org/definitions.htm

Vulnerability: can be defined as the extent to which people and property are exposed to harm created by a hazard.

www.wa.gov/wsem/3-map/mit/lhmp/local-govt-mit-wkbk/14-Igm-wkbk-app-b.htm

Disaster-prone: The level of risk related to a hazard or the immediate cause of a disaster. Disaster-proneness is determined by analyzing the history of past events as well as new conditions that may increase the risk of a disaster occurring in the future.

One process for assessing the state vulnerability by jurisdiction is to keep the above definitions in mind and simultaneously examine the Table of Contents in conjunction with Section 3 and the Section 3 Attachments. By doing this one can determine each South Dakota County's identified potential hazards, population, property, facilities and infrastructure at risk. This combined effort will provide a snap shot of each jurisdiction's vulnerability and South Dakota's vulnerability statewide.

Social and Economic impacts of threats can be estimated as well. As indicated in the Table of Contents, Reference Notebook 2 on file in the SDOEM contains Economic Development Plans for every county in South Dakota. The information in those plans includes the following information: Demographics, Labor Force, Leading Employers, New and Expanding Companies, Four Year Institutions, Closest Vocational/Technical institutions, Average Salary by Occupation, Labor management Relations, Transportation, Taxation, Utilities, Government and Quality of Life. This information can also be accessed at website: http://www.sdgreatprofits.com/. Using this information in conjunction with Section 3 of this plan and the Section 3 Attachments assists in determining the social and economic vulnerability of each county.

By following the same process, counties and other local jurisdictions can use this information to assist in developing or updating their local mitigation plans.

Assessing Vulnerability of State Facilities

At this time, a complete and comprehensive list of state owned and operated facilities is not available therefore it is not possible to assess current vulnerability of state owned and operated facilities separately from other owned and operated facilities.[1] However, in

[1] The staff of OEM contacted the Bureau of Administration on numerous occasions concerning a list of state owned and leased property. We received a list of State-owned building located with the city limits of Pierre and a list of colleges within the state. The Space Management office

the data, tables, maps, etc. in the Section 3 Attachments, state facilities are included jointly with all other facilities and infrastructure. It can additionally be said that where state facilities are located within county jurisdictions vulnerable to identified threats, those state facilities are vulnerable.

The National Inventory of Dams (NATDAM), http://crunch.tec.army.mil/nid/webpages/nid.cfm, states approximately 30 of the "High" hazard dams in South Dakota do not have Emergency Action Plan. The largest (based on normal storage volume) of these high hazard dams without EAPs include Lake Corsica Dam owned by Douglas County and White Clay owned by the Oglala Sioux Tribe." The state owns two dams classified as a high hazard without Emergency Action Plans. These dams are Kroetch Dam and Brunning No. 1. The staff contacted the Dam Safety coordinator with the Department of Environmental Resources and confirmed the ownership of these two dams.

The U.S. DOT National Bridge Inventory (NBI) http://www.nationalbridgeinventory.com included with the HAZUS-MH datasets (Attachment 3-1) indicate that no State-owned highway bridges are considered rated critical for flood scour potential. According to the 2003 NBI report for South Dakota, http://www.nationalbridgeinventory.com/nbi_report_200340.htm, the State has 1,048 Structurally Deficient Bridges (56 are State-owned) and 486 Functionally Obsolete Bridges (15 are State-owned). The NBI includes an estimate of $244M needed for bridge improvement costs in South Dakota.

Estimated Losses by Jurisdiction

Attachment 3-1 represents potential estimated losses to residential, commercial industrial, agricultural, religious and government buildings organized by county. The estimates were taken from HAZUS MH data sets, which indicate estimated total losses county by county for each category. Over 750,000 residents of the State and approximately $45,086 million of building stock are at risk for losses from potential disasters.

Additionally, Attachment 3-1 represents estimated potential losses to critical facilities. This data was also gleaned from HAZUS-MH data sets. At risk are 841 schools representing $374 million in

informed the OEM that a database of leased property would be provided, but has not been received. The staff of OEM has now started formulating a plan to contacting each state agency to determine location of state offices. The staff is working through the Technical Advisory Group (TAG), whose membership represents: Department of Tourism and State Development; Game, Fish and Parks; Bureau of Information and Telecommunication; Department of Public Safety; Department of Revenue and Regulation; Department of Environmental and National Resources; and Department of Transportation, to obtain available information concerning vulnerability and potential losses to State owned or operated facilities. We have also obtained a geocoded database of government office buildings in the State from FEMA and have begun utilizing this data as a potential starting point to address this critical portion of the risk assessment. Once all members of TAG provide their information, the staff will contact the remaining agencies. The first step of a comprehensive analysis of potential vulnerability and losses to State facilities will include generating a comprehensive list of facilities that includes available information on their vulnerability and estimates of replacement costs, as well as geographic locations. The second step will be to overlay these facilities on digital hazard maps, including those developed through the Flood Map Modernization program and prioritize facilities by vulnerability and potential losses.

potential losses, 54 hospitals with 4,538 beds representing $290 million in potential losses, 157 police departments, 122 fire departments and 23 emergency operations centers representing $196 million, $65 million and $20 million in potential losses respectively.

These numbers are organized by county jurisdiction, however they represent collectively, people and property at risk statewide from any disaster event.

For purposes of this plan, it should be noted here that county boundaries are the smallest jurisdiction considered and in total include information pertinent to all jurisdictions located within the county. Within each county, other geographical, political and jurisdictional boundary plans such as cities, towns, and townships are much better suited for presenting detailed information for their respective jurisdictions.

The potential losses for flood were estimated by HAZUS-MH (Attachment 3-27 through 3-31) for Aberdeen, Pierre, Rapid City, Sioux Falls and Watertown. The program indicates that the greatest potential losses were in the Sioux Falls region and future versions of HAZUS-MH combined with improved datasets and hazard information as a result of Map Modernization are planned for future revision of the State Risk Assessment. The historic flood losses over an 43 year period total to $99.2M, resulting in an average annualized loss of about $2.3M for the State (source: www.sheldus.org) The State's January 2004 Map Modernization Plan divides the State into five regions based on population and flooding hazards. The priority regions and the jurisdictions associated with those regions are:

Priority 1, Big Sioux Region: Brookings, Clark, Clay, Codington, Day, Deuel, Grant, Hamlin, Hutchinson, Kingsbury, Lake, Lincoln, Marshall, McCook, Miner, Minnehaha, Moody, Roberts, Turner, Union, and Yankton.

Priority 2, James Region: Aurora, Beadle, Bon Homme, Brown, Brule, Buffalo, Campbell, Charles Mix, Davison, Douglas, Edmunds, Faulk, Hand, Hanson, Hughes, Hyde, Jerauld, McPherson, Potter, Sanborn, Spink, Sully, and Walworth.

Priority 3, Grand/Moreau Region: Butte, Corson, Dewey, Harding, Meade, Perkins, and Ziebach.

Priority 4, Cheyenne Region: Custer, Fall River, Haakon, Lawrence, Pennington, Shannon, and Stanley.

Priority 5, White/Bad Region: Bennett, Gregory, Jackson, Jones, Lyman, Mellette, Todd, and Tripp.

In addition, the nine counties listed as the top priority in the State's 2002 Flood Mapping Plan are all within highest priority region, the Big Sioux Region.

The exposure to Winter Storm hazards in South Dakota is statewide, and therefore the entire estimated building replacement value for the whole state of South Dakota is considered equally exposed ($45.4B) to this threat. The historic Winter Storm losses over an 35 year period total to $99.5M, resulting in an average annualized loss of about $2.8M (www.sheldus.org) .

There are counties in South Dakota that appear to be more vulnerable to wildland fire (including prairie fires) and tornados than others. These jurisdictions are summarized in Tables 1 and 2, present countywide exposure information for those jurisdictions most threatened by tornados and wildland fire, respectively. The tornado losses over a 44 year period total to $170M, resulting in an average annualized loss of about $3.9M for the State. The wildland and prairie fire losses were available through www.sheldus.org for only a 6 year period and totaled only $58,000, resulting in an average annualized loss of about $10K for the State. However, fire suppression costs for the 2000 Jasper Fire and the 2002 Grizzly Gulch Fire, both located in the Black Hills, were each approximately $10-20M (http://www.fema.gov/pdf/reg-viii/woods/61_64.pdf), bringing the approximate annualized loss total to about $2M per year.

Table 1: Tornado Exposure

County	**Estimated Building Replacement Value (HAZUS-MH)**	**Population (2000 Census)**	**exposure per capita**
Lawrence*	1,141,121,000.00	21,802	$52,340.20
Lincoln*	1,178,883,000.00	24,131	$48,853.47
Meade*	1,106,298,000.00	24,253	$45,614.89
Minnehaha*	7,428,584,000.00	148,281	$50,098.02
Pennington*	4,218,101,000.00	88,565	$47,627.18

*Counties with the highest risk to tornados identified in the hazard profile (Table 1), however, all counties in South Dakota are exposed to some degree of tornado risk

Table 2-Wildland and Prairie Fire Exposure

County	Estimated Building Replacement Value (HAZUS-MH)	Population (2000 Census)	exposure per capita
Bennett	119,833,000.00	3574	$33,529.10
Butte	372,293,000.00	9094	$40,938.31
Corson	139,216,000.00	4181	$33,297
Custer	391,352,000.00	7275	$53,794.09
Dewey	187,090,000.00	5972	$31,327.86
Fall River	390,717,000.00	7453	$52,424.12
Gregory	242,088,000.00	4792	$50,519.20
Haakon	103,882,000.00	2196	$47,305.10
Harding	75,463,000.00	1353	$55,774.58
Jackson	101,760,000.00	2930	$34,730.38
Jones	59,930,000.00	1193	$50,234.70
Lawrence	1,141,121,000.00	21802	$52,340.20
McPherson	152,607,000.00	8304	$18,377.53
Meade	1,106,298,000.00	24253	$45,614.89
Mellette	76,059,000.00	2083	$36,514.16
Pennington	4,218,101,000.00	88565	$47,627.18
Perkins	174,919,000.00	3363	$52,012.79
Shannon	272,555,000.00	12466	$21,863.87
Todd	254,054,000.00	9050	$28,072.27
Ziebach	72,809,000.00	2519	$28,903.93

*Counties with the highest risk to wildland and prairie fire identified in the hazard profile (Table 2)

Estimated Losses of State Owned and Operated Facilities

As stated previously, a complete and comprehensive separate list of state owned and operated facilities is not available at this time. However, the data in Attachment 3-1 includes all state owned and operated facilities as part of the total numbers of buildings, square feet, dollars and other pertinent information for each county. Again this data was extracted from HAZUS-MH data sets. For example, the Government category under Building Stock as well as Schools, Police Departments, Fire Departments and Emergency Operations Centers include all facilities owned and operated by the State of South Dakota. The total value of buildings included in these five categories total approximately $837 million.

Probability of Future Events

As discussed previously, vulnerability is determined by identifying what is at risk statewide-[estimated numbers of people and property (dollars and square feet) at risk from identified threats]. For South Dakota, these estimates were determined and are provided and/or illustrated in Section 3.0 in the Basic Plan in conjunction with information provided and/or reflected in the entire Section 3.0 Attachments. Additionally, the Table of Contents describes the information located in the Section 3.0 Attachments.

Predicting probability of future events is estimated by using the results of the vulnerability assessment as discussed in the previous paragraph and multiplying that times past events quantified.

Using the South Dakota information provided and the process as discussed in this section one can safely conclude that it is highly probable that flooding, severe winter storms, tornadoes, wildfires, landslides, mudflow and earthquakes will continue to occur in the future much as they have in the past.

What could reduce this probability in the future? One way is to continue the process of identifying and implementing good mitigation measures which result in people and property being protected or moved away from potential threats. If people and property are not impacted by a threat, even if it does occur, then the vulnerability of people and property are reduced. The threats can still occur, however, people and property would not be impacted because they would no longer be vulnerable to the threat. The best example of this is when structures including repetitive loss flood properties are removed from the path of potential floods and flooding. Moving the structures reduces the potential risk to life and property. Therefore, lives and property are less vulnerable to the potential flooding threat thereby making loss of life and property less probable.

3.2 Profiling Hazard Events

The following hazard events are profiled:

- Floods including:
  - Flash floods
  - Long-rain floods
  - Snowmelt floods
  - Dam failure floods
- Severe Winter Storms
- Tornadoes including:
  - Hailstorm
  - Straight-line wind
  - Thunder
  - Lightning
- Wildfires
- Landslide and Mudflow
- Earthquake

A short overview of South Dakota's geology and general geography is located in Attachment 3-43.

Event	Historic Occurrences	Future Probability	Jurisdictions most Vulnerable
Flooding	10[2], 243fatalities, 2,943 injuries, $99.2M historic losses	1% of any given year in identified by Special Flood Hazard Area; $2.3M year in average annualized losses	***Big Sioux Region:** Including the counties of Brookings, Clark, Clay, Codington, Day, Deuel, Grant, Hamlin, Hutchinson, Kingsbury, Lake, Lincoln, Marshall, McCook, Miner, Minnehaha, Moody, Roberts, Turner, Union, and Yankton.
Winter Storm	4[3], 33.99 fatalities, 363.36 injuries, $99.5 historic losses	100% from late Fall to early Spring $2.8M year in average annualized losses	All of South Dakota
Tornado	11,39[4], 11 fatalities, 243 injuries, $170M historic losses	High Risk, $3.9M year in average annualized losses	Lawrence, Lincoln, Meade, Minnehaha, and Pennington Counties[5], however all counties in South Dakota are considered at some risk to tornados.
Wildfire	6[6], 1 fatalities, 1 injuries, $12Mhistoric losses	100% from early spring to late Fall $2M year in average annualized losses	Mostly the western half of South Dakota.

Flood Hazard Profile

Data, tables, maps, etc. that augment and/or support this section are located in Annex A, Attachments 3-8, 3-21 through 3-31,343,3-44,4-1 through 4-4,4-7,4-8,4-10 and 4-11. It is important to note that the flooding profile includes the section written here along with the Annex and Attachments identified.

Throughout the United States, flooding is recognized as the most prominent disaster-producing phenomenon, generating annual losses in the billions of dollars. Floods are among the most serious, devastating and costly natural hazards that affect South Dakota. The greatest impact of these phenomena has been to the eastern half of the state, principally, the Big Sioux, Vermillion, and James River basins, which have recurring problems.

A flood occurs when water rises to flow over land that is normally dry. Floods happen in low-lying areas, such as valley bottoms and lake basins. In South Dakota, flooding occurs mainly in valley

[2] Count includes only presidential disasters and two historical events, historic loss information is based on www.sheldus.org.
[3] Count includes only presidential disasters; historic loss information is based on www.sheldus.org.
[4]The number of occurrences, fatalities, injuries and losses are from: http://www.spc.noaa.gov/archive/tornadoes/sttrank.html, and are based on records from 1950 to 1994 (44 years)
[5] See attachment 3-32
[6] The number included only Fire Management Assistance Declarations. The total number of wildfires is extensive. The numbers of occurrences increase when the land is dry. Historic loss information is based only a 6 year time period available from www.sheldus.org and supplemented with suppression cost estimates from http://www.fema.gov/pdf/reg-viii/woods/61_64.pdf

bottoms, deep canyons and lake basins when the amount of water moving through a river, or entering a lake, is so great that the natural or artificial banks can no longer contain all of the water. Therefore, the water overflows the banks of the river or lake and spreads out onto low-lying areas that are not normally covered with water.
In South Dakota, there are two main climatologic causes of flooding: runoff from rainfall and runoff from melting snow. The water from rainfall or melting snow flows overland until it reaches a nearby river or lake. If the river or lake cannot hold all of the water that is entering it, some of the water will begin to overflow the banks of the river or lake, causing flooding. The size of the flood is commonly influenced by such factors as the intensity of the rainfall, length of the rainfall, melting rate of the snow and the infiltration of the water into the ground.

In addition to climatologic reasons for flooding in South Dakota, floods can also result from the failure of dams. Dam failure can result from defective construction or a poor foundation. Many small dams in South Dakota fail because their spillway is not big enough. Often, failure occurs because of extremely heavy rainfall that causes a large increase in the amount of water held by the dam. This increase in water behind the dam could place more stress (pressure) on the dam than it was designed to handle, causing the dam to fail.

Four types of floods can occur in South Dakota.

The first type is commonly called a flash flood.

A flash flood follows a situation in which rainfall is so intense and severe and runoff so rapid that it precludes recording and relating it to stream stages and other information in time to forecast a flood condition (FEMA definition).

Another way to describe a flash flood is the result of several inches or more of rain falling in a very short period of time. This high intensity rainfall is commonly caused by powerful thunderstorms that cover a small geographic area. Because so much water is falling onto the ground very rapidly, there is little time for the water to soak in, and most of the water runs off into nearby rivers or lakes. The flood that occurs as a result of this runoff happens very rapidly, hence the term "flash". This type of flood is generally very destructive, affecting a fairly small, localized area, commonly several tens of square miles or less. The flash flood often ends almost as quickly as it started. Probably the best-known flash flood in South Dakota occurred when Rapid Creek left its banks on June 9, 1972, in Rapid City. Fifteen inches of rain that fell in less than 6 hours caused the flooding. This flood was devastating both in terms of loss of human life and property damage. Two hundred thirty-eight people lost their lives in this flood and about $150 million (in 1972 dollars) of property damage occurred.

The second type of flooding is sometimes termed the long-rain flood, and is the most common cause of major flooding. FEMA describes this type of flood as a general and temporary condition of partial or complete inundation of normally dry land areas from overflow of inland or tidal waters, unusual or rapid accumulation or runoff of surface waters, or mudslides/mudflows caused by accumulation of water This type of flood results after several days or even weeks of fairly low-intensity rainfall over a widespread area, often hundreds of square miles. As a result, the ground becomes "water logged," and the water can no longer infiltrate into the ground; therefore, the water begins to How toward rivers or lakes. The Hooding that can result is often widespread, covering hundreds of square miles, and can last for several days or many weeks. Much of the Hooding that occurred in eastern South Dakota during the summer of 1993 was this type of Hooding.

The third type of flood in South Dakota is the result of melting snow in the spring. This type has characteristics that are almost a combination of the flash flood and long-rain Hood. The area covered by this type of Hood is generally not as large as that covered by the long-rain Hood, but is typically larger than that covered by the flash flood. Generally, the flood lasts for several days, occurring when large amounts of snow melt rapidly due to warm temperatures. The flooding can be made worse if the ground remains frozen while the snow is melting; this causes all of the melt water to run off to nearby rivers and other bodies of water such as streams, drainage systems and lakes rather than infiltrate into the ground.

Some of the largest floods that have occurred in South Dakota were the result of melting snow and ice. These large Hoods have occurred along the entire length of the Missouri River. The Great Flood of 1881 is probably the most well known of all the Hoods to take place in South Dakota. Ice jams on the river caused the flooding to become extremely devastating, destroying large amounts of property and causing many lives to be lost. Towns such as Yankton, Vermillion, Burbank, Meckling, and Pierre were all severely damaged by the Hooding.

The fourth type of flood results from the failure of dams. According to the Flooding in South Dakota fact sheet written by Stan F. Pence, Division of Geological Survey, Department of Natural Resources located in Vermillion, South Dakota, the four largest dams in South Dakota - Oahe at Pierre, Big Bend at Fort Thompson, Fort Randall at Picks town, and Gavins Point at Yankton - are all located on the Missouri River. Large dams in the Black Hills are the Deerfield, Pactola, Sheridan and Angostura dams. If any of these large dams were to fail, considerable numbers of people and property would be at risk. Fortunately, all of these dams are considered to be properly constructed, and have been designed to hold back very large amounts of water; therefore, they are considered to be very safe, and the likelihood of failure is extremely small. Except for these Missouri and Black Hills dams, the majority of the dams in South Dakota are very small, and if they were to fail, Hooding would likely be minimal.

In FEMA Publication 333 *Federal Guidelines for Dam Safety: Hazard Potential Classification Systems for Dams* dated October 1998 (Located in Reference Notebook #3 on file in the SDOEM), Dams are classified as follows:

Low Hazard Potential Classification means that no loss of human life is expected and economic, environmental, and lifeline losses are expected to be low and generally limited to the owner.

Significant Hazard Potential Classification means that no loss of human life is expected but economic, environmental and lifeline losses are expected.

High Hazard Potential Classification means that loss of human life is probable and is expected to be more than one. Economic, environmental, and lifeline losses are expected but are not necessary to receive this classification. Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

Critical to the mission of disaster identification and risk assessment is the ability to statistically log and compare various types of flood and demographic data. Through the use of modern GIS technologies, multiple analyses of structures, historical sites, city boundaries, airports, and schools can be performed and then compared to the flood plain zones in which they are located. This capability provides a quicker and more accurate work product than previous techniques of printed transparencies and stickpins. Based on numbers of people and property at risk Le., vulnerability of people and property at risk, the South Dakota Office of Emergency Management has determined that the cities of Aberdeen, Pierre, Rapid City, Sioux Falls and Watertown are at the greatest risk from flooding events. Attachments 3-26 through 3-31 contain flood data extracted from HAZUS-MH and reflect the flood risk in these communities. See also, Attachment 3-8, 322, 3-23, 3-24 and 3-25.

South Dakota is divided into 14 river drainage basins. These basins extend beyond the political boundary of the state. Although not discussed or included in this plan, an interstate understanding of water policy is required to fully analyze and comprehend South Dakota water systems.

With regard to South Dakota Geology, Geography, Flood Risk Analysis and River Basins, please see Attachments 3-21, 3-22, 3-23,3-26 through 3-31,3-43 and 3-44.

Missouri River Basin - Geographic Description

Considered as a separate river, the Missouri is the longest in the United States. In combination with the Mississippi River into which it flows at St Louis, it is the longest river system in the U.S. The river begins where the Gallatin River, Jefferson River, and Madison River come together in the foothills of the Rockies in Montana. It flows through Montana, North Dakota and South Dakota, before forming the boundary between Iowa and Nebraska. It forms the extreme northeast border of Kansas before turning almost due east through the state of Missouri.

South Dakota is drained almost entirely by the Missouri Rivet and its tributaries. The only sections that are not lie in the extreme northeast and northwest. The Missouri flows southward and then southeastward across the state, in a deep, wide channel. It forms part of the South Dakota-Nebraska state line. Much of the South Dakota section of the river is now made up of a chain of four reservoirs impounded by large dams. These dams include Fort Randall, Gavins Point, Big Bend, and Oahe dams, built for flood control and to provide water for irrigation and the generation of hydroelectricity. Lake Oahe is formed by Oahe Dam at Pierre. The James River, the Vermillion River, and the Big Sioux River, all in the eastern half of the state, flow southward in roughly parallel courses to join the Missouri. In the western part of the state the Grand, Moreau, Cheyenne, Bad, and White rivers flow generally eastward to join the Missouri.

South Dakota cities on the river include Pierre, Mobridge, Oacoma, Chamberlain, Pickstown, Fort Thompson, and Lower Brule. The interstate effects of water policy are evident in the capital city of Pierre, where national policy objectives produce an ever-rising Missouri River to offset flooding in down river states.

The largest natural lake in South Dakota is Lake Thompson in the east-central part of the state. Other natural lakes of significant size in South Dakota are lakes Traverse and Big Stone, both in the northeastern corner of the state. In addition, there are the Waubay Lakes Chain and adjoining closed basins (discussed further in this section) located in the northeastern part of the state, which have continuous ongoing flooding issues. Numerous small lakes and sloughs dot the landscape of northeastern South Dakota, as well. The largest lakes are the reservoirs behind dams on the Missouri River, all of which were constructed as part of the Missouri river basin project.

Source: "South Dakota," Microsoft@ Encarta@ Online Encyclopedia 2004 http://encarta.msn.com(Q1997-2004 Microsoft Corporation.

Big Sioux River Basin - Geographic Description

The Big Sioux River basin is the eastern most major river pattern in South Dakota. It is formed within a topographic feature known as the Coteau de Prairie Highlands. This glacial formed feature rises about 800 feet above the bordering Red River lowlands of Minnesota. It is also bordered on the west by the James River lowlands. The Coteau has what is known as a flatiron shape lying in a general northwest to southeast direction. It is about 200 miles long and 80 miles wide at the widest point. It has a variation in elevation from 2,050 feet at the highest point to 1,090 feet at the lowest point.

The northern part of the Coteau has geologically developed features of potholes, sloughs, and lakes. During periods of low precipitation, these features tend to hold backwater and do not contribute to the drainage of the Big Sioux River. Conversely, during wet years, this area can accumulate enough moisture to greatly increase the water supply to the drainage basin. There are about 1,970 square miles of land within the basin that is designated as non-contributing to the drainage system. The portion of the basin that does contribute to the Big Sioux River registers about 7,280 square miles. A total of 4,280 square miles of the figure is located in South Dakota

The headwaters for the Big Sioux River are found in the Coteau Lake Region of Roberts and Day counties. The river flows in a southerly direction to its junction with the Missouri River near Sioux City, Iowa. The variation in elevation from the headwaters to the mouth greatly influences the movement of water through the basin. The elevation decreases from 1,826 feet near Waubay to 1,281 at Sioux Falls. The Granite Falls formation of Sioux Falls has a 100-foot drop in elevation. Below the Falls, the elevation varies from 1,281 feet to 1,098 feet at its mouth near Sioux City, Iowa.

Associated with the elevation is the slope profile of the river. The slope varies from 1.83 feet per mile near Watertown, 1.50 feet per mile at Sioux Falls, and 0.5 feet per mile at the junction with the Missouri River. The Big Sioux River has a steeper gradient than the James or Vermillion rivers. This steep slope causes water to move quickly down the drainage system and thus shortens the time of peak flooding in any given portion of the basin.

Waubay Lakes Chain and Adjoining Closed Basins

The Waubay Lakes Chain is part of a closed basin area in northeastern South Dakota. It is primarily located in Day County and is a 409 square mile closed sub-basin within the Big Sioux River Basin. The 10 major lakes in this chain are glacial in origin and include Bitter Lake, Blue Dog Lake, Enemy Swim Lake, Hillebrands Lake, Minnewasta Lake, Pickerel Lake, Rush Lake, Spring Lake, Swan Pond and Waubay Lake.

Much of Day County and the surrounding area (parts of Clark, Codington, Grant, Marshall and Roberts Counties) are considered to be within a "closed basin". This means, that under most circumstances, water does not have a direct drainage path to a river outside the closed basin and the water would have to evaporate into the atmosphere for lake levels to recede. The northeastern area of South Dakota is much like a giant bathtub. Water fills the basin until it overflows the sides. Because the area is atop a flat area of high ground, the sides of the tub are higher than the normal drainage routes (e.g., the Big Sioux and the James Rivers) leaving the accumulated runoff without a natural outlet.

Rising waters have inundated portions of Day County, South Dakota and the surrounding areas over the past 12 years. Significant increases in lake levels within the Waubay Lakes Chain have occurred mainly due to greater-than-normal precipitation along with less-than-normal evaporation. Several Presidential Disasters and Declarations allowed for funding to be used to address the immediate problems of inundated roads and structures for emergency access purposes. As of 1999, the Federal government had spent over $71 million in northeastern South

Dakota for response and recovery efforts and emergency measures. However, because a major storm event or flash flood did not cause the damage (it was caused by an accumulation of annual runoff and a lack of evaporation), established FEMA disaster programs could not adequately address the situation.

Rising water levels in the Waubay Lakes Chain have resulted in substantial damage to public and private properties in the basin. Numerous public roads and highways have been damaged or closed because of high water and some have been raised at great cost. Many parks and recreational facilities have been adversely affected as well. The available data show that the greatest impacts from flooding have been to agriculture and transportation.

In September 1998, FEMA issued a mission assignment to the USGS to provide oversight, coordination and hydrologic expertise for a study of the Waubay Lakes Chain and the adjoining closed basins. This study including pertinent maps is on file with the SDOEM and FEMA Region VIII. The USACE also provided technical expertise and analysis for the study as well as possible structural mitigation solutions. The NRCS provided soils data. The completed study consists of five Task Reports and a Summary Report.

The studies from the various agencies found that from 1991 until the report was published in 1999, the Waubay Lakes Chain were experiencing a wet climatic period that can be expected to occur less than once every 100 years, on the average. Due to greater-than-normal precipitation along with less-than-normal evaporation, significant increases in lake levels and inundation areas within closed basins in northeastern South Dakota have been observed. In the Waubay Lakes Chain, the lake levels for Bitter, Hillebrands, Minnewasta, Rush, Spring and Waubay Lakes and Swan Pond have significantly increased.

The total surface area of the 10 major lakes in the Waubay Lakes Chain increased by 15,804 acres or over 74% between 1991 and 1998. The water levels for Bitter, Hillebrands, Spring and Waubay Lakes and Swan Pond have increased between 15 to 18 feet from 1991 to 1998. Blue Dog, Enemy Swim and Pickerel Lakes have concrete weir outlet structures and have experienced lake level increases of 2.7, 1.8 and 0.1 feet respectively between Fall 1991 and Fall 1998. Minnewasta and Rush Lakes have experienced lake level increases of 9.2 feet and 3.9 feet respectively.

At the time the study was published, the USACE hydrologic model simulation indicated that whether the climate was wet or dry for the few years following 1999, flooding problems would persist in the region and as of 2004, it has. It would take at least a decade of drought similar to the 1930's conditions to return the lakes back to the conditions that existed prior to 1992. If relatively wet climate conditions persist, the lakes will continue to climb until Bitter, Blue Dog, Rush and Waubay Lakes form a single lake inundating over 60,000 acres. It would take nearly 15 years of wet conditions for this to occur.

According to the study, if the scenario of continuing wet conditions were to persist for more than 15 years and the lakes continue to rise and expand, the natural drainage divide south of Bitter Lake could overflow and spill to the Big Sioux River.

James River Basin - Geographic Description

The James River Basin is the largest of the East River Basin Systems. It is bordered on the east by highlands of the Coteau de Prairie and on the west by the high ground of the Coteau de Missouri. The valley is a nearly flat stretch of land about 216 miles long and averaging 60 miles wide. It is only in the southern portion that the topography becomes steeper. There is little variance in the elevation of the basin. At Columbia, where the river basin forms in South Dakota, the elevation is 1,290 feet. At the southern terminus of the basin near Yankton, the elevation is 1,162 feet.

The James River drainage area encompasses all or part of 23 counties. It drains 12,609 square miles or over eight million acres of land in South Dakota. This represents 16.3 percent of the total land in the state. The river valley is about 400 miles long, 25 to 75 feet deep and varies in width from a few hundred feet to three miles. The slope of the valley is .493 feet per mile and the average slope of the river is .280 feet per mile.

There are seventeen contributing streams within the James River Valley. These streams drain 10,606 square miles. The majority of the basin lacks good drainage features. This is due to the slight variance in elevation and limited slope of the river. Much of its drainage is non-contributing and remains in small swales and basins.

Vermillion River Basin - Geographic Description

The Vermillion River Basin is the smallest of the East River systems. It has its headwaters in the lake country of Kingsbury County. The river flows through McCook, Turner, and Clay counties to join with the Missouri River near Burbank, South Dakota. The west branch originates in Miner County and connects with the main stem near Parker in Turner County.

The Vermillion River Basin is formed in the Dakota Valley or what is more commonly called the James River Lowland. This area is more than 200 miles long and about 60 miles wide and occupies a portion of the lower half of the basin. The gradient of this river system is approximately 400 feet throughout the length of the river. The east branch elevation is 1,518 feet and the elevation near Vermillion is 1,119 feet. The slope profile is approximately 4.0 feet per mile.

The drainage system is supplied with water from both the east and west portion of the basin. The major tributaries are the Little Vermillion River, Turkey Ridge Creek, and Saddle Creek. There are also a number of very small tributaries contributing to its drainage pattern.

Black Hills Region - Geographic Description

The western most drainage system is found in the Black Hills region. The Black Hills lie within the states of Wyoming and South Dakota with the majority of the area within the western border of South Dakota. It is described as being 125 miles in length and 60 miles in width. The general shape of the Black Hills is elliptical. This formation presents a startling contrast to the surrounding topography. Its eastern side rises from the prairie to a height from 2,600 to 3,500 feet. The western part of the Black Hills varies in elevation from 3,500 to 7,200 feet at Harney Peak.

The major drainage creeks of Alkali, Battle, Bear Butte, Beaver, Box Elder, Elk, French, Rapid, Spearfish, Spring, and Whitewood are all capable of causing heavy flooding and flood related damage. These eleven creeks drain about 7,500 square miles of land.

Profiling Flood Hazard Events

South Dakota is remarkable in the sense that as early as the late 1800's flood mitigation efforts were pursued and implemented. The first effort was after the 1881 flood of the Vermillion and Missouri Rivers that wiped out the town of Vermillion. The town was relocated on the bluffs behind the former town to prevent another recurrence - thus marking the first recorded hazard mitigation effort by a government entity in South Dakota and possibly the Nation.

The second effort followed the 1972 Black Hills/Rapid City flood. This flood stands out in South Dakota history as the deadliest and most expensive in terms of damage. Because of this flood, Rapid City engaged in the second recorded hazard mitigation effort in South Dakota by refusing to allow rebuilding in the floodway. This program effectively launched Federal government efforts to create a Hazard Mitigation Program.

Since 1984, eight Presidential Disaster Declarations have been issued for flooding events in South Dakota costing an estimated $80.8 million dollars with numerous other devastating flooding disasters occurring in the years before 1984.

Detailed information on South Dakota flood hazard events is located in Annex A, Attachments 3-1, 3-21 through 3-31, 4-1 through 4-4, and 4-7 through 4-11.

FEMA-1375-DR-SD

The on-set of flooding problems was prompted by a spring thaw in early March 2001. Ice jam fluctuations substantially damaged a bridge in Mellette County causing the County to close the bridge to through traffic. This action resulted in a 40-mile detour for residents needing to cross the White River.

On April 6, 2001, a series of rainstorms that dropped from two to six inches of rain resulted in flooding of the James, Vermillion and Big Sioux Rivers.

According to the National Weather Service, the James River, at Huron, reached its highest crest of 18.1 feet (flood stage of 11.0 feet) on April 1 0, 2001, the second highest crest on record.
On April 11, 2001 a second similar weather system produced more heavy rains in the Aberdeen, Huron, Watertown, and Brookings areas. Flooding of the James River occurred in and around Huron and Mitchell. The West Fork of the Vermillion River caused flooding around Parker and Centerville. The Big Sioux River flooded in and around Watertown, Dells Falls, and Sioux Falls. At Mitchell, the James River reached its highest crest of 21 feet (flood stage of 14.0 feet) on April I!, 2001, the second highest crest on record according to the National Weather Service. Peak crests on the Vermillion and West Vermillion Rivers were at
two to four feet above flood stage. The Big Sioux River in Sioux Falls crested at 22.0 (flood stage of 16.0 feet) on April 24, 2001. The James River was forecasted to remain above flood stage for the following few weeks.

A third major system passed through South Dakota on April 21-22, 2001. The Black Hills, in the western part of the State, received up to twenty-two inches of heavy wet snow and the eastern portion of the State received from 4-8 inches. This storm resulted in damage to county and township roads in the eastern and northeastern portion of the State that had previously not been affected by floodwater.

On April 23, 2001, Governor Janklow requested that FEMA conduct a Preliminary Damage Assessment (PDA) for Public Assistance (PA) in eleven (11) counties. A joint PDA was performed for PA from April 30 through May 04,2001, utilizing seven (7) inspection teams comprised of personnel from FEMA, Bureau of Indian Affairs (BIA), South Dakota Division of Emergency Management (SDDEM), and local governments. BIA participation in this PDA was a joint venture between FEMA and the BIA. The BIA requested that FEMA provide damage assessment training to BIA personnel to give them the ability to accomplish successful damage assessments on the Reservations when an event is not a Presidential disaster declaration. The BIA paid all expenses for two (2) individuals out of the Aberdeen Area Office. The field training was successful.

Description of Damages

Discussions with the State Farm Services Agency office in South Dakota indicate there were widespread agricultural impacts from the series of winter storms affecting the northeast portion of the state. Croplands were heavily impacted which will result in crops being planted later than normal or not planted at all, resulting in reduced yields. The existing winter wheat crop was heavily impacted by the cold and many acres were lost. A larger than normal number of spring calves were lost due to the winter storm and farm building damage was reported in most of the surveyed counties.

Loss of electrical service was experienced because of ice and wind damage to utility poles. Numerous line breaks were also noted.

Numerous bridges were identified as damaged or destroyed.

Types of debris included siltation of road ditches, floatable and non-floatable debris deposited at culverts and bridges, and temporary sandbags. This material had to be removed to protect public health and safety and/or restore the functioning of essential public facilities. The culverts that were plugged or washed out by debris needed to be replaced or re-installed, and many miles of roads had to be repaired. Road damage consisted of eroded or breached embankments, structure approaches, eroded drainage ditches, and loss of aggregate surfacing. Several roads were temporarily impassable, causing residents to travel greater distances because of detours. Some of the damaged roads included school bus, mail and farm-to-market routes. Travel on these roadways involved significant elements of risk. Many farmers were unable to access their fields to begin spring planting. Required repair of the roads had a significant impact on road construction and maintenance budgets due to the numerous disaster declarations South Dakota has experienced over the last 10 years. Various Federal Aid System Roads were damaged due to flooding. The extent of damage to these roadways is unknown at this time.

Flooding damaged the playing field in Corona City Park. Roads in Lake Norden City Park were flooded. The footbridge Over Lake Kampeska inlet in Watertown was severely damaged due to ice flows.

FEMA-1173-DR-SD

This disaster has its roots in past flooding events. Beginning in 1992, the state had a series of weather related events of a sufficient magnitude and impact to warrant eight Presidential Disaster Declarations through the end of 1997; five for flooding, three for ice/snow; and one for just snow. Whether or not the country or the region had entered into a "wet-weather cycle," these previous events kept the water table saturated. The saturation consistently prevented much of the winter snowmelt and the spring/summer rains from soaking into the ground, thus contributing to flooding.

1996 Weather Events that Contributed to the 1173 Disaster

A slow moving winter storm with severe snow and freezing rain entrenched itself over much of the state. The effects of the storm were felt primarily in the Black Hills and southeastern portions of the state. The storm was a combination of a strong system of cold air, hovering close to the ground, with a system of warm air above. This combination made for rain, fog, and snow that quickly turned to damaging ice. The snow and ice formed and amassed on roadways, trees, electric transmission lines, and power poles. Some power lines were swollen by ice to five inches in diameter. The excessive weight and severe wind conditions snapped lines and flattened poles. Thousands of pole-braces, crossarms, and anchors at scattered locations also cracked under the heavy stress. Six rural electric cooperatives (REC), affecting approximately 10,700 REC customers experienced serious outages due to the loss of poles, braces, lines, crossarms, anchors, and substation failures. Customers were without power in subfreezing temperatures for continuous periods ranging from several hours to several days. The force of the storm caused major delays on Interstates 90 and 29. Portions of state and county highways and roads were closed for an extended period of time due to heavy ice and snow accumulation and extremely poor visibility.

1997 Weather Events that Contributed to the 1173 Disaster

Twice in a 7-day period in early January, cold Arctic air swept down and "froze" the state. The governor closed the Interstates for public safety. More than 36,000 head of cattle perished. Roads were blocked or covered by 20-foot drifts of snow. Fifteen days after the storm ended, some roads were still blocked by snow. The Day County highway superintendent reported 20- and 40-foot vertical drifts blocking the highway. Livestock losses, damaged buildings, and feed shortages occurred in an area called "red zone." This is an area of 4,722 cattle operations, 1,200 sheep operations, 1,000 hog farms, and 515 dairies along the northern third of the state west to east. This storm caused a minimum of $29,527,562 in damages/cleanup efforts and resulted in a Presidential Disaster Declaration (FEMA-1161-DR-SD). Three people died while trapped in vehicles along the highways. The snowmelt from this record-breaking storm was a major contributor to the flood disaster.

1997 Flooding Disaster

From mid November to mid February, the general weather across the eastern part of the state could be described as cold and wet with below normal temperatures (in excess of 30 degrees below zero) and record setting above normal snowfall. The persistent cold greatly limited snowmelt between storms allowing the snow to pile up to 48 inches across much of the northeastern portions of the state. Mid February snow depths elsewhere across eastern portions ranged from 10 to 24 inches. The National Weather Service (NWS) snow water equivalent measurements of February 12th ranged from approximately 2 inches near the Missouri River to over 6 inches in Marshall County. Snow water equivalent values from 4 to 5 V2 inches were common over the central and northern portions of the James and Big Sioux River basins.

Seasonably cool and relatively dry weather prevailed across the eastern parts from mid February to early April. An early April blizzard added to the remaining snow pack, which gradually melted south to north by the end of April. Heavy rain and snowstorms in April, compounded by the severe winter blizzards and existing saturated soil conditions, resulted in persistent flooding throughout the state. Many people were evacuated form their homes and farms, while others had limited or no access or escape. Heavy snowmelt and pounding rains turned prairie potholes into lakes, pushed people from their homes, and prevented farmers from planting thousands of acres of land. Due to the saturated conditions, many people experienced lengthy delays, or not being able to return to their homes, farms, or businesses. The James River Water Development District estimated that five years of flooding have destroyed or severely damaged approximately 75 percent of the forested areas in the James River valley. Riverine flooding destroyed or damaged many homes and businesses, impacted water and sewage treatment plants, and damaged or destroyed many roads and bridges. This flood caused a minimum of $51,249,493 in damages. Two people died. On April 7th the President declared the entire state a disaster area (FEMA-1173DR-SD).

The Presidential Disaster Declaration made the entire state eligible to receive federal disaster assistance from FEMA's Public Assistance, HMGP, and Individual & Family Grant programs.

1993 Flooding Events that Contributed to the 1173 Disaster

In 1993, FEMA-999-DR-SD was declared for severe flooding and heavily impacted 39 counties in South Dakota, over half the State. This flood caused $11,024,621 dollars worth of damage to public infrastructure alone. DR-999 is also considered part of the top ten natural disasters ranked by FEMA Relief Costs. Twice, South Dakota has experienced flooding considered to be in the top ten natural disasters to occur in our country. First in 1993, DR-999 and second in 1997, DR1173.

The 1972 Black Hills-Rapid City Flood

On June 9-10, 1972, extremely heavy rains over the eastern Black Hills of South Dakota produced record floods on Rapid Creek and other streams in the area. Nearly 15 inches of rain fell in about 6 hours near Nemo and more than 10 inches of rain fell over an area of 60 square miles. According to the Red Cross, the resulting floods left 238 people dead and 3,057 people injured. In addition to the human tragedy, total damage was estimated in excess of $160 million (about $664 million in 2002 dollars), which included 1,335 homes and approximately 5,000 automobiles that were destroyed.

Scattered showers had occurred throughout the Black Hills area on several days prior to the heavy rains that began on June 9. Near Pactola Dam, these earlier showers had left the soil saturated, which increased the amount of runoff for the flood of June 9-10.

Rainfall began in the Black Hills area on the afternoon of June 9 when a group of almost-stationary thunder-storms formed over the eastern Black Hills. The heavy rains that fell until about midnight partly were the result of a strong low-level easterly airflow that forced moist air upslope over the Black Hills. This strong and sustained orographic effect caused the air to rise, cool, become very unstable, and release its moisture in repeating thunderstorms. Light winds at higher atmospheric levels allowed the storms to remain nearly stationary, which resulted in extremely heavy rainfall. Precipitation totals for June 9-10 ranged from 4 inches to more than 12 inches in the Rapid Creek watershed between Pactola Dam and Rapid City. In the Boxelder Creek watershed, 15 inches of rain during a 6-hour period was measured at Nemo. The heaviest rainfall averaged about four times the 6-hour amounts that are to be expected once every 100 years in the area.

The resulting runoff produced record floods (highest peak flows recorded) along Battle, Spring, Rapid, and Boxelder Creeks. Smaller floods also occurred along Elk Creek and Bear Butte Creek.

Although Pactola Reservoir was effective in storing runoff that originated upstream of Pactola Dam, the heaviest rainfall occurred down-stream of the dam. Most of the flow that passed through Rapid City via Rapid Creek originated in the 51-square-mile drainage area between Pactola Dam and Canyon Lake. Floodwaters that reached Rapid City between 9:30 and 10:00 p.m. on June 9 carried large amounts of debris that clogged the spillway of the Canyon Lake Dam. The dam at Canyon Lake failed at about 10:45 p.m. However, the effect of this dam failure on the subsequent flood wave into urban Rapid City has been difficult to assess because the amount of water coming down Rapid Creek and several tributaries (accounting for 86 percent of the peak flow) far over-shadowed the amount of water in the small lake. The peak flow of 50,000 cubic feet per second (ft3/s) was carried through Rapid City via Rapid Creek at about midnight on June 9, while many people were asleep and unaware of the impending flood. The stage of Rapid Creek (measured above Canyon Lake) rose more than 13 feet in 5 hours during the flood.

Extreme flooding also occurred along Battle Creek and its tributaries because this area received some of the most intense rainfall. In Keystone, eight people were killed and much of the town was washed away. High runoff occurred between Hill City and Sheridan Lake, where some water was stored for a short time and slightly reduced the flood peaks downstream. Boxelder Creek also experienced extreme flooding, although total damage was relatively low because of the area's sparse development at that time. Significant flooding occurred in the Elk Creek and Bear Butte Creek Basins, although these basins were not in the area of heaviest rainfall.

The floods struck quickly and forcefully, but they did not last long nor did they make much impact farther downstream in the basins. Water in Rapid Creek within Rapid City was back within its banks by 5:00 a.m. on June 10. All of the streams that experienced flooding drain into the Cheyenne River, but the peaks were diminished considerably by the time they were discharged into the Cheyenne River. As the peak flows moved into less-steep terrain, the flows spread out over a wide area, and much of the water was stored in the flood plains.

Winter Storm Hazard Profile

Data, tables, maps, etc. that augment and/or support the Winter Storm Profile are located in Annex B, Attachments 3-21 through 3-

23, 4-1 through 4-4, and 5-1 through 5-3. It is important to note that the winter storm hazard profile includes the section written here along with the Annex and Attachments identified.

Winter storms are not limited to one portion of the state and historically occur from late fall to the middle of spring. They vary in intensity from mild to severe. Winter storms regularly destroy property and kill livestock and people. Such storms are generally classified into four categories with some taking the characteristics of several categories during distinct phases of the storm. These categories are: freezing rain, sleet, snow, and blizzard.

Freezing rain coats objects with ice. Although morning sunlight produces a spectacular landscape, the ice coating on sidewalks, roads, etc., creates dangerous conditions.

Sleet does not generally cling to objects like freezing rain, but it does make the ground very slippery. This also increases the number of traffic accidents and personal injuries due to falls.

Blizzards are most commonly connected with blowing snow (resulting from storms) and low visibility. When such conditions arise, blizzard warnings or severe blizzard warnings ate issued. Blizzard warnings take effect when wind conditions are at least 35 mph and temperatures of 20 degrees F or less over an extended period of time are expected. Severe blizzard conditions exist when winds obtained speeds of at least 45 mph plus a great density of falling or blowing snow and a temperature of 10 degrees F or lower.

FEMA-1330-DR-SD

April 18-20, 2000 - Winter Ice Storm - On April 19, 2000 southwestern South Dakota experienced severe snowfall, ice and wind weather conditions. One to three feet of heavy, wet snow coupled with ice and high winds caused significant damage to three Rural Electric Associations (REA's) resulting in widespread power outages to homes and businesses. The power providers reported that over 1,500 power poles were damaged or destroyed. Eligible damage to public infrastructure was estimated to be approximately $2,500,000. A Presidential Major Disaster Declaration was made for Custer, Fall River, Pennington, Shannon and Jackson Counties and was signed on May 19, 2000.

The State of South Dakota has received federal funding from FEMA several times because of similar damage from ice storms.

FEMA-I045-DR-SD

January/February - Winter Ice Storm - Damage to electric power lines in 21 counties was caused by unusual foggy January weather. Continuous fog in many areas resulted in a heavy crust of ice forming on many of the powerlines in central South Dakota. The fog-crust was reported to be from 3-5 inches in diameter. The addition of high winds caused power poles to snap. Deep drifts of snow made it difficult for power company repairers to gain access to the damaged power lines and in many areas county snow removal equipment was required to provide access. According to reports submitted, 13,435 households were without electric power for varying periods of time. Loss of heat was a major concern. The maximum time without power was 12 days. Early damage reports indicated that damages would exceed $3,218,126. More than 1,700 power poles had to be replaced.

FEMA-I052-DR-SD

March/May - Winter Ice Storm and Flooding - The entire state had above normal precipitation from January through May, ranging from about 1-2 inches above in the Southwest to 5-9 inches above in the east. This is up to 200% of normal. Many official reporting stations such as Huron, Mitchell, and Sioux Falls, experienced the all-time wettest Spring on record. This was the case for a large portion of central and eastern SD. Most damage to public facilities was caused by ground saturation and flooding due to very high residual groundwater tables from 1994, heavy winter snow and spring rain, and rapid snowmelt. Many roads were under water or unusable due to high groundwater saturation of the sub grade, causing interruption of emergency services. Damage also included power transmission and distribution facilities owned by rural electric cooperatives. Preliminary damage surveys identified over 3,000 homes with some type of damage. The vast majority of damage was from groundwater seepage of 1-3 inches of water into basements. In many areas the water table rose to near land surface levels, saturating septic drain fields and preventing proper treatment of residential sewage. Also identified during the preliminary damage surveys was $9.3 million in damages to infrastructure of public facilities. Roads & Bridges and Utilities were the two highest categories with almost $5.7 million and $2.6 million in estimated damages, respectively.

FEMA-I075-DR-SD

October- Snow and Ice Storm- Between October 22 and 24, 1995, a severe autumn snow and ice storm caused widespread damage in South Dakota. The effects of this storm were felt first in the Black Hills with portions of the Hills receiving up to 22 inches of snow. As the storm moved across the state, ice and 5 to 15 inches of wet snow formed on electric lines, poles and trees. Winds associated with the storm caused lines to slap together and poles to snap producing widespread power outages to large portions of rural South Dakota. Tree damage also produced significant damage to electrical utilities. The damage included broken poles, broken wires and substation failures due to transmission line damage.

The storm forced major transportation delays as portions of Interstate 90 and Interstate 29 had to be closed because of the snow accumulation on the roadway and poor visibility. The interstate closures caused Davison and Codington Counties to initiate their sheltering plan for travelers who could not find rooms at local motels. The storm also caused numerous cancellations and delays in school openings because of travel conditions or the lack of power.

The power outages lead to several rural water system pumping stations to go off-line causing a loss of water utilities to members of rural water systems. The National Guard was utilized to provide generators to power these pumping stations, thereby restoring water service.
Crews from electric cooperatives in South and North Dakota, Minnesota, Iowa, and Nebraska assisted local cooperatives with line repairs. In addition to the full resources of the local cooperatives affected, an additional 363 repairers, 75 digger trucks, 78 bucket trucks, 45 service trucks, and 41 pole trailers and 2 semi trucks with fresh poles were utilized in the repair effort. Additional help was still needed. Governor Janklow signed an executive order on October 24 that waived certain permit requirements for the transportation of equipment and supplies to repair electrical utilities.

The cooperatives lost nearly 9,500 poles and 170 transmission lines in this storm. Damage was estimated at $10 million to $10.3 million to rural electric infrastructure only. This estimate did not include any damage or eligible expenses that may have been incurred by other public entities. Approximately 30,290 households were affected by the power outages. Some cooperatives did not expect to get all households restored until November 5.

Local disaster declarations were received from 28 counties including Aurora, Beadle, Bon Homme, Brookings, Brule, Buffalo, Charles Mix, Clark, Codington, Davison, Day, Deuel, Douglas, Grant, Gregory, Hamlin, Hanson, Hutchinson, Jerauld, Kingsbury, Lake, McCook, Marshall, Miner, Roberts, Sanborn, Spink, and Tripp Counties.

The topography of South Dakota is such that no one area is immune from effects of winter storms. Prairie lands, which cover most of the state, offer little resistance to high winds and drifting snow. Even the Black Hills region, which presents some resistance to wind conditions, is not excluded from blizzard conditions. Blizzards in this region are often less severe than elsewhere in the state, but they can still produce heavy drifting shows. Early blizzards were so devastating that South Dakota had the dubious distinction of being called the Blizzard State.

Tornado Hazard Profile

Data, tables, maps, etc. that augment and/or support the Tornado Profile are located in Annex C, Attachments 3-21 through 323, 3-32 through 3-36, 4-1 through 4-4, and 5-1 through 5-3. It is important to note that the tornado hazard profile includes the section written here along with the Annex and Attachments identified.

FEMA defines a tornado as a local atmospheric storm, generally of short duration, formed by winds rotating at very high speeds, usually in a counter-clockwise direction. The vortex, up to several hundred yards wide, is visible to the observer as a whirlpool-like column of winds rotating about a hollow cavity or funnel. Winds may reach 300 miles per hour or higher.

Tornadoes are one of nature's most violent storms. A violently rotating column of air extending from a thunderstorm to the ground capable of tremendous destruction with wind speeds of 250 mph or more. Damage paths can be a mile wide and can extend for 50 miles or more. Tornadoes present a rather unique mitigation challenge, since few structures can withstand the violent winds of a twister. Steps can be taken, however, to prevent the loss of life and lessen property damage.

Tornadoes mostly occur in South Dakota during the months of May, June, and July. The greatest period of tornado activity (about 82 percent of occurrence) is from 11 a.m. to midnight. Within this time frame, most tornadoes occur between 4 p.m. and 6 p.m. Unlike other disaster producing events, early information on tornadoes in South Dakota is limited. Possible explanations for historical warning times being limited are sparse population and the vast amount of agricultural and ranch land which reduced the chance of sightings during the pioneer and westward migration decades.

Statistical historical information was not developed until the early 1950's. It was at this time that the United States Department of Commerce began to systematically file tornado events throughout the U.S. This fact is exemplified by reported tornadoes before and after 1950. One source of information placed the number of tornadoes between 1915 and 1949 at an average of about three (3) per year. This amounts to 114 tornadoes for the 35-year period. National Weather Service (NWS) data places the number of tornadoes from 1950 to 1991 at 1,030 (30 related deaths). This averages to 25.12 tornadoes per year. The wide variation in reported tornadoes prior to 1950 appears not to be from an increase in such activity but rather from better records of sightings and damages.

Tornado disasters are often associated with Tornado Alley (the area from the southern Gulf States to upper Midwest plans states that experiences a substantial amount of annual tornado sightings). South Dakota sits in the northern region of tornado alley. The formation of tornadoes has been attributed to specific climatological conditions: warm Gulf air coming in contact with cool Canadian air fronts and dry air systems from the Rocky Mountains (NOAA). The intersection of these three systems produces thunderstorm conditions that can spawn tornadoes (NOAA). Geologically, South Dakota shares a number of variables that make it prone to tornado conditions, close proximity to Canada, its bordered on the west by the Rocky Mountains and the Gulf Stream passes through the state a large portion of the year.

The progression of the tornado season begins in the Gulf States and shifts north as the season progresses. South Dakota's tornado season begins in mid-March and runs through the beginning of November (NOAA). According to NOAA, weather flow patterns in the southeastern part of the state will become historically at risk before areas north and east of the state enter their tornado season. As the season progresses, the central, west central, and northern parts of the state become at risk.

The severe tornado systems (F4 or greater) of South Dakota typically do not proceed along the lines of the tornado season. F4 or greater tornado risk occur in Southern Minnesota and swell west, from the southeast, and from the northwest tri-state intersection of North Dakota, Montana, and South Dakota (NOAA).

NOAA and NCDC data has been used in the analysis for this report. These organizations have received international respect and commendation for their reporting and recording of data, but due to the variability of tornado reporting in the last fifty years, many 100 year and greater occurrences of severe tornadoes may not be included in the historical average (NOAA). This may support the occurrence of severe tornado activity in areas that are not typically included in Tornado Alley. The reported F4 or greater zone that occurs at the North Dakota, Montana, and South Dakota borders may be explained by such an anomaly. According to NOAA, tornadoes can occur at any location and from a wide variety of conditions. Western South Dakota, though not in the Tornado Alley, should not be discounted as low risk to tornadoes due to the potential for moderate and severe tornado anomalies in the region.

Though climate data is available to explain a predisposition to tornadoes, there is no accurate way of predicting when or where a tornado may occur. Tornado systems have been linked to the development of temperature and wind flow patterns in the atmosphere, which can cause moisture, instability, lift, and wind shear (NOAA). Expert predictions of these conditions begins first by modeling in the long term and relying on critical analysis of satellite data, weather stations, balloon packages, airplanes, wind profilers and radar-derived winds to pinpoint storm activity for the short term (NOAA).

The South Dakota Office of Emergency Management respects the need and use of quality data sources in its analysis and relies on the National Weather Service for its weather data in times of an emergency and NOAA and NCDC data for historical raw data.

Based upon data gathered from 1959 and 1995 by www. disastercenter.com South Dakota ranks number 10 for frequency of tornadoes, 28 for number of deaths, 29 for injuries and 27 for cost of damages when compared to other states.

From 1950 through the end of 2003, there has been a total of 1431 tornadoes with 18 deaths, 447 injuries and a total cost of $212,116,000. This averages out to 26.5 tornadoes, .33 deaths, 8.28 injuries and $3.9 million in losses per year. See Attachment 3-32 Tornado and Population Map from HAZUS.

Three major tornado events have occurred in South Dakota in the last 10 years, two of which resulted in Presidential Disaster Declarations, FEMA-1280-DR-SD and FEMA-I218-DR-SD. June

24, 2003, proved to be a historic day in South Dakota as 67 tornadoes touched down in the state. This rare occurrence equaled the U.S. record for the most tornadoes within a state in a 24 hour time period. However, the 67 tornado touchdowns recorded that day occurred in a period of time less than eight hours. The strongest of the 67 tornadoes to hit the state that night was an F4 on the Fujita Scale, which destroyed the town of Manchester, resulting in five injuries. Winds were estimated to be in the 207 to 260 mph range.

The tornado warning issued by the National Weather Service in Sioux Falls provided the residents of Manchester with 28 minutes of advance warning. The NOAA Weather Service offices in Aberdeen and Sioux Falls issued more than 350 warnings, statements and storm reports on the evening of June 24th. The 67 tornado touchdowns recorded that day represented a significant portion of the 85 total tornado touchdowns recorded for the entire year of 2003. Despite the historic events of this day and the destruction of the town of Manchester, no presidential disaster declarations were issued. The two most active years for tornadoes since 1950 were 1993 and 2003 both of which had 85 recorded tornado touchdowns. Fortunately, there were no deaths associated with tornado events in either of these years. The events of June 4, 1999 and May 30, 1998 were not so fortunate.

Description of event for FEMA-1280-DR-SD July 9,1999

A deadly tornadic storm moved across southwest South Dakota during the late afternoon and evening of 4 June, 1999. Multiple tornadoes were observed from several supercells which moved toward the northeast from west of Chadron, NE, to near Kyle, SD between 5:30 and 8:00 PM MDT. The most severe damage occurred where the paths of these storms passed near the community of Oglala, SD.

The first sighting of a tornado was around 5:30 p.m. north of the town of Whitney, NE. This storm moved into extreme southeast Fall River County and southwest Shannon County between 5:45 and 6:00 p.m. MDT. Several sightings of tornadoes were made around 6:30 as the storms moved to the west-northwest of Pine Ridge (5-10 miles southeast of Oglala).

As the storm moved toward Oglala between 6:33 and 6:40 p.m., heavy rain and hail wrapped around the tornado-making sighting difficult if not impossible. As the tornadic storm moved through the Oglala area between 6:40 and 6:50 p.m. residents observed that the sky was black with rain and hail with very low visibility. After the storm passed Oglala, the WSR-88D radar indicated that the storm circulation weakened somewhat as it merged with another supercell storm just to the south. The storm reorganized into a larger, "high-precipitation" supercell storm south of Sharps Corner around 7: 15 p.m. MDT. Soon after this time, several tornadoes formed east of Sharps Corner about five miles to the southwest of Kyle, SD. These were the last observed tornadoes from this storm, though radar indications suggest that it may have remained tornadic as it approached the Hisle area in Jackson County.

Staff from the National Weather Service office in Rapid City, SD traveled to the Oglala area early on June 5 to conduct a damage survey and assess the severity of this event. The damage, which was observed, was generally in the F1-F2 range with the most severe damage just to the east of the main intersection in Oglala. One, perhaps two tornadoes were responsible for the most severe damage observed.

The area in and around Oglala also experienced very strong straight-line winds from the north to the northeast, which accounted for F I-type damage on the western and northern parts of Oglala. Further to the east, several locations experienced F2-type damage. The spread of debris indicated that one and perhaps F2 tornadoes affected the area. One-half to three-quarters of a mile further to the east there was a more continuous region of severe F2 damage. In this area, all of the telephone poles were snapped and tossed, mobile homes were thrown over 100 yards with debris strewn over a quarter of a mile and a newly framed house was leveled with wood projectiles in the ground 100 yards downstream.

With the lack of trees and structures in the area, it was difficult to identify any "path" of the tornado(s). If the tornado was retrograding at the time it struck Oglala the damage could have been caused by one tornado. However, if the tornado(s) were moving with the storm and low-level circulation, there would have likely have to be two tornadoes to explain the damage that was observed over the Oglala area. Very large hail was also reported in the area. Grapefruit-sized hail (4" in diameter) was observed 2 miles west of Oglala with golf ball and baseball-sized stones reported in Oglala itself. It appears that the storm complex responsible for the Oglala damage was intermittently producing tornadoes from 5:30 p.m. to almost 8:00 p.m. MDT, a period of 2 *Y2* hours.

The Red Cross estimated that 123 homes sustained major damage and an additional 139 sustained minimal damage. FEMA deemed 49 homes beyond repair and were demolished. One person was killed during this event and over 40 injured. Twenty-two individuals required medical attention at area hospitals. The one-recorded death from this event was the first fatality from a tornado in western South Dakota since 1939 and only the third ever-recorded in western South Dakota.

The series of tornadoes and flooding was concentrated on the Pine Ridge Indian Reservation in Shannon County. The Reservation was declared for FEMA's Individual Assistance, Public Assistance and Hazard Mitigation programs on June 9, 1999. The community of Oglala was heavily impacted by the tornadoes along with other smaller communities spread throughout the Reservation in Shannon County. Many homes and structures were damaged and destroyed to varying degree. The total PA damage for the disaster was $1,029,000.

Description of event for FEMA-1218-DR-SD, May 30, 1998

By late afternoon of May 30, 1998, the atmosphere over the north central United States had become favorable to a significant outbreak of severe weather. An air mass stationed over southeastern South Dakota had become very unstable, while a dry line/cold front combination was advancing slowly to the east/southeast into the unstable air mass. At jet stream level, a well-defined wind maximum (jet streak) was approaching the dry line/cold front intersection. All of these factors combined to produce towering cumulus clouds near the Missouri River by 4:30 p.m. CDT.

At approximately 8:40 p.m., following a series of thunderstorm warnings and numerous funnel sightings in the area, a violent tornado struck the town of Spencer, South Dakota, which lies approximately 45 miles west-northwest of Sioux Falls in extreme western McCook County. The tornado, rated F4 on the Fujita Tornado Intensity Scale, injured more than one-third of the town's 320 residents, destroyed most of the town's 190 buildings, including all public and numerous private facilities, and killed six people making it the deadliest tornado in South Dakota history. An assisted living center was also destroyed. The center had no basement, which offered little protection from the tornado. In fact, most of the six fatalities were residents of the center. Only 12 structures were left standing in the entire town of Spencer.

During the storm, electrical service was our. Survivors reported that the warning siren system lost power prior to the touchdown of the tornado. Whether warnings were sounded has not been established.

In addition to the town of Spencer, some farms in Hanson and McCook Counties were heavily damaged. Total damage was estimated at $18 million. On June 1, 1998, the President declared disasters in McCook and Hanson Counties as a result of the tornadoes (FEMA-1218-DR-SD)

On June 3, 1998, this disaster declaration was expanded to include Day, Clark, Marshall, and Spink Counties in northeastern South Dakota. Severe storms had struck that portion of the state beginning on April 25, 1998, and had resulted in damage and more flooding.

Approximately 90 percent of South Dakota falls within a Wind Zone III (200 mph) with the remaining 10 percent located in a Wind Zone II (160 mph) based upon the Wind Zones in the United States Map prepared by ASCE 7-95. See Attachment 3-33 Wind Zones in the United States.

Data gathered by the Storm Prediction Center of NOAA indicate that approximately 80 percent of South Dakota falls within an area that should expect 1 - 5 tornadoes per year per 1,000 square miles. The remaining 20 percent can expect to receive less than one tornado per 1,000 square miles. See Attachment 3-34 Tornado Activity in the United States Map.

By consulting the risk matrix located on page 8 of Taking Shelter from the Storm (FEMA Publication 320) (Attachment 3-35) approximately 80 percent of South Dakota is in a High Risk area, 10 percent is in a Moderate Risk area and the remaining 10 percent is in a Low Risk area. Approximately 90 percent of South Dakota has a Moderate to High Risk from tornadoes. It should be noted that the Low Risk area, located in the Northwest corner of the state, is still listed as a Zone II (160 mph) windzone. Therefore, for purposes of this report the determination has been made that the entire state of South Dakota and all 66 counties are vulnerable to tornado hazards.

As was stated previously, 90 percent of South Dakota lies within a Moderate to High Risk area with regards to tornadoes based upon data from NOAA and ASCE. The remaining 10 percent Low Risk area is located within a Zone II (160 mph) wind zone. Therefore, the entire state and all state owned facilities, regardless of location, are vulnerable to damage from tornadoes.

It should be noted that Pierre, SD, the state capital, where the highest concentration of state owned buildings, facilities and employees are located sits within a ZONE III (200 mph) wind zone and is predicted by NOAA to receive on average 1-5 recorded tornadoes per 1,000 miles. This indicates a High Risk from tornadoes in Pierre, SD according to the risk matrix located on page 8 of Taking Shelter from the Storm (FEMA Publication 320/Attachment 3-35 to this plan).

Wildfire Hazard Profile

Data, tables, maps, etc. that augment and/or support the Wildfire Hazard Profile are located in Annex D with special attention drawn to the Appendices, Attachments 3-21, 3-22 and 3-23, 337 through 3-40. It is important to note that the wildfire hazard profile includes the section written here along with the Annex and Attachments identified.

Wildfires have caused major damage in South Dakota. Six years of drought, along with extremely low percentages of normal snowpack in the Black Hills coupled with widespread infestations by tree-killing beetles has created the potential for catastrophic wildfires in South Dakota. Consequently, there is great concern for wildfires in the urban wildland interface and also for agricultural or rural wildfires. Fires involving grass, prairie, or timber have the potential to create mass destruction of property and vegetation - both public and private. Grass or prairie wildfires are most commonly associated with the physical features of the state. Early writings by explorers, trappers, and settlers many times describe South Dakota as a sea of waving grass. The descriptions would not be valid today for the eastern half of the state. The more fertile and climatically desirable prairie of the eastern portion is under agriculture crop production. It is in the western part of the state where the wild prairie still exists. South Dakota's portion of the Great Plains now exists from the foothills of the Black Hills to the western boundary of the Missouri River. This amounts to nearly 35,000 square miles of land. Utilization of this land remains chiefly in livestock grazing with some wheat cultivation. The threat of fire is present throughout most of the year in this area. The nature of the ground cover and the limited precipitation makes this area very susceptible to fire.

The second major source of vegetation fires is forests. The largest timber development is found in the Black Hills region of western South Dakota. The Black Hills National Forest encompasses 1,524,164 acres of land in South Dakota and Wyoming. Over one million acres of the forest are exclusively in South Dakota. Of the one million acres about 80% is federal controlled and the state or private citizens control only 20%.

In addition to the Black Hills forest, there are lesser size timber stands in Harding County, the Pine Ridge Reservation of Shannon County (unorganized) and the Rosebud reservation of Todd County (also unorganized). These three counties are in western South Dakota.

Since August of 2000, South Dakota has experienced six federally designated wildfire disasters. They are:

FEMA- 2319- FSA-SD - The Flagpole Fire in Hot Springs Declared August 13, 2000

FEMA-2324-FSA-SD - The Jasper Fire Declared August 25, 2000

FEMA-2369-FSA-SD -The Elk Mountain Fire in the Black Hills Declared July 31,2001

FEMA-2434-FSA-SD -The Grizzly Gulch Fire in the Black Hills Declared June 29,2001

FEMA-2458-FSA-SD - The Battle Creek Fire in the Black Hills Declared August 18, 2002

FEMA-2513-FSA-SD - The Mill Road Fire in the Black Hills Declared November 23,2003.

These six wildfire disasters have occurred in a relatively short time one right after another and have resulted in several million dollars of worth of damage.

Landslide and Mudflow Profile

What Is A Landslide?

Landslides are a serious geologic hazard common to almost every state in the United States. It is estimated that nationally they cause up to $2 billion in damages and from 25 to 50 deaths annually. Globally, landslides cause billions of dollars in damage and thousands of deaths and injuries each year. Individuals can take steps to reduce their personal risk. Know about the hazard potential where you live, take steps to reduce your risk, and practice preparedness plans.

Some landslides move slowly and cause damage gradually, whereas others move so rapidly that they can destroy property and take lives suddenly and unexpectedly. Gravity is the force driving landslide movement. Factors that allow the force of gravity to overcome the resistance of earth material to landslide movement include: saturation by water, steepening of slopes by erosion or construction, alternate freezing or thawing, earthquake shaking, and volcanic eruptions.

Landslides are typically associated with periods of heavy rainfall or rapid snow melt and tend to worsen the effects of flooding that often accompanies these events. In areas burned by forest and brush fires, a lower threshold of precipitation may initiate landslides.

What Is A Mudflow?

Mudflows (or debris flows) are rivers of rock, earth, and other debris saturated with water. They develop when water rapidly accumulates in the ground, such as during heavy rainfall or rapid snowmelt, changing the earth into a flowing river of mud or "slurry." A slurry can flow rapidly down slopes or through channels, and can strike with little or no warning at avalanche speeds. A slurry can travel several miles from its source, growing in size as it picks up trees, cars, and other materials along the way.

A mudflow caused by heavy rain occurred after the Black Hills Grizzly Gulch Fire in 2001. The mudflow caused damage to many homes in the burn area or below. This is another example of what can cause mudflows or landslides. In hilly or mountainous areas and for years to come, heavy rainfall following a wildfire creates risks to and subsequent vulnerability of people, structures and infrastructure located below such areas.

Mudflows are covered under the National Flood Insurance Program; however, landslides are not.

Areas that are generally prone to landslide hazards include existing old landslides; the bases of steep slopes; the bases of drainage channels; and developed hillsides where leach-field septic systems are used.

Areas that are typically considered safe from landslides include areas that have not moved in the past; relatively flat-lying areas away from sudden changes in slope; and areas at the top or along ridges, set back from the tops of slopes.

The Columbia Electronic Encyclopedia, 6th ed. Copyright @ 2003, Columbia University Press defines **landslides** as rapid slipping of a mass of earth or rock from a higher elevation to a lower level under the influence of gravity and water lubrication. More specifically, rockslides are the rapid downhill movement of large masses of rock with little or no hydraulic flow, similar to an avalanche. Water-saturated soil or clay on a slope may slide downhill over a period of several hours. Earthflows of this type are usually not serious threats to life because of their slow movement, yet they can cause blockage of roads and do extensive damage to property. Mudflows are more spectacular streams of mud that pour down canyons in mountainous regions during major rainstorms where there is little vegetation to protect hillsides from erosion. The runoff from the storm and mud becomes a thin slurry that funnels down the canyons until it thickens and stops. Earthquakes also may cause landslides by shaking unconsolidated or weathered material from slopes. Rockslides triggered by an earthquake in Montana in 1959 caused an entire mountainside to slide into the Madison River gorge, killing 27 people in its path, damming the gorge, and forming a new lake. Humans have triggered a number of tragic landslides that have caused great damage and loss of life. In the Los Angeles area of California, extensive real estate development carried out on hillsides has resulted in widespread mudflows after winter rains have saturated the over-steepened embankments of soil. In some areas, slow-moving earthflows have been initiated by the lubrication of certain types of underlying clays by septic tank effluent. Submarine slides, or a sliding mix of seawater and mud, are called turbidity currents. Undersea landslides can travel several hundred miles across very gradual slopes, riding on a thin film of water that reduces friction.

Due to the terrain in South Dakota, landslides do occur. Over the years, many landslides have been dealt with by the State of South Dakota and in particular the South Dakota Department of Transportation (SDDOT). The SDDOT has spent a lot of time stabilizing landslides throughout the state. Two of the larger slides were the US 12 Missouri River Crossing at Mobridge and the US 212 Missouri River crossing at Forest City. At Mobridge stone columns were used for the first time in the United States to stabilize a clay-shale landslide. Forest City also used stone columns and also incorporated the use of massive concrete shear pins installed by slurry wall process to stabilize the approach berm. This was the first time in the United States that this technique was used to mitigate a landslide of this magnitude. A civil engineer, who was head of the SDDOT Geotechnical Activity Section from 1969 to 2001 achieved national recognition and notoriety for his innovative work with these two landslides.

Attachment 3-42 is a map of the South Dakota Landslide Areas. See also Attachments 3-22 and 3-23.

Earthquake Profile

Data, tables, map, etc. that support or augment this section are located in Attachments 3-22, 3-23 and 3-41

South Dakota is somewhat more seismically active than other areas in the northern plains states although the earthquake magnitudes have been relatively minor to date. A zone of higher earthquake frequency extends from the northeastern corner of the state and a generally higher frequency of earthquakes is recorded along the eastern flank of the Black Hills and in the southwestern corner of the state. The earthquakes occurring in South Dakota appear to be concentrated along the GLTZ [Great Lakes Tectonic Zone] and possibly along the boundaries of the structural provinces in the

Precambrian, crystalline basement. At least two mechanisms may be important in generation of the earthquakes. These include initiation of movement along preexisting fractures due to crustal plate movements or movements due to glacial rebound. Ground motion accelerations can be calculated based upon historical seismic records, bur the poor quality of the database does not allow great confidence to be placed in those calculations. These calculations show highs in ground motion acceleration that correspond reasonably closely with areas of greater earthquake frequency.

Historically, earthquakes cause relatively minor damage in South Dakota. Documented damages include: cattle stampedes, shaking buildings, falling or rattling dishes and pictures, stuck doors and windows, cracked window glass, foundations heaving or cracking, wall and ceiling plaster cracks, furniture moving, etc.

As the population grows near known seismological active areas, the potential for increasing amounts of "minor" damage increases. South Dakota seems to be relatively geologically stable based upon the sparse data available. However, there is potential for larger earthquakes than the magnitude 4.4 (Richter Scale) quake, which struck the Black Hills in 1964. One estimate places this risk as only a 10 percent chance of exceeding a 5.1 magnitude in any 1 DO-year period.

Summary

Although the majority of the state is vulnerable to all the hazards identified and discussed in this section, concerns vary widely between areas of the state and times of the year events might occur. Drought is of great concern to farmers more than to urban residents, except where the Wildland/Urban interface exists. Additionally, technological hazards exist which may vary in degree of concern depending upon the exact hazard or the location of occurrence. The hazards as identified in Section 3.1 have impacted or have the potential to impact the citizens and governments of the state to one degree or another at any given time. However, based upon the research conducted for writing this plan, the annexes and attachments, and reference material it is evident that floods, winter storms, wildfires and tornadoes require the most effort and expense in terms of response and recovery activities and their associated costs. Therefore, the planning process used to develop this plan indicates why these hazards have emerged as the top four hazard mitigation priorities for the state to continue addressing. These priorities have driven how the state has pursued and will continue to pursue mitigation planning, measures, projects, and strategies for the future within the parameters of the programs as identified in this plan.

4.0 South Dakota Mitigation Strategies -See Attachment 4-1

4.1 Hazard Mitigation Goals

The goal of the State of South Dakota Multi-Hazard Mitigation Plan is to prevent and/or minimize loss of life and suffering and prevent and/or minimize damage to property caused by natural and/or man-made disasters. Based on review of local plans submitted to the State (Attachments 5-1, 5-2, 5-3), past occurrences and the probability of future events, the State of South Dakota has identified the following priorities for the four highest risks facing the State:

Priorities:
Floods

Goal 1: Reduce injuries and the loss of life.

Goal 2: Reduce flood damage to flood prone properties and structures.

Priorities:
Structural hazard control or protection projects on existing structures or control systems
Development of comprehensive mitigation programs with implementation as an essential component
Construction activities that result in hazard protection
Retrofitting of facilities
Development of State or local mitigation standards
Debris removal and channel clearance
Development or improvement of warning systems Acquisition or relocation
Other mitigation activities

Winter Snow and Ice Storms

Goal 1: Reduce the loss of power systems during winter storms.

Priorities:
Upgrade/modify existing systems Relocate
Develop and implement standards Develop and implement programs
New construction
Other mitigation activities

Tornadoes

Goal 1: Reduce the loss of life during tornado events.

Priorities:
Warning and forecasting
Tornado resistant shelters
Community based planning and implementation Public infrastructure
Construction
Other mitigation activities

Wildfires

Goal 1: Reduce injuries and the loss of life.

Goal 2: Reduce the loss of property and wilderness habitat.

Priorities:
Communications
Fire prediction
Land management
Planning and zoning
Public information
Resource information
Other mitigation activities

These priorities were established and based upon the information located in Attachments 4-1, 4-2, 4-3, 4-4, 5-1, 5-2, 5-3 and Annexes A-D of this plan. These attachments and annexes are based on research and extrapolated data and information from HAZUS99 and HAZUS-MH, past disaster events and reports, 31 South Dakota local jurisdiction plans and reference notebooks on file in SDOEM.

4.2 State Capability Assessment

4.2 Local Capability Assessment

STATE: The State mitigation strategy includes a discussion of the State's pre-and post-disaster hazard management policies, programs, and capabilities to mitigate the hazards in the State including an evaluation of State laws, regulations, policies, and programs related to hazard mitigation as well as to development in hazard prone areas and a discussion of State funding capabilities for hazard mitigation projects.

LOCAL: The State mitigation strategy includes a general description and analysis of the effectiveness of local mitigation policies, programs and capabilities.

Information in the following documents/web sites was reviewed and analyzed to perform this requirement:

1. Northeastern South Dakota Closed Basin Study dated November 15, 1999. Five-volume study with an executive summary compiled by nine federal and State agencies and

other organizations, which used the work of 34 scientists, engineers and other experts. The study covers past, present, and projected flooding in ten lakes of the Waubay Lake Basin: Bitter Lake, Blue Dog Lake, Enemy Swim Lake, Hillenbrands Lake, Minnewasta Lake, Pickerel Lake, Rush Lake, Spring Lake, Swan Pond and Waubay Lake. The report includes details about historic precipitation and evaporation within individual lakes, water flows among the lakes, scientific evidence about lake levels over the past several thousand years, and statistical projections of future levels – focusing on the next 50 years in particular. One section of the report deals with possible solutions that may help alleviate the problem, and their estimated cost. On file in the SDOEM and FEMA Region VIII.

2. Website www.intlcode.org indicates adoption status of International Codes and Standards in South Dakota - Attachment 4-5.
3. Attachment 4-6 South Dakota Floodplain Administrators Directory for the National Flood Insurance Program dated April 1 , 2002.
4. Attachment 4-7 FEMA's Federal Insurance Administration List of Communities Participating in the National Flood Program.
5. Flood Map Modernization Business Plan for South Dakota dated January 2004 - on file in the SDOEM.
6. FEMA NFIP Loss and Policy Statistics from FEMA Website - Attachment 4-8
7. South Dakota Office of Emergency Management NFIP website
8. A review of all local jurisdiction hazard mitigation plans submitted to the State by April 1, 2004.
9. Attachment 2-7 to this plan - State Agency Resources.
10. Attachments 2-1, 2-2, 2-3 to this plan - Federal Agency Resources.
11. Website www.sodaklive.com
12. South Dakota Codified Laws and Constitution
13. Argus Leader Newspaper Website www.argusleader.com
14. American Planning Association review of South Dakota planning statutes. Located in reference notebook on file in SDOEM
15. Memorandum to All interested persons from Charles D. McGuigan, Assistant Attorney General regarding Legislation Passed by the 2004 Legislature dated April 2, 2004. Located in reference notebook on file in SDOEM.
16. Insurance Services Office, Inc. website www.isomitigation.com/index.html
17. Spruce Up South Dakota website www.spruceup.sd.gov
18. "South Dakota," Microsoft @ Online Encyclopedia 2004
19. Attachment 4-9, copies of the seven local jurisdiction plans that mention local zoning issues
20. Attachment 4-10 South Dakota NFIP Repetitive Loss Properties

Background and Discussion

In order to discuss "the State's pre-and post-disaster hazard management policies, programs, and capabilities to mitigate hazards including an evaluation of State laws, regulations, policies and programs related to hazard mitigation as well as to development in hazard prone areas", and to further provide a "general description and analysis of the effectiveness of local mitigation policies, programs and capabilities", the following needs to be taken into consideration.

In geographical land mass size, South Dakota ranks 16th among all 50 States. The State encompasses 77,123 square miles and is 380 miles across from east to west and 245 miles long from the north to south border. Statewide travel for any purpose is arduous, time-consuming and expensive. Weather conditions can render travel unpredictable and dangerous. Geographically, South Dakota is essentially divided up the middle by the Missouri River. Land east of the river is suited for cultivation and farming; west of the river is a more dry climate, and ranching is the predominant agricultural activity. There are noticeable cultural differences between these two regions. The third area consists of the far western counties and contains the Black Hills, which has an even different history, industry and cultural perspective. Major industry in this area includes mining, timber and tourism. The State's population is 754,844. The five largest cities in South Dakota in order of highest to lowest population are Sioux Falls, Rapid City, Aberdeen, Watertown and Brookings.

There are nine separate independent Indian reservations in South Dakota, See Attachment 3-2-A. Each has its own government, history, culture, code of laws and fully operating judicial system. The State's laws generally do not apply to tribal members residing in Indian Country. Approximately 60,000 American Indians live in South Dakota. The American Indian population is approximately 8.3 percent of the total population. Shannon County, the poorest county in the nation is located within the Pine Ridge Indian Reservation.

In terms of State owned and operated property, the South Dakota State Park system includes 12 State parks, 42 recreation areas, 5 nature areas, 1 historic prairie, 70 lakeside use areas, 220 public water access areas, 10 marina/resorts and consists of 105,589 acres. Custer Park is the largest with 71,000 acres. De Smet State Forest located in the lake region of east-central South Dakota is the only State forest.

Two national forest areas in South Dakota cover a combined area of about 2,013,000 acres. The Black Hills National Forest encompasses the entire area of the Black Hills. The other forest is the Custer National Forest, which covers grasslands and rolling pine-covered hills in northwestern South Dakota.

Within the State of South Dakota, the federal government owns approximately 2,697,618.3 acres of land. This makes up approximately 5.52 percent of the total acres of land within South Dakota. This acreage includes the Mount Rushmore National Memorial and the Wind Cave National Park in the Black Hills, the

Jewel Cave National Monument and the Badlands National Park.

In 2003, farmland occupied approximately 43.8 million acres or 91 percent of the State's land area. These figures represent cultivation of crops in the east and rangeland in the west. Ranchers in western South Dakota lease land from the federal government for seasonal grazing.

Leading industries are agriculture, manufacturing, financial services and tourism.

Tourism in South Dakota is a very large yearly industry, which generates $1.5 billion worth of economic activity while employing an estimated 29,000 people. When planning for mitigating potential disasters, the expanded population during tourist season has to be factored into that equation. An illustration of this is the fact that each year, although not at once, more than 2.8 million people visit South Dakota's top attraction, Mount Rushmore.

Another example is the Sturgis, South Dakota Motorcycle Rally held each summer. During that time the population of Sturgis increases one-hundred fold. Again, this shows why tourism numbers have to be factored in.

South Dakota is a composite of federal, State, and local government, private sector, public foundation and conservancy owned lands along with nine separate Indian Reservations. With this composite of land ownership one can understand why governmentally, South Dakota is complex. The State has 66 counties, which is comparable to other States, however it also has 309 municipalities, 956 towns or townships and nine federally recognized Indian Tribes which totals 1,274 different political and jurisdictional sub-divisions. Among all States, South Dakota ranks 11th highest in the number of sub-county governments. This many political sub-divisions contribute significantly to the State's governmental complexity.

With regard to land use planning, building codes and zoning, South Dakota's largest political issue is the concern for balancing private citizens/landowners' property rights with local governmental control and flexibility over land-use decisions. In general, the State legislature has maintained a "hands-off" approach to most planning and land-use issues. There is strong leaning toward libertarianism in the Black Hills and in South Dakota as a whole. That is, the rights of individuals are considered as important as the rights of the government.

An example of current South Dakota land use and development issues can be seen in the Black Hills. Land ownership in the Black Hills is made up of federal, State, local and private sector entities including foundations and conservancies attempting to protect and balance the essence of the natural environment with the push for land development. A steady influx of retirees and tourists is attracting residential development (land developers) on private lands, which brings zoning, building code, landscape and environmental issues (to name a few) to bear.

Cities and counties in the Black Hills should consider enacting and enforcing zoning and planning regarding current development in order to ensure this development is done to a standard that creates disaster resistance and/or is out of "harms way".

Summary of Background Discussion

In examining smaller jurisdictional levels of government, sometimes that level's perspective of and capability to deal with potential disasters and subsequent damages are inhibited. Because any given local government experiences the fewest exposures to disaster loss, it may not perceive or have the ability to address potential disasters as an important issue. There is a variety of reasons for this. The major challenge may stem from the simple fact that many local jurisdictional governments lack the human and financial resources to make disaster mitigation a key priority let alone to actually pursue mitigation activities. Additionally, because these local jurisdictions are most likely to be faced with the responsibility for carrying out disaster response and recovery activities, the resources they do have tend to be prioritized for that function. The trend in the U.S. is to place most of the responsibility for disaster response on local governments, and local governments bear a large part of the responsibility because they are the closest to the event and are apt to be on the scene before substantial state or federal resources are available. With respect to mitigating the effects of potential disasters, this is a major factor challenging today's local governments.

What does exist?

Conversely and on the positive side, it must be noted that within South Dakota, the following describes some of what does exist.

The following includes identification of some State and local codes that have been adopted:

- South Dakota Statewide
  International Building Code
  (Approved for local adoption)
  International Plumbing Code

- South Dakota Local Jurisdictions
  - Hughes County
    - *International Building Code*
    - *International Property Maintenance Code*
    - *International Residential Code*
  - Pierre
    - *International Building Code*
    - *International Property Maintenance Code*
    - *International Residential Code*
  - Sioux Falls
    - *International Building Code*
    - *International Energy Conservation Code*
    - *2003 International Existing Building Code*
    - *International Fire Code*
    - *International Fuel Gas Code*

International Mechanical Code
International Plumbing Code
International Property Maintenance Code
International Residential Code

In addition, other programs provide for mitigation activities at the state and local level. They include but are not limited to, the following:

National Flood Insurance Program (NFIP)

The South Dakota Office of Emergency Management administers the National Flood Insurance Program for South Dakota under cooperative agreement with FEMA. Training, technical assistance and orientation are provided under the terms of the agreement to insure program knowledge and understanding by community officials, local administrators, and residents of the community.

Enrollment in the NFIP is initiated by a voluntary agreement between the local jurisdiction and the federal government. It is agreed that if a community implements and enforces measures to reduce the risk from flooding in special flood hazard areas, the federal government will make flood insurance available within the community to mitigate future flood losses. Because of participation in the NFIP, these communities are also practicing floodplain management, which generally includes zoning, subdivision, or building requirements, and special-purpose floodplain ordinances.

As an added incentive, the NFIP offers the Community Rating System (CRS), a voluntary program for NFIP-participating communities. The CRS was developed to provide incentives for communities to go beyond the minimum floodplain management requirements by developing extra measures for providing protection from flooding. The incentives are in the form of premium discounts. Eligible communities must be in full compliance with the NFIP and be in the Regular phase of the program. Communities in the emergency phase of the program are not eligible. Rapid City, South Dakota is the only CRS community in South Dakota.

There are nearly 200 communities participating in the NFIP in South Dakota. (See Attachments 4-6, 4-7, and 4-8.)

One major issue involving community participation in the NFIP is the status of Floodplain mapping in South Dakota.

Following is a description of the status of floodplain mapping in South Dakota. It is quoted verbatim from the Flood Map Modernization Business Plan for South Dakota dated January 2004.

"Few of South Dakotas Flood Insurance Rate Maps (FIRMS) are available in a digital (vector overlay) format. Counties that have some digital data available (in a format conforming to older specifications) include:

1. Aurora County
2. Charles Mix County

3. Custer County
4. Day County
5. Dewey County
6. Hughes County
7. Kingsbury County
8. Lake County
9. Lawrence County
10. Lincoln County
11. Minnehaha County
12. Pennington County
13. Stanley County
14. Union County
15. Ziebach County

With the exception of Day County, none of the above are countywide maps. More than half of South Dakota communities have maps that are more than 15 years old and almost one in five (18%) have not yet been mapped."

Closed Basin Lake Flooding

One rather unique flooding issue in South Dakota is the fact that much of Day County and the surrounding area (parts of Clark, Codington, Grant, Marshall and Roberts counties) are considered to be within a "closed basin" lake area and have experienced or are in jeopardy of experiencing major flooding. This means, that under most circumstances, water does not have a direct drainage path to a river outside the closed basin. Instead, the water ponds until it can evaporate into the atmosphere. (Summary of Studies of the Waubay Lakes Chain and Adjoining Closed Basins in Northeastern South Dakota dated November 1999) Since 1992, rising water levels from lakes and localized ponding areas have inundated significant portions of Day County and the surrounding area in Northeast South Dakota. Some of the affected areas lie within the boundaries of the Lake Traverse Indian Reservation.

Significant increases in lake levels within the Waubay Lakes Chain have occurred mainly due to greater-than-normal precipitation along with less-than-normal evaporation.

Due to this and as of 1999, the federal government had spent over $71 million in northeastern South Dakota for flooding response and recovery efforts and emergency measures. This amount does not include State, local or private dollars spent up to 1999 nor any dollars (federal, State, local, or private) spent since 1999. Established FEMA disaster programs cannot adequately address the situation because a major storm event or flash flood did not cause the damage.

Day County participates in the NFIP. They started the process to become a participating Closed Basin Community (see Attachment 4-11), however they stopped the process. Approximately 41 Day County landowners have been or are affected by the Bitter Lake raise and a potential channel has been or is affecting approximately seven landowners.

Additionally, in 1998 144 locations on county and township roads within these closed basins were inundated due to soil saturation along with El Nino influenced rains. The State in partnership with FEMA through the Hazard Mitigation Grant Program raised the road grade on approximately 26 sites in order to restore access and essential services to Day County residents. Day County flooding issues are ongoing.

South Dakota Dam Safety Program

The South Dakota Dam Safety program is implemented through the South Dakota Department of Environmental and Natural Resources (SDDENR), Water Rights Program. Although a separate dam safety budget does not exist, it is estimated the annual dam safety budget to be $225K. State Assistance Grants from FEMA have been applied for and received. Funding under the FFY '03 FEMA State Assistance Grant is $97,630. Funding requested under FFY '04 FEMA State Assistance Grant. Funds is $89,985 which is targeted to be used for many purposes including: travel and training expenses; computer, office and field equipment upgrades; updating emergency action plans; and for support in their cost-sharing efforts with the U.S. Geological Survey on gaging stations located either above or below several dams. Recent grant money purchases include three Motorola ASTRO Digital XTS 3000 portable radios, which will allow access to over 7000 safety officials across the State through various statewide interagency talk groups.

South Dakota has 2,467 dams in the National Inventory of dams; 2,229 are classified as low hazard, 155 are classified as Significant Hazard, and 84 are classified as High Hazard risk. The State regulates 2,323 of those dams, including 47 of the High Hazard dams. The State performed 81 dam inspections on State regulated dams in 2004. For definitions of the low hazard, significant hazard and high hazard dams, please see the dam failure discussion located in the Flood Hazard Profile in Section 3.2 of the plan

Thirty of the State-regulated High Hazard dams and five of the State-regulated dams in South Dakota have written emergency action plans. South Dakota meets all but two of the requirements in the Basic Criteria found in Public Law 107-310 and Public Law 104-307 Section 215 Subsection 8(f) 2A of the National Dam Safety Act.

South Dakota Flood Mitigation Assistance (FMA) Program

The Flood Mitigation Assistance (FMA) Program was created to reduce or eliminate the long-term risk of flood damage to structures in communities participating in the National Flood Insurance Program (NFIP). The funding source for the NFIP is the National Flood Insurance Fund. Monies for the National Flood Insurance Fund come from insurance premiums paid by policyholders in the NFIP. The highest priority for the FMA Program is removing repetitive loss structures from the floodplain (See Attachment 411). This program is implemented through the SDOEM.

Between federal fiscal years 1997 through 2002, the SDOEM coordinated seven FMA program plans. All seven plans were approved by FEMA. No plans are in progress at this time.

During that same time frame, the SDOEM monitored seven completed FMA projects. No FMA projects are in progress at this time.

If the State of South Dakota cannot provide a 25% match for the technical assistance grant, the technical assistance grant is moved to the project grant in order to provide additional funds to communities for their projects.

South Dakota Hazard Mitigation Grant Program (HMGP)

The South Dakota Hazard Mitigation Grant Program is funded through FEMA and implemented by the SDOEM. The HMGP is authorized under Section 404 of the Stafford Act, the Hazard Mitigation Grant Program. The HMGP provides grants to States and local governments to implement long-term hazard mitigation measures after a major disaster declaration. The purpose of the program is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the recovery phase following a disaster declaration.

Hazard Mitigation Grant Program funding is only available in States following a Presidential disaster declaration.

Eligible applicants are:

- State and local governments
- Indian tribes or other tribal organizations
- Certain private non-profit organization

Individual homeowners and businesses may not apply directly to the program, however a community may apply on their behalf. HMGP funds may be used to fund projects that will reduce or eliminate the losses from future disasters. Projects must provide a long-term solution to a problem, for example, elevation of a home to reduce the risk of flood damages as opposed to buying sandbags and pumps to fight the flood. In addition, a project's potential savings must be more than the cost of implementing the project. Funds may be used to protect either public or private property or to purchase property that has been subjected to, or is in danger of, repetitive damage. Additional HMGP information is located on the FEMA website www.fema.gov within the Multi-hazard pages.

South Dakota Pre-Disaster Mitigation Program (PDM)

The PDM program is funded through FEMA and implemented through the SDOEM. The PDM program provides technical and financial assistance to South Dakota local jurisdictions for cost-effective pre-disaster hazard mitigation activities that complement a comprehensive mitigation program for reducing injuries, loss of life, and damage and destruction of property. FEMA provides grants to States and Federally recognized Indian tribal governments that, in turn, provide sub-grants to local governments (to include Indian Tribal governments) for mitigation activities such as planning and the implementation of projects identified through the evaluation of natural hazards.

Summary

Of the 31 local jurisdiction hazard mitigation plans submitted to the State, seven narrowly mention or address local zoning and building codes. The seven jurisdictions are: Bennett, Clay, Custer, Meade, McCook, Turner and Union Counties. (See Attachment 4-9.)

With respect to flooding and the fact that flooding issues are a priority in South Dakota, the South Dakota Office of Emergency Management Staff believe that when the Flood Map Modernization Business Plan for South Dakota is implemented and mapping is completed, better local jurisdiction land use planning, zoning, building codes and policy can be pursued, adopted and implemented. The Staff also believe that where mitigation planning, zoning, building codes and policy currently exist, they are effective.

However, as stated previously, in South Dakota the challenge is to balance private citizens/landowners' property rights with local governmental control and flexibility over land-use decisions along with the observed trend that the State legislature has maintained a "hands-off' approach to most planning and land-use issues.

The State of South Dakota does not fund or provide a funding match for Flood Mitigation Assistance grants, Hazard or Predisaster Mitigation Grant Program projects. In the equation of 75% federal funding share and 25% other funding share which is required for funding mitigation projects-25% is funded from a source other than the State.

4.4 Mitigation Measures

This plan in conjunction with the State of South Dakota Hazard Mitigation Grant Administrative Plan includes identification, evaluation, and prioritization of cost-effective, environmentally sound, and technically feasible mitigation actions and activities the State is considering and indicates or implies how each activity contributes to the overall mitigation strategy.

Information in the following documents/web sites was reviewed and analyzed to perform this requirement:

1. Local jurisdiction plans as indicated in the "South Dakota's Local Jurisdiction Projects and Priorities" Tables located in Attachment 5-2 and 5-3
2. Interagency or Hazard Mitigation Survey Team Reports, or Strategy Papers for Federally declared disasters: Flooding Disasters 1173 and 1052, Severe Winter Storms, Flooding and Ice Jams 1375, Severe Storms, Rain, Heavy Snow, High Winds 1330, Ice

Storm 1161 and 1075, Winter Storm 1052, Ice Storm 1045, Tornado and Severe Storms 1280 and 1218, Wildfires 2319, 2324, and 2369 - on file in the SDOEM.

3. Actual South Dakota Mitigation Projects in NEMIS, See Attachment 4-2
4. Annex A-D
5. Weapons of Mass Destruction Annex dated February 2002- on file in SDOEM.

"Environmentally Sound and Technically Feasible" Discussion

Under the National Environmental Policy Act (NEPA), FEMA is responsible for performing environmental reviews to produce environmental documents on all projects proposed for federal funding.

Where appropriate and pertinent - an environmental review by FEMA and/or the State includes review of the following Public Laws or Executive Orders (in no particular order):
Wild and Scenic Rivers Act
Executive Order 11988 in conjunction with Executive Order 11990
Executive Order 12898
Clean Water Act - Section 404
Clean Water Act - Sections 313, 401 and 402
Resource Conservation and Recovery Act Clean Air Act Farmland Protection Policy Act
Fish and Wildlife Coordination Act
National Environmental Policy Act
National Historic Preservation Act
Coastal Barrier Resources Act
Coastal Zone Management Act; Comprehensive Environmental Response Compensation and Liability Act, and Endangered Species Act.
Source: http://www.fema.gov/regions/viii/env/
Environmental Laws And Executive Orders Overview

To administer the HMGP in South Dakota, the State Hazard Mitigation Officer (SHMO), Predisaster Mitigation (PDM) and NFIP Coordinators obtain environmental training in order to understand and perform NEPA requirements. Training of such personnel is coordinated with the FEMA Region VIII office. This training allows the State to offer and provide valuable technical assistance to actual grant (HMGP, PDM, and FMA) applicants regarding environmental requirements. This ultimately assists the applicants to produce successful competitive projects. Environmental assessments are included in project funding.

All proposed project applications submitted to FEMA Region VIII contain a detailed project description with coordinating maps and drawings, including an engineering report, if applicable, and a copy of the NEMIS Environmental Questionnaire with all agency coordination letters attached.

The State reviews the technical aspects of proposed projects to insure all information is complete and ready for submittal to FEMA.

After funding and during the construction phase, the State monitors all projects in order to be aware of any changes in scopes of work. To ensure continued funding, any changes in scopes of work are immediately reported to FEMA for additional environmental review.

The SHMO reviews applications before submittal to FEMA, in particular the Environmental Section.

After projects are funded, the State implements existing monitoring procedures for the purpose of: ensuring identified potential environmental impacts are avoided during the project construction phases; inspecting projects after completion to certify all conditions of the environmental document were met; and providing complete environmental documentation at the time of project closeout.

State Priorities and Actual Projects

The State's strategy and priorities have been established and are based upon past disaster history, recent disaster history from 1993 to the present, and the potential for disaster events in the future as identified in Section 3.0 of this plan. Information located in Attachments 4-1, 4-2, 4-3, 4-4, 5-1, 5-2, 5-3 and Annexes AD of this plan indicates, supports and reflects the State's strategy and priorities and how and why these priorities were established. Further, the information in these Attachments and Annexes prioritizes identified actions and actual projects (hat will be pursued in the future.

As stated previously the State's priorities are:

<u>Floods</u>

Structural hazard control or protection projects on existing structures or control systems
Development of comprehensive mitigation programs with implementation as an essential component
Construction activities that result in hazard protection
Retrofitting of facilities
Development of State or local mitigation standards
Debris removal and channel clearance
Development or improvement of warning systems
Acquisition or relocation
Other mitigation activities

<u>Winter Snow and Ice Storms</u>

Upgrade/modify existing systems
Relocate
Develop and implement standards
Develop and implement programs
New construction
Other mitigation activities

Tornadoes

Warning and forecasting
Tornado resistant shelters
Community based planning and implementation
Public infrastructure
Construction
Other mitigation activities

Wildfires

Communications
Fire prediction
Land management
Planning and zoning
Public information
Resource information
Other mitigation activities

4.5 Funding Sources

The State mitigation strategy includes identification of current and potential projects as discussed on page 88 and 89. Funding sources are identified in the following:

1. Section 2.0 Attachments
   - 2-1 Federal Programs and Assistance (general overview)
   - 2-2 Federal Department/Agency Program Resources (more detailed)
   - 2-3 Federal Mitigation Points of Contact
   - 2-4 Federal Programs/Type of Assistance/Agency & Contact
   - 2-7 State Agency Programs, Agencies and Resources
2. All Section 4.0 Attachments
3. All local plans submitted to the State by April 1, 2004.
4. Section 5.0 Attachments
   - 5-1 Table indicating that local jurisdiction priorities and projects contribute to the State's overall mitigation strategy
   - 5-2 Overview of 31 local jurisdiction plans' priorities and projects
   - 5-3 Copies of 31 local jurisdiction plans' priorities and projects submitted to the State by 04/01/04
5. Annexes A-D

5.0 Local Mitigation Planning Coordination

5.1 Local Funding and Technical Assistance

In 2002, SDOEM notified all 66 counties and nine Indian Reservations regarding the amount of Predisaster Mitigation funding that was available for developing and writing local mitigation plans. Applications were submitted to the State and 36 counties received funding for PDM plans. A State training team traveled to all 36 counties and provided training on how to develop and write local jurisdiction mitigation plans for implementation.

In 2003, SDOEM notified the remaining 30 counties and Indian Reservations of funding available for PDM planning. Three tribes and ten more counties applied for and received funding dollars toward the development of their plans. Again, a State training team traveled to these jurisdictions and provided the necessary training. One tribe applied directly to FEMA and worked with them to develop their plan.

In the future and as funding becomes available this is the process the State will use to assist local jurisdictions in developing their local mitigation plans.

5.2 Local Plan Integration

As of April 1, 2004, 31 local jurisdiction plans were submitted to SDOEM. All 31 local jurisdiction plans were reviewed by the State, forwarded to FEMA Region VIII and have been included in the preparation of this plan. Local plans submitted after the April 1, 2004 date are immediately reviewed by SDOEM and then submitted to FEMA. Future revisions of the South Dakota Multi-Hazard Mitigation Plan will include those particular local jurisdiction plans.

5.3 Prioritizing Local Assistance

Under potential and available funding, the criteria for prioritizing eligible communities and local jurisdictions to receive planning and project grants includes the following:

1. Communities with the highest risk - Determined by highest population numbers jointly compared with the dollars and amounts of property at risk from identified hazards and the probability of such hazards happening in the future. This is thoroughly explored in Section 3.0 of this plan in conjunction with the Annexes and Attachments as referenced in that Section.
2. Repetitive loss properties - See Attachment 4-1 0 South Dakota NFIP Repetitive Loss Properties
3. Most intense development pressures - discussed in

Section 4-2 and 4-3 of this plan.

4. Eligible entities/applicants who are able to provide the 25% matching funds required for receiving federally funded projects.
5. Eligible entities/applicants who are able to follow and complete all requirements of the grants application and management processes in the timeframes and schedules as required.

All non-planning grants will be prioritized by the extent to which benefits are maximized according to a cost benefit review of proposed projects and their associated costs. However, please note that this particular step is actually performed in the mitigation grant application process.

6.0 Plan Maintenance Procedures

6.1 Monitoring Evaluating and Updating the Plan

Under the DMA 2000 Interim Final Rules, FEMA requires that the State Multi-Hazard Mitigation Plan be updated every three years. However, monitoring and evaluating the plan will occur at least annually with a major plan update occurring every three years. Although it's not required, the plan will be evaluated following any significant disaster or unexpected changes in land use or demographics in or near hazard areas. The effectiveness of existing mitigation programs naturally rises to the surface during the day-to-day management and operations of pertinent hazard mitigation programs implemented within State and local government. In the future, lessons learned from that process will be considered and used when reviewing applications for potential mitigation projects.

6.2 Monitoring Progress of Mitigation Activities

Monitoring progress of mitigation activities occurs through ongoing actual mitigation activities including the grants application and management processes. Across the board, monitoring progress of mitigation activities is explored as funding is lost or becomes available and subsequent disaster events that occur. Mitigation activities are evaluated based on State priorities and projects as identified in the plan along with other federal, State and local plans and activities that through design or happenstance mitigate or minimize loss of life and property.

A schedule for the review and update to the Plan within the Office of Emergency Management will take place every six months as an action of maintenance. The Plan will also be monitored on a monthly basis in regards to updates needing to be addressed and implemented. This will be carried out by the State Hazard Mitigation Officer. All goals, activities, and projects will be reviewed and this monitoring process will be the responsibility of the State Hazard Mitigation Officer.

Also, prior to the three-year required review process, and after each disaster event, a mitigation review meeting will take place within the Office of Emergency Management involving the State Hazard Mitigation Team members , as well as Kristi Turman, Office of Emergency Management Director; Jason Bauder, Disaster Assistance Manager; Michelle Saxman, NFIP Coordinator; and Cindy Maszk, State Hazard Mitigation Officer. Information gathered at this Team meeting will be implemented into the plan in the form of a Team Report and will be used to evaluate and implement the goals and projected both proposed and completed. This Team Report will then be incorporated into the existing plan to ensure all information is documented and current.

The responsibility of all the review and implementation timeframes will be monitored by the Office of Emergency Management and the State Hazard Mitigation Officer.

Summary

In summary, following is an excerpt quoted verbatim from a section in the August 2001 FEMA publication, Telling the Tale of Disaster Resistance "Tips and Tools to Help You Capture the Story". This publication gives examples of mitigation activities, how to determine the impact of mitigation activities and things to consider when measuring the benefit of mitigation activities. The excerpt very nicely summarizes South Dakota's Multi-Hazard Plan in general and addresses specifically Section 6.2 of this plan. Even though the referenced document discusses capturing a story, what it actually does is identify mitigation actions that can be pursued to minimize loss of life and property. Additionally, it mentions things to consider when determining impacts of disasters. Finally, the excerpt makes suggestions of things to consider when measuring benefits of mitigation actions pursued.

Telling the Tale of Disaster Resistance "Tips and Tools to Help You Capture the Story" .
" . . . . **..In Search of a Disaster-Resistant Story**

The basic premise of disaster resistance is taking an action that will reduce or prevent the impact of a disaster. And that's just what you need to tell a story-action and impact that, together, produce a benefit.

Identifying Action

The easiest stories to recognize are those involving an obvious physical action-building something new, fortifying something old, or tearing something down. For example, it's easy to see the intent of elevating structures in a floodplain or removing homes from floodplain, landslide or fire-prone areas.
But there are many other actions that can make excellent disaster-resistance stories. The actions can be funded using local, State, federal and/or private resources. Here are just a few examples:

- ***Public Infrastructure***
  --Raising, grading or resurfacing roads
  --Building bigger, longer or stronger bridges
  --Cleaning out, widening or redirecting drainage ditches
  --Reinforcing culverts to counteract washouts
  --Constructing retention ponds to handle excess water runoff
  --Adding lift stations
  --Putting in flood-control measures such as levees and dikes
  --Improving water-pumping capacity
  --Elevating and securing fuel tanks
  --Fortifying critical public facilities such as water treatment plants, electrical and gas utilities, sewage lagoons, police and fire stations, hospitals, and communications systems
  --Installing back-up generators to run communications systems or other key facilities
  --Burying power lines to protect against high-wind events

- ***Residences***

  --Elevating utilities such as water heaters, furnaces, washers, dryers
  --Adding shutters, hurricane straps
  --Installing drain tiles, sump pumps or backflow valves
  --Using French drains or waterproof membranes to combat seepage
  --Improving guttering and/or extending downspouts
  --Adding window-well covers
  --Landscaping to improve water drainage or to protect against fires
  --Securing bookshelves or other tall objects to prevent movement in an earthquake
  --Building a room or reinforcing an interior space to provide shelter from tornadoes and other high-wind events

- ***Businesses***

  --Installing back-up power or communications systems
  --Elevating Utilities
  --Protecting inventory (e.g., moving it to shelving, securing it to walls, storing it at more than one location, etc.)
  --Storing critical records in a safe, alternate location
  --Adding floodgates
  --Installing sump pumps, backflow valves for sewers
  --Using equipment tie-downs

- ***Environment***
  --Creating greenways or other recreational areas in floodplains
  --Planting trees and shrubs to minimize blowing and drifting snow
  --Using vegetation to curb erosion along rivers
  --Creating windbreaks to control soil erosion

Disaster resistance also can be accomplished using non-structural techniques. Here are some ideas for these kinds of stories:" (Explanation: for example, the word activities could be exchanged for the word stories.)

- ***Insurance***
  --Securing flood insurance for buildings and/or contents
  --Adding special riders that cover damages caused by earthquakes, sewer backup, sump pump failure, etc., to standard residential and commercial insurance policies
- ***Codes and Ordinances***
  --Regulating floodplain development
  --Establishing disaster-resistance standards for new construction
  --Requiring seismic or wind-resistance protection for commercial or public buildings --Controlling urban runoff through proper development
  --Incorporating disaster-resistance elements into land-use planning
  --Securing rights-of-first refusal to buy and remove properties in high-risk flood or landslide areas
  --Deed restricting land in high-risk areas against future development
- ***Emergency Operations Plans***
- ***Specialized emergency response training***
- ***Public education programs or special events promoting disaster resistance***

  --Severe Weather Awareness week
  --Fire Prevention Week
  --Workshops at building supply stores for do-it-yourselfers
- ***Public-private partnerships that foster disaster resistance***
  --Leveraging money and resources to better protect a business, a neighborhood, and a school

Determining Impact

Impact is more than broken windows or collapsed structures. It's emotional and economic as well.

When you look at impact, consider what the disaster-resistance action does to reduce or prevent:

- Injury or death
- Structural damage
- Failure of critical facilities or infrastructure
- Wear and tear on government resources such as equipment and manpower
- Psychological injury
- Public panic
- Citizens, businesses from moving away
- Financial losses for citizens, businesses, local government
- Loss of jobs due to disaster damage or inability to do business
- Loss of tax revenue for local governments

Measuring Benefit

Benefit is the result of action and impact. Sometimes, the benefit isn't realized for years because future disaster losses can be infrequent. Bur when disaster does strike, here are the kinds of benefits you could see:

- Fewer injuries and deaths
- Less damage to homes and businesses
- Reduced personnel costs in taking emergency protective measures
- Continued operation of critical facilities like water treatment plants
- Schools and businesses that can immediately reopen because structural damage was avoided
- Preservation of historic structures (e.g., moved from repetitive-loss areas)
- Roads and bridges that remain open because of retrofitting. . . . ."

Appendix A – Acronyms

BIT	Bureau of Information and Telecommunications
BMP	Best Management Practices
BOR	US Bureau of Reclamation
CAA	Community Action Agencies
CDBG	Community Development Block Grant
CDT	Central Daylight Time
CFSA	Consolidated Farm Service Agency (USDA)
CWA	County Warning Area
DCR	SO Department of Commerce and Regulation
DECA	SD Department of Education and Cultural Affairs
DENR	SD Department of Environment and Natural Resources
DOA	SD Department of Agriculture
DOH	SD Department of Health
DOT	SD Department of Transportation
SDDPS	South Dakota Department of Public Safety
DR	Disaster Record
EMWIN	Emergency Management Weather Information Network
EPA	US Environmental Protection Agency
EWP	Emergency Watershed Program
FAS	Federal Aid Secondary
FEMA	Federal Emergency Management Agency
FMA	Flood Mitigation Assistance Program
FPA	Floodplain Administrator
FSA	Farm Service Agency
GAR	Governor's Authorized Representative
GFP	SD Department of Game, Fish, & Parks
GOED	Governor's Office of Economic Development
HDA	SD Housing Development Authority
HM	Hazard Mitigation
HMGP	Hazard Mitigation Grant Program (FEMA)
HMST	Hazard Mitigation Survey Team
IBHS	Institute for Business and Home Safety
IHMT	Interagency Hazard Mitigation Team (FEMA)
LHMO	Local Hazard Mitigation Officer
LHMT	Local Hazard Mitigation Team
LRC	Legislative Research Council
MOU	Memorandum of Understanding
MPH	Miles per Hour
NEXRAD	Next Generation Weather Radar
NFIP	National Flood Insurance Program (FEMA)
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service (USDOI)
NRCS	Natural Resources Conservation Service (USDA)
NWS	National Weather Service (NOAA)
NWSFO	NEXRAD Weather Service Forecast Office
OTGR	Office of Tribal Government Relations
REA	Rural Electric Association

Appendix A – Acronyms

REC	Rural Electric Cooperatives
SD	South Dakota
SDACD	South Dakota Association of Conservation Districts
SDOEM	South Dakota Office of Emergency Management (formerly SD Division of Emergency Management)
SDHMO	South Dakota Hazard Mitigation Officer/Coordinator
SDHMT	South Dakota Hazard Mitigation Team
SHMT	State Hazard Mitigation Team
SOP	Standard Operating Procedures
TNC	The Nature Conservancy
UBC	Unified Building Code
USACE	US Army Corps of Engineers
USDA	US Department of Agriculture
USDOI	US Department ofInterior
USFWS	US Fish & Wildlife Service
USGS	US Geological Survey
USHHS	US Department of Health and Human Services
Y2K	Year 2000