

HAZUS-MH: Earthquake Event Report



Region Name: *Chaffee County*

Earthquake Scenario: *Chase Gulch M6.75 CEUS Event*

Print Date: *January 24, 2006*

Disclaimer:

The estimates of social and economic impacts contained in this report were produced using HAZUS loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific earthquake. These results can be improved by using enhanced inventory, geotechnical, and observed ground motion data.

DOI: <https://doi.org/10.58783/cgs.ha09.ukny2731>

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General Description of the Region

HAZUS is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of HAZUS is to provide a methodology and software application to develop earthquake losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from earthquakes and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes 1 county(ies) from the following state(s):

Colorado

Note:

Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 1,013.91 square miles and contains 4 census tracts. There are over 6 thousand households in the region and has a total population of 16,242 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 7 thousand buildings in the region with a total building replacement value (excluding contents) of 1,011 (millions of dollars). Approximately 99.00 % of the buildings (and 82.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 1,002 and 258 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

HAZUS estimates that there are 7 thousand buildings in the region which have an aggregate total replacement value of 1,011 (millions of dollars). Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 60% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

HAZUS breaks critical facilities into two (2) groups: essential facilities and high potential loss (HPL) facilities. Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 1 hospitals in the region with a total bed capacity of 33 beds. There are 3 schools, 2 fire stations, 2 police stations and 1 emergency operation facilities. With respect to HPL facilities, there are 10 dams identified within the region. Of these, 1 of the dams are classified as 'high hazard'. The inventory also includes 1 hazardous material sites, 0 military installations and 0 nuclear power plants.

Transportation and Utility Lifeline Inventory

Within HAZUS, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 2 and 3.

The total value of the lifeline inventory is over 1,260.00 (millions of dollars). This inventory includes over 155 kilometers of highways, 59 bridges, 4,080 kilometers of pipes.

Table 2: Transportation System Lifeline Inventory

System	Component	# locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	59	17.40
	Segments	16	778.10
	Tunnels	4	1.30
	Subtotal		796.80
Railways	Bridges	0	0.00
	Facilities	0	0.00
	Segments	37	64.20
	Tunnels	0	0.00
	Subtotal		64.20
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
	Subtotal		0.00
Bus	Facilities	0	0.00
	Subtotal		0.00
Ferry	Facilities	0	0.00
	Subtotal		0.00
Port	Facilities	0	0.00
	Subtotal		0.00
Airport	Facilities	4	21.10
	Runways	4	120.60
	Subtotal		141.70
		Total	1,002.70

Table 3: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	40.80
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		40.80
Waste Water	Distribution Lines	NA	24.50
	Facilities	4	258.40
	Pipelines	0	0.00
	Subtotal		282.90
Natural Gas	Distribution Lines	NA	16.30
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		16.30
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		0.00
Electrical Power	Facilities	0	0.00
	Subtotal		0.00
Communication	Facilities	4	0.40
	Subtotal		0.40
	Total		340.40

Earthquake Scenario

HAZUS uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.

Scenario Name	Chase Gulch M6.75 CEUS Event
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-105.62
Latitude of Epicenter	39.00
Earthquake Magnitude	6.75
Depth (Km)	10.00
Rupture Length (Km)	27.86
Rupture Orientation (degrees)	157.00
Attenuation Function	CEUS Event

Building Damage

Building Damage

HAZUS estimates that about 441 buildings will be at least moderately damaged. This is over 6.00 % of the total number of buildings in the region. There are an estimated 3 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the HAZUS technical manual. Table 4 below summaries the expected damage by general occupancy for the buildings in the region. Table 5 summaries the expected damage by general building type.

Table 4: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	1	0.02	0	0.01	0	0.01	0	0.02	0	0.01
Commercial	52	0.88	9	1.38	7	1.82	2	2.83	0	4.31
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	7	0.12	1	0.15	1	0.17	0	0.22	0	0.27
Industrial	4	0.07	1	0.10	0	0.11	0	0.13	0	0.13
Other Residential	977	16.56	277	40.66	211	55.57	26	43.22	1	43.87
Religion	3	0.04	0	0.04	0	0.04	0	0.05	0	0.05
Single Family	4,857	82.32	394	57.67	160	42.28	32	53.53	2	51.35
Total	5,900		682		379		60		3	

Table 5: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	3,856	65.35	269	39.37	54	14.12	4	6.57	0	3.80
Steel	20	0.34	3	0.44	3	0.66	1	0.87	0	1.91
Concrete	15	0.26	3	0.46	2	0.56	0	0.72	0	0.72
Precast	6	0.11	1	0.17	1	0.34	0	0.77	0	0.64
RM	951	16.12	104	15.24	90	23.85	23	38.30	0	11.73
URM	112	1.89	31	4.58	21	5.63	6	10.59	1	38.67
MH	940	15.93	271	39.73	208	54.84	25	42.18	1	42.53
Total	5,900		682		379		60		3	

*Note:

RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 33 hospital beds available for use. On the day of the earthquake, the model estimates that only 17 hospital beds (54.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 85.00% of the beds will be back in service. By 30 days, 99.00% will be operational.

Table 6: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	1	0	0	1
Schools	3	0	0	3
EOCs	1	0	0	1
PoliceStations	2	0	0	2
FireStations	2	0	0	2

Transportation and Utility Lifeline Damage

Table 7 provides damage estimates for the transportation system.

Table 7: Expected Damage to the Transportation Systems

System	Component	Number of Locations_				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	16	0	0	16	16
	Bridges	59	0	0	59	59
	Tunnels	4	0	0	4	4
Railways	Segments	37	0	0	37	37
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	0	0	0	0	0
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	4	0	0	4	4
	Runways	4	0	0	4	4

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 8-10 provide information on the damage to the utility lifeline systems. Table 8 provides damage to the utility system facilities. Table 9 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, HAZUS performs a simplified system performance analysis. Table 10 provides a summary of the system performance information.

Table 8 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	4	0	0	3	4
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	4	0	0	4	4

Table 9 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	2,040	9	2
Waste Water	1,224	7	2
Natural Gas	816	7	2
Oil	0	0	0

Table 10: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	6,584	0	0	0	0	0
Electric Power		0	0	0	0	0

Induced Earthquake Damage

Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. HAZUS uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 1 ignitions that will burn about 0.00 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 0 people and burn about 0 (millions of dollars) of building value.

Debris Generation

HAZUS estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 0.00 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 0.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 0 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Social Impact

Shelter Requirement

HAZUS estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 9 households to be displaced due to the earthquake. Of these, 2 people (out of a total population of 16,242) will seek temporary shelter in public shelters.

Casualties

HAZUS estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

- Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
- Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
- Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
- Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 11 provides a summary of the casualties estimated for this earthquake

Table 11: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	2	0	0	0
	Single Family	3	0	0	0
	Total	5	1	0	0
2 PM	Commercial	3	0	0	0
	Commuting	0	0	0	0
	Educational	1	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	1	0	0	0
	Single Family	1	0	0	0
	Total	5	1	0	0
5 PM	Commercial	2	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	1	0	0	0
	Single Family	1	0	0	0
	Total	4	1	0	0

Economic Loss

The total economic loss estimated for the earthquake is 33.91 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 15.47 (millions of dollars); 18 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 60 % of the total loss. Table 12 below provides a summary of the losses associated with the building damage.

Table 12: Building-Related Economic Loss Estimates
(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	0.13	0.75	0.02	0.05	0.95
	Capital-Related	0.00	0.05	0.75	0.01	0.01	0.83
	Rental	0.27	0.28	0.40	0.00	0.02	0.97
	Relocation	0.03	0.01	0.02	0.00	0.00	0.06
	Subtotal	0.30	0.47	1.92	0.04	0.08	2.81
Capital Stock Losses							
	Structural	1.21	0.48	0.68	0.08	0.10	2.55
	Non_Structural	3.67	1.56	1.53	0.24	0.27	7.26
	Content	1.30	0.35	0.81	0.15	0.16	2.77
	Inventory	0.00	0.00	0.04	0.04	0.00	0.08
	Subtotal	6.18	2.38	3.05	0.52	0.53	12.67
	Total	6.48	2.85	4.98	0.56	0.61	15.47

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, HAZUS computes the direct repair cost for each component only. There are no losses computed by HAZUS for business interruption due to lifeline outages. Tables 13 & 14 provide a detailed breakdown in the expected lifeline losses.

HAZUS estimates the long-term economic impacts to the region for 15 years after the earthquake. The model quantifies this information in terms of income and employment changes within the region. Table 15 presents the results of the region for the given earthquake.

Table 13: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	778.13	\$0.00	0.00
	Bridges	17.38	\$0.04	0.21
	Tunnels	1.28	\$0.00	0.21
	Subtotal	796.80	0.00	
Railways	Segments	64.21	\$0.00	0.00
	Bridges	0.00	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	64.20	0.00	
Light Rail	Segments	0.00	\$0.00	0.00
	Bridges	0.00	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Bus	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Ferry	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Port	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Airport	Facilities	21.15	\$2.57	12.16
	Runways	120.59	\$0.00	0.00
	Subtotal	141.70	2.60	
	Total	1002.70	2.60	

Table 14: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Line	40.80	\$0.04	0.09
	Subtotal	40.80	\$0.04	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	258.40	\$15.71	6.08
	Distribution Line	24.50	\$0.03	0.12
	Subtotal	282.89	\$15.74	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Line	16.30	\$0.03	0.20
	Subtotal	16.32	\$0.03	
Oil Systems	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Electrical Power	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Communication	Facilities	0.40	\$0.02	5.59
	Subtotal	0.39	\$0.02	
	Total	340.40	\$15.83	

Table 15. Indirect Economic Impact with outside aid
(Employment as # of people and Income in millions of \$)

	LOSS	Total	%
First Year			
	Employment Impact	0	0.00
	Income Impact	0	-0.07
Second Year			
	Employment Impact	0	0.00
	Income Impact	0	-0.22
Third Year			
	Employment Impact	0	0.00
	Income Impact	0	-0.29
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	0	-0.29
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	0	-0.29
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	0	-0.29

Appendix A: County Listing for the Region

Chaffee,CO

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Colorado	Chaffee	16,242	831	179	1,011
Total State		16,242	831	179	1,011
Total Region		16,242	831	179	1,011

HAZUS-MH: Earthquake Event Report



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Earthquake Scenario: *Frontal M7.0 CEUS Event*

Print Date: *January 24, 2006*

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Transportation and Utility Lifeline Inventory

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The total value of the lifeline inventory is over 1,260.00 (millions of dollars). This inventory includes over 155 kilometers of highways, 59 bridges, 4,080 kilometers of pipes.

Table 2: Transportation System Lifeline Inventory

System	Component	# locations/ # Segments	Replacement value (millions of dollars)
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	Segments	16	778.10
	Tunnels	4	1.30
	Subtotal		796.80
Railways	Bridges	0	0.00
	Facilities	0	0.00
	Segments	37	64.20
	Tunnels	0	0.00
	Subtotal		64.20
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
	Subtotal		0.00
Bus	Facilities	0	0.00
	Subtotal		0.00
Ferry	Facilities	0	0.00
	Subtotal		0.00
Port	Facilities	0	0.00
	Subtotal		0.00
Airport	Facilities	4	21.10
	Runways	4	120.60
	Subtotal		141.70
		Total	1,002.70

Table 3: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	40.80
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		40.80
Waste Water	Distribution Lines	NA	24.50
	Facilities	4	258.40
	Pipelines	0	0.00
	Subtotal		282.90
Natural Gas	Distribution Lines	NA	16.30
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		16.30
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		0.00
Electrical Power	Facilities	0	0.00
	Subtotal		0.00
Communication	Facilities	4	0.40
	Subtotal		0.40
	Total		340.40

Earthquake Scenario

HAZUS uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.

Scenario Name	Frontal M7.0 CEUS Event
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-106.16
Latitude of Epicenter	39.68
Earthquake Magnitude	7.00
Depth (Km)	10.00
Rupture Length (Km)	42.66
Rupture Orientation (degrees)	156.00
Attenuation Function	CEUS Event

Building Damage

Building Damage

HAZUS estimates that about 302 buildings will be at least moderately damaged. This is over 4.00 % of the total number of buildings in the region. There are an estimated 1 buildings that will be damaged beyond repair. The definition of the ' damage states' is provided in Volume 1: Chapter 5 of the HAZUS technical manual. Table 4 below summaries the expected damage by general occupancy for the buildings in the region. Table 5 summaries the expected damage by general building type.

Table 4: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	1	0.01	0	0.01	0	0.02	0	0.03	0	0.02
Commercial	58	0.95	7	1.12	4	1.51	1	2.44	0	4.00
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	8	0.12	1	0.14	0	0.17	0	0.25	0	0.31
Industrial	4	0.07	0	0.08	0	0.10	0	0.14	0	0.17
Other Residential	1,088	17.85	236	37.60	155	57.23	13	43.26	1	40.24
Religion	3	0.04	0	0.04	0	0.04	0	0.06	0	0.07
Single Family	4,933	80.95	383	61.02	111	40.93	16	53.82	1	55.19
Total	6,094		627		271		30		1	

Table 5: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	3,849	63.15	287	45.77	44	16.07	3	9.05	0	0.03
Steel	22	0.35	3	0.40	2	0.61	0	0.83	0	1.87
Concrete	17	0.28	2	0.38	1	0.44	0	0.51	0	0.38
Precast	7	0.12	1	0.15	1	0.29	0	0.70	0	0.33
RM	1,029	16.88	76	12.14	54	19.96	10	32.95	0	5.43
URM	124	2.04	27	4.23	16	5.93	4	13.52	1	52.59
MH	1,047	17.17	232	36.93	154	56.70	13	42.44	1	39.36
Total	6,094		627		271		30		1	

*Note:

RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 33 hospital beds available for use. On the day of the earthquake, the model estimates that only 24 hospital beds (75.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 95.00% of the beds will be back in service. By 30 days, 100.00% will be operational.

Table 6: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	1	0	0	1
Schools	3	0	0	3
EOCs	1	0	0	1
PoliceStations	2	0	0	2
FireStations	2	0	0	2

Transportation and Utility Lifeline Damage

Table 7 provides damage estimates for the transportation system.

Table 7: Expected Damage to the Transportation Systems

System	Component	Number of Locations_				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	16	0	0	16	16
	Bridges	59	0	0	59	59
	Tunnels	4	0	0	4	4
Railways	Segments	37	0	0	37	37
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	0	0	0	0	0
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	4	0	0	4	4
	Runways	4	0	0	4	4

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 8-10 provide information on the damage to the utility lifeline systems. Table 8 provides damage to the utility system facilities. Table 9 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, HAZUS performs a simplified system performance analysis. Table 10 provides a summary of the system performance information.

Table 8 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	4	0	0	4	4
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	4	0	0	4	4

Table 9 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	2,040	6	2
Waste Water	1,224	5	1
Natural Gas	816	5	1
Oil	0	0	0

Table 10: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	6,584	0	0	0	0	0
Electric Power		0	0	0	0	0

Induced Earthquake Damage

Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. HAZUS uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 0 ignitions that will burn about 0.00 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 0 people and burn about 0 (millions of dollars) of building value.

Debris Generation

HAZUS estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 0.00 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 0.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 0 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Social Impact

Shelter Requirement

HAZUS estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 3 households to be displaced due to the earthquake. Of these, 1 people (out of a total population of 16,242 will seek temporary shelter in public shelters.

Casualties

HAZUS estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

- Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
- Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
- Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
- Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 11 provides a summary of the casualties estimated for this earthquake

Table 11: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	1	0	0	0
	Single Family	2	0	0	0
	Total	3	0	0	0
2 PM	Commercial	2	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	0	0	0	0
	Total	3	0	0	0
5 PM	Commercial	1	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	0	0	0	0
	Single Family	1	0	0	0
	Total	3	0	0	0

Economic Loss

The total economic loss estimated for the earthquake is 17.51 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 9.32 (millions of dollars); 17 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 66 % of the total loss. Table 12 below provides a summary of the losses associated with the building damage.

Table 12: Building-Related Economic Loss Estimates
(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	0.07	0.40	0.01	0.03	0.51
	Capital-Related	0.00	0.03	0.40	0.01	0.01	0.44
	Rental	0.17	0.16	0.21	0.00	0.01	0.55
	Relocation	0.02	0.00	0.01	0.00	0.00	0.03
	Subtotal	0.19	0.26	1.02	0.02	0.05	1.54
Capital Stock Losses							
	Structural	0.81	0.31	0.36	0.05	0.07	1.60
	Non_Structural	2.63	0.91	0.75	0.13	0.17	4.59
	Content	0.82	0.18	0.38	0.08	0.09	1.55
	Inventory	0.00	0.00	0.02	0.02	0.00	0.04
	Subtotal	4.26	1.40	1.51	0.28	0.33	7.78
	Total	4.45	1.67	2.53	0.30	0.38	9.32

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, HAZUS computes the direct repair cost for each component only. There are no losses computed by HAZUS for business interruption due to lifeline outages. Tables 13 & 14 provide a detailed breakdown in the expected lifeline losses.

HAZUS estimates the long-term economic impacts to the region for 15 years after the earthquake. The model quantifies this information in terms of income and employment changes within the region. Table 15 presents the results of the region for the given earthquake.

Table 13: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	778.13	\$0.00	0.00
	Bridges	17.38	\$0.01	0.07
	Tunnels	1.28	\$0.00	0.03
	Subtotal	796.80	0.00	
Railways	Segments	64.21	\$0.00	0.00
	Bridges	0.00	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	64.20	0.00	
Light Rail	Segments	0.00	\$0.00	0.00
	Bridges	0.00	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Bus	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Ferry	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Port	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Airport	Facilities	21.15	\$1.38	6.52
	Runways	120.59	\$0.00	0.00
	Subtotal	141.70	1.40	
	Total	1002.70	1.40	

Table 14: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Line	40.80	\$0.03	0.07
	Subtotal	40.80	\$0.03	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	258.40	\$6.71	2.60
	Distribution Line	24.50	\$0.02	0.09
	Subtotal	282.89	\$6.74	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Line	16.30	\$0.02	0.15
	Subtotal	16.32	\$0.02	
Oil Systems	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Electrical Power	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Communication	Facilities	0.40	\$0.01	2.32
	Subtotal	0.39	\$0.01	
	Total	340.40	\$6.80	

Table 15. Indirect Economic Impact with outside aid
(Employment as # of people and Income in millions of \$)

	LOSS	Total	%
First Year			
	Employment Impact	0	0.00
	Income Impact	0	-0.05
Second Year			
	Employment Impact	0	0.00
	Income Impact	0	-0.14
Third Year			
	Employment Impact	0	0.00
	Income Impact	0	-0.18
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	0	-0.18
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	0	-0.18
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	0	-0.18

Appendix A: County Listing for the Region

Chaffee,CO

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Colorado	Chaffee	16,242	831	179	1,011
Total State		16,242	831	179	1,011
Total Region		16,242	831	179	1,011

HAZUS-MH: Earthquake Event Report



Region Name: *Chaffee County*

Earthquake Scenario: *Mosquito M7.0 CEUS Event*

Print Date: *January 24, 2006*

Disclaimer:

The estimates of social and economic impacts contained in this report were produced using HAZUS loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific earthquake. These results can be improved by using enhanced inventory, geotechnical, and observed ground motion data.

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General Description of the Region

HAZUS is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of HAZUS is to provide a methodology and software application to develop earthquake losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from earthquakes and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes 1 county(ies) from the following state(s):

Colorado

Note:

Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 1,013.91 square miles and contains 4 census tracts. There are over 6 thousand households in the region and has a total population of 16,242 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 7 thousand buildings in the region with a total building replacement value (excluding contents) of 1,011 (millions of dollars). Approximately 99.00 % of the buildings (and 82.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 1,002 and 258 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

HAZUS estimates that there are 7 thousand buildings in the region which have an aggregate total replacement value of 1,011 (millions of dollars). Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 60% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

HAZUS breaks critical facilities into two (2) groups: essential facilities and high potential loss (HPL) facilities. Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 1 hospitals in the region with a total bed capacity of 33 beds. There are 3 schools, 2 fire stations, 2 police stations and 1 emergency operation facilities. With respect to HPL facilities, there are 10 dams identified within the region. Of these, 1 of the dams are classified as 'high hazard'. The inventory also includes 1 hazardous material sites, 0 military installations and 0 nuclear power plants.

Transportation and Utility Lifeline Inventory

Within HAZUS, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 2 and 3.

The total value of the lifeline inventory is over 1,260.00 (millions of dollars). This inventory includes over 155 kilometers of highways, 59 bridges, 4,080 kilometers of pipes.

Table 2: Transportation System Lifeline Inventory

System	Component	# locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	59	17.40
	Segments	16	778.10
	Tunnels	4	1.30
	Subtotal		796.80
Railways	Bridges	0	0.00
	Facilities	0	0.00
	Segments	37	64.20
	Tunnels	0	0.00
	Subtotal		64.20
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
	Subtotal		0.00
Bus	Facilities	0	0.00
	Subtotal		0.00
Ferry	Facilities	0	0.00
	Subtotal		0.00
Port	Facilities	0	0.00
	Subtotal		0.00
Airport	Facilities	4	21.10
	Runways	4	120.60
	Subtotal		141.70
		Total	1,002.70

Table 3: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	40.80
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		40.80
Waste Water	Distribution Lines	NA	24.50
	Facilities	4	258.40
	Pipelines	0	0.00
	Subtotal		282.90
Natural Gas	Distribution Lines	NA	16.30
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		16.30
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		0.00
Electrical Power	Facilities	0	0.00
	Subtotal		0.00
Communication	Facilities	4	0.40
	Subtotal		0.40
	Total		340.40

Earthquake Scenario

HAZUS uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.

Scenario Name	Mosquito M7.0 CEUS Event
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-106.16
Latitude of Epicenter	39.38
Earthquake Magnitude	7.00
Depth (Km)	10.00
Rupture Length (Km)	42.66
Rupture Orientation (degrees)	9.00
Attenuation Function	CEUS Event

Building Damage

Building Damage

HAZUS estimates that about 960 buildings will be at least moderately damaged. This is over 14.00 % of the total number of buildings in the region. There are an estimated 11 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the HAZUS technical manual. Table 4 below summaries the expected damage by general occupancy for the buildings in the region. Table 5 summaries the expected damage by general building type.

Table 4: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	1	0.01	0	0.02	0	0.02	0	0.03	0	0.05
Commercial	43	0.90	12	0.96	11	1.40	3	1.89	0	2.85
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	5	0.11	2	0.14	2	0.21	1	0.30	0	0.42
Industrial	3	0.06	1	0.07	1	0.10	0	0.12	0	0.15
Other Residential	686	14.36	355	27.50	372	47.64	74	44.31	5	44.03
Religion	2	0.04	1	0.04	0	0.05	0	0.07	0	0.10
Single Family	4,034	84.51	919	71.27	395	50.57	89	53.28	6	52.41
Total	4,773		1,290		781		168		12	

Table 5: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	3,209	67.23	748	57.99	204	26.12	20	11.74	1	7.41
Steel	15	0.32	5	0.35	5	0.60	1	0.68	0	1.43
Concrete	12	0.25	4	0.32	4	0.46	1	0.55	0	0.51
Precast	5	0.11	1	0.11	2	0.23	1	0.47	0	0.43
RM	794	16.63	148	11.44	167	21.34	59	35.17	2	14.71
URM	86	1.81	37	2.86	32	4.08	13	7.65	4	32.16
MH	651	13.64	347	26.92	369	47.17	73	43.75	5	43.35
Total	4,773		1,290		781		168		12	

*Note:

RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 33 hospital beds available for use. On the day of the earthquake, the model estimates that only 16 hospital beds (49.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 81.00% of the beds will be back in service. By 30 days, 99.00% will be operational.

Table 6: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	1	0	0	0
Schools	3	0	0	2
EOCs	1	0	0	1
PoliceStations	2	0	0	1
FireStations	2	0	0	1

Transportation and Utility Lifeline Damage

Table 7 provides damage estimates for the transportation system.

Table 7: Expected Damage to the Transportation Systems

System	Component	Number of Locations_				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	16	0	0	16	16
	Bridges	59	0	0	59	59
	Tunnels	4	0	0	4	4
Railways	Segments	37	0	0	37	37
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	0	0	0	0	0
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	4	0	0	4	4
	Runways	4	0	0	4	4

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 8-10 provide information on the damage to the utility lifeline systems. Table 8 provides damage to the utility system facilities. Table 9 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, HAZUS performs a simplified system performance analysis. Table 10 provides a summary of the system performance information.

Table 8 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	4	0	0	1	4
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	4	1	0	4	4

Table 9 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	2,040	26	6
Waste Water	1,224	20	5
Natural Gas	816	22	5
Oil	0	0	0

Table 10: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	6,584	0	0	0	0	0
Electric Power		0	0	0	0	0

Induced Earthquake Damage

Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. HAZUS uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 1 ignitions that will burn about 0.00 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 0 people and burn about 0 (millions of dollars) of building value.

Debris Generation

HAZUS estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 0.00 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 0.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 0 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Social Impact

Shelter Requirement

HAZUS estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 18 households to be displaced due to the earthquake. Of these, 4 people (out of a total population of 16,242) will seek temporary shelter in public shelters.

Casualties

HAZUS estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

- Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
- Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
- Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
- Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 11 provides a summary of the casualties estimated for this earthquake

Table 11: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	1	0	0	0
	Industrial	0	0	0	0
	Other-Residential	4	1	0	0
	Single Family	7	1	0	0
	Total	12	2	0	0
2 PM	Commercial	6	1	0	0
	Commuting	0	0	0	0
	Educational	1	0	0	0
	Hotels	0	0	0	0
	Industrial	1	0	0	0
	Other-Residential	1	0	0	0
	Single Family	2	0	0	0
	Total	11	2	0	0
5 PM	Commercial	5	1	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	0	0	0	0
	Other-Residential	2	0	0	0
	Single Family	3	0	0	0
	Total	10	2	0	0

Economic Loss

The total economic loss estimated for the earthquake is 65.82 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 38.23 (millions of dollars); 14 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 69 % of the total loss. Table 12 below provides a summary of the losses associated with the building damage.

Table 12: Building-Related Economic Loss Estimates
(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	0.31	1.32	0.05	0.12	1.80
	Capital-Related	0.00	0.13	1.32	0.03	0.02	1.50
	Rental	0.70	0.59	0.70	0.01	0.06	2.06
	Relocation	0.07	0.01	0.03	0.00	0.01	0.14
	Subtotal	0.78	1.05	3.38	0.08	0.22	5.50
Capital Stock Losses							
	Structural	3.20	0.99	1.23	0.17	0.30	5.88
	Non_Structural	11.60	3.44	2.76	0.50	0.79	19.08
	Content	4.50	0.83	1.48	0.31	0.48	7.60
	Inventory	0.00	0.00	0.07	0.09	0.01	0.16
	Subtotal	19.29	5.26	5.53	1.06	1.58	32.73
	Total	20.07	6.31	8.91	1.14	1.80	38.23

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, HAZUS computes the direct repair cost for each component only. There are no losses computed by HAZUS for business interruption due to lifeline outages. Tables 13 & 14 provide a detailed breakdown in the expected lifeline losses.

HAZUS estimates the long-term economic impacts to the region for 15 years after the earthquake. The model quantifies this information in terms of income and employment changes within the region. Table 15 presents the results of the region for the given earthquake.

Table 13: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	778.13	\$0.00	0.00
	Bridges	17.38	\$0.12	0.68
	Tunnels	1.28	\$0.03	2.06
	Subtotal	796.80	0.10	
Railways	Segments	64.21	\$0.00	0.00
	Bridges	0.00	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	64.20	0.00	
Light Rail	Segments	0.00	\$0.00	0.00
	Bridges	0.00	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Bus	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Ferry	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Port	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Airport	Facilities	21.15	\$2.91	13.74
	Runways	120.59	\$0.00	0.00
	Subtotal	141.70	2.90	
	Total	1002.70	3.00	

Table 14: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Line	40.80	\$0.11	0.28
	Subtotal	40.80	\$0.11	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	258.40	\$24.20	9.37
	Distribution Line	24.50	\$0.09	0.37
	Subtotal	282.89	\$24.29	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Line	16.30	\$0.10	0.59
	Subtotal	16.32	\$0.10	
Oil Systems	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Electrical Power	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Communication	Facilities	0.40	\$0.03	8.35
	Subtotal	0.39	\$0.03	
	Total	340.40	\$24.54	

Table 15. Indirect Economic Impact with outside aid
(Employment as # of people and Income in millions of \$)

	LOSS	Total	%
First Year			
	Employment Impact	0	0.00
	Income Impact	0	-0.19
Second Year			
	Employment Impact	0	0.00
	Income Impact	(1)	-0.57
Third Year			
	Employment Impact	0	0.00
	Income Impact	(1)	-0.73
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	(1)	-0.73
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	(1)	-0.73
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	(1)	-0.73

Appendix A: County Listing for the Region

Chaffee,CO

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Colorado	Chaffee	16,242	831	179	1,011
Total State		16,242	831	179	1,011
Total Region		16,242	831	179	1,011

HAZUS-MH: Earthquake Event Report



Region Name: *Chaffee County*

Earthquake Scenario: *N Sangre M7.5 CEUS Event*

Print Date: *June 30, 2005*

Disclaimer:

The estimates of social and economic impacts contained in this report were produced using HAZUS loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific earthquake. These results can be improved by using enhanced inventory, geotechnical, and observed ground motion data.

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General Description of the Region

HAZUS is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of HAZUS is to provide a methodology and software application to develop earthquake losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from earthquakes and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes 1 county(ies) from the following state(s):

Colorado

Note:

Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 1,013.91 square miles and contains 4 census tracts. There are over 6 thousand households in the region and has a total population of 16,242 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 7 thousand buildings in the region with a total building replacement value (excluding contents) of 1,011 (millions of dollars). Approximately 99.00 % of the buildings (and 82.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 1,002 and 258 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

HAZUS estimates that there are 7 thousand buildings in the region which have an aggregate total replacement value of 1,011 (millions of dollars). Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 60% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

HAZUS breaks critical facilities into two (2) groups: essential facilities and high potential loss (HPL) facilities. Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 1 hospitals in the region with a total bed capacity of 33 beds. There are 3 schools, 2 fire stations, 2 police stations and 1 emergency operation facilities. With respect to HPL facilities, there are 10 dams identified within the region. Of these, 1 of the dams are classified as 'high hazard'. The inventory also includes 1 hazardous material sites, 0 military installations and 0 nuclear power plants.

Transportation and Utility Lifeline Inventory

Within HAZUS, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 2 and 3.

The total value of the lifeline inventory is over 1,260.00 (millions of dollars). This inventory includes over 155 kilometers of highways, 59 bridges, 4,080 kilometers of pipes.

Table 2: Transportation System Lifeline Inventory

System	Component	# locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	59	17.40
	Segments	16	778.10
	Tunnels	4	1.30
	Subtotal		796.80
Railways	Bridges	0	0.00
	Facilities	0	0.00
	Segments	37	64.20
	Tunnels	0	0.00
	Subtotal		64.20
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
	Subtotal		0.00
Bus	Facilities	0	0.00
	Subtotal		0.00
Ferry	Facilities	0	0.00
	Subtotal		0.00
Port	Facilities	0	0.00
	Subtotal		0.00
Airport	Facilities	4	21.10
	Runways	4	120.60
	Subtotal		141.70
		Total	1,002.70

Table 3: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	40.80
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		40.80
Waste Water	Distribution Lines	NA	24.50
	Facilities	4	258.40
	Pipelines	0	0.00
	Subtotal		282.90
Natural Gas	Distribution Lines	NA	16.30
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		16.30
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		0.00
Electrical Power	Facilities	0	0.00
	Subtotal		0.00
Communication	Facilities	4	0.40
	Subtotal		0.40
	Total		340.40

Earthquake Scenario

HAZUS uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.

Scenario Name	N Sangre M7.5 CEUS Event
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-105.63
Latitude of Epicenter	37.90
Earthquake Magnitude	7.50
Depth (Km)	10.00
Rupture Length (Km)	100.00
Rupture Orientation (degrees)	161.00
Attenuation Function	CEUS Event

Building Damage

Building Damage

HAZUS estimates that about 3,935 buildings will be at least moderately damaged. This is over 56.00 % of the total number of buildings in the region. There are an estimated 923 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the HAZUS technical manual. Table 4 below summaries the expected damage by general occupancy for the buildings in the region. Table 5 summaries the expected damage by general building type.

Table 4: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	0	0.02	0	0.01	0	0.01	0	0.02	0	0.01
Commercial	3	0.21	4	0.29	13	0.74	19	1.53	30	3.28
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	1	0.05	1	0.06	2	0.14	3	0.21	2	0.24
Industrial	0	0.01	0	0.02	1	0.06	2	0.12	2	0.19
Other Residential	69	4.30	149	9.99	381	21.52	470	37.82	424	45.87
Religion	0	0.03	0	0.03	1	0.04	1	0.06	1	0.08
Single Family	1,524	95.37	1,335	89.60	1,371	77.49	749	60.25	465	50.33
Total	1,598		1,490		1,769		1,243		923	

Table 5: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	1,395	87.30	1243	83.41	1,090	61.60	370	29.77	84	9.07
Steel	1	0.05	1	0.07	4	0.22	7	0.58	13	1.42
Concrete	1	0.07	1	0.10	4	0.24	6	0.47	8	0.90
Precast	0	0.02	0	0.02	1	0.08	2	0.20	5	0.52
RM	124	7.78	87	5.84	268	15.16	358	28.77	332	35.94
URM	13	0.82	19	1.25	36	2.01	39	3.10	66	7.11
MH	63	3.95	139	9.31	366	20.69	461	37.12	416	45.03
Total	1,598		1,490		1,769		1,243		923	

*Note:

RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 33 hospital beds available for use. On the day of the earthquake, the model estimates that only 0 hospital beds (1.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 4.00% of the beds will be back in service. By 30 days, 26.00% will be operational.

Table 6: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	1	1	0	0
Schools	3	2	0	1
EOCs	1	1	0	0
PoliceStations	2	1	0	0
FireStations	2	1	0	0

Transportation and Utility Lifeline Damage

Table 7 provides damage estimates for the transportation system.

Table 7: Expected Damage to the Transportation Systems

System	Component	Number of Locations_				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	16	0	0	16	16
	Bridges	59	1	0	58	58
	Tunnels	4	0	0	4	4
Railways	Segments	37	0	0	37	37
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	0	0	0	0	0
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	4	3	0	4	4
	Runways	4	0	0	4	4

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 8-10 provide information on the damage to the utility lifeline systems. Table 8 provides damage to the utility system facilities. Table 9 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, HAZUS performs a simplified system performance analysis. Table 10 provides a summary of the system performance information.

Table 8 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	4	3	0	0	4
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	4	2	0	2	4

Table 9 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	2,040	668	167
Waste Water	1,224	529	132
Natural Gas	816	565	141
Oil	0	0	0

Table 10: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	6,584	2,207	1,150	0	0	0
Electric Power		2,061	1,278	524	100	3

Induced Earthquake Damage

Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. HAZUS uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 2 ignitions that will burn about 0.03 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 2 people and burn about 0 (millions of dollars) of building value.

Debris Generation

HAZUS estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 0.00 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 0.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 0 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Social Impact

Shelter Requirement

HAZUS estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 759 households to be displaced due to the earthquake. Of these, 195 people (out of a total population of 16,242) will seek temporary shelter in public shelters.

Casualties

HAZUS estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

- Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
- Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
- Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
- Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 11 provides a summary of the casualties estimated for this earthquake

Table 11: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	3	1	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	13	4	1	1
	Industrial	3	1	0	0
	Other-Residential	73	18	2	3
	Single Family	123	36	6	11
	Total	215	60	9	16
2 PM	Commercial	182	59	10	20
	Commuting	0	0	0	0
	Educational	33	11	2	4
	Hotels	3	1	0	0
	Industrial	19	6	1	2
	Other-Residential	18	5	0	1
	Single Family	32	9	2	3
	Total	287	90	15	29
5 PM	Commercial	131	42	7	14
	Commuting	0	0	1	0
	Educational	2	1	0	0
	Hotels	4	1	0	0
	Industrial	12	4	1	1
	Other-Residential	27	7	1	1
	Single Family	48	14	2	4
	Total	225	69	12	22

Economic Loss

The total economic loss estimated for the earthquake is 425.76 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 356.47 (millions of dollars); 15 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 60 % of the total loss. Table 12 below provides a summary of the losses associated with the building damage.

Table 12: Building-Related Economic Loss Estimates
(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	3.80	13.50	0.44	0.81	18.55
	Capital-Related	0.00	1.62	13.35	0.25	0.16	15.40
	Rental	6.16	5.87	6.06	0.10	0.47	18.67
	Relocation	0.64	0.12	0.29	0.01	0.11	1.16
	Subtotal	6.80	11.41	33.21	0.80	1.56	53.78
Capital Stock Losses							
	Structural	29.23	9.48	15.14	1.76	2.44	58.05
	Non_Structural	92.69	36.70	44.72	6.46	7.24	187.81
	Content	20.71	7.33	19.71	3.79	3.25	54.81
	Inventory	0.00	0.00	0.89	1.09	0.05	2.03
	Subtotal	142.64	53.51	80.46	13.10	12.98	302.70
	Total	149.44	64.93	113.67	13.90	14.54	356.47

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, HAZUS computes the direct repair cost for each component only. There are no losses computed by HAZUS for business interruption due to lifeline outages. Tables 13 & 14 provide a detailed breakdown in the expected lifeline losses.

HAZUS estimates the long-term economic impacts to the region for 15 years after the earthquake. The model quantifies this information in terms of income and employment changes within the region. Table 15 presents the results of the region for the given earthquake.

Table 13: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	778.13	\$0.00	0.00
	Bridges	17.38	\$0.86	4.97
	Tunnels	1.28	\$0.02	1.31
	Subtotal	796.80	0.90	
Railways	Segments	64.21	\$0.00	0.00
	Bridges	0.00	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	64.20	0.00	
Light Rail	Segments	0.00	\$0.00	0.00
	Bridges	0.00	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Bus	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Ferry	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Port	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Airport	Facilities	21.15	\$7.57	35.82
	Runways	120.59	\$0.00	0.00
	Subtotal	141.70	7.60	
	Total	1002.70	8.50	

Table 14: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Line	40.80	\$3.01	7.37
	Subtotal	40.80	\$3.01	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	258.40	\$52.81	20.44
	Distribution Line	24.50	\$2.38	9.72
	Subtotal	282.89	\$55.19	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Line	16.30	\$2.54	15.58
	Subtotal	16.32	\$2.54	
Oil Systems	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Electrical Power	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Communication	Facilities	0.40	\$0.09	23.79
	Subtotal	0.39	\$0.09	
	Total	340.40	\$60.83	

Table 15. Indirect Economic Impact with outside aid

(Employment as # of people and Income in millions of \$)

LOSS	Total	%

Appendix A: County Listing for the Region

Chaffee,CO

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Colorado	Chaffee	16,242	831	179	1,011
Total State		16,242	831	179	1,011
Total Region		16,242	831	179	1,011

HAZUS-MH: Earthquake Event Report



Region Name: *Chaffee County*

Earthquake Scenario: *N Sangre M7.5 WUS-Extensional*

Print Date: *June 30, 2005*

Disclaimer:

The estimates of social and economic impacts contained in this report were produced using HAZUS loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific earthquake. These results can be improved by using enhanced inventory, geotechnical, and observed ground motion data.

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General Description of the Region

HAZUS is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of HAZUS is to provide a methodology and software application to develop earthquake losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from earthquakes and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes 1 county(ies) from the following state(s):

Colorado

Note:

Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 1,013.91 square miles and contains 4 census tracts. There are over 6 thousand households in the region and has a total population of 16,242 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 7 thousand buildings in the region with a total building replacement value (excluding contents) of 1,011 (millions of dollars). Approximately 99.00 % of the buildings (and 82.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 1,002 and 258 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

HAZUS estimates that there are 7 thousand buildings in the region which have an aggregate total replacement value of 1,011 (millions of dollars). Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 60% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

HAZUS breaks critical facilities into two (2) groups: essential facilities and high potential loss (HPL) facilities. Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 1 hospitals in the region with a total bed capacity of 33 beds. There are 3 schools, 2 fire stations, 2 police stations and 1 emergency operation facilities. With respect to HPL facilities, there are 10 dams identified within the region. Of these, 1 of the dams are classified as 'high hazard'. The inventory also includes 1 hazardous material sites, 0 military installations and 0 nuclear power plants.

Transportation and Utility Lifeline Inventory

Within HAZUS, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 2 and 3.

The total value of the lifeline inventory is over 1,260.00 (millions of dollars). This inventory includes over 155 kilometers of highways, 59 bridges, 4,080 kilometers of pipes.

Table 2: Transportation System Lifeline Inventory

System	Component	# locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	59	17.40
	Segments	16	778.10
	Tunnels	4	1.30
	Subtotal		796.80
Railways	Bridges	0	0.00
	Facilities	0	0.00
	Segments	37	64.20
	Tunnels	0	0.00
	Subtotal		64.20
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
	Subtotal		0.00
Bus	Facilities	0	0.00
	Subtotal		0.00
Ferry	Facilities	0	0.00
	Subtotal		0.00
Port	Facilities	0	0.00
	Subtotal		0.00
Airport	Facilities	4	21.10
	Runways	4	120.60
	Subtotal		141.70
		Total	1,002.70

Table 3: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	40.80
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		40.80
Waste Water	Distribution Lines	NA	24.50
	Facilities	4	258.40
	Pipelines	0	0.00
	Subtotal		282.90
Natural Gas	Distribution Lines	NA	16.30
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		16.30
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		0.00
Electrical Power	Facilities	0	0.00
	Subtotal		0.00
Communication	Facilities	4	0.40
	Subtotal		0.40
	Total		340.40

Earthquake Scenario

HAZUS uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.

Scenario Name	N Sangre M7.5 WUS-Extensional
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-105.63
Latitude of Epicenter	37.90
Earthquake Magnitude	7.50
Depth (Km)	10.00
Rupture Length (Km)	100.00
Rupture Orientation (degrees)	161.00
Attenuation Function	WUS Shallow Crustal Event - Extensional

Building Damage

Building Damage

HAZUS estimates that about 1,478 buildings will be at least moderately damaged. This is over 21.00 % of the total number of buildings in the region. There are an estimated 235 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the HAZUS technical manual. Table 4 below summaries the expected damage by general occupancy for the buildings in the region. Table 5 summaries the expected damage by general building type.

Table 4: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	1	0.02	0	0.01	0	0.01	0	0.00	0	0.00
Commercial	22	0.48	8	0.75	15	1.95	15	3.16	10	4.44
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	5	0.12	1	0.11	1	0.16	1	0.18	1	0.24
Industrial	2	0.04	1	0.07	1	0.16	1	0.18	0	0.15
Other Residential	545	12.16	238	22.27	330	42.69	242	51.59	137	58.40
Religion	2	0.04	0	0.03	0	0.05	0	0.07	0	0.09
Single Family	3,903	87.15	819	76.76	425	54.97	211	44.82	86	36.67
Total	4,479		1,067		773		470		235	

Table 5: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	3,236	72.24	698	65.45	220	28.49	26	5.57	2	0.75
Steel	6	0.13	3	0.25	6	0.72	6	1.32	5	2.33
Concrete	7	0.16	2	0.22	4	0.53	4	0.89	3	1.24
Precast	3	0.06	1	0.08	2	0.23	2	0.45	2	0.75
RM	625	13.96	104	9.71	186	24.01	175	37.24	79	33.75
URM	82	1.83	31	2.94	32	4.09	17	3.71	9	3.87
MH	520	11.61	228	21.34	324	41.92	239	50.82	135	57.32
Total	4,479		1,067		773		470		235	

*Note:

RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 33 hospital beds available for use. On the day of the earthquake, the model estimates that only 1 hospital beds (5.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 20.00% of the beds will be back in service. By 30 days, 65.00% will be operational.

Table 6: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	1	1	0	0
Schools	3	0	0	3
EOCs	1	0	0	1
PoliceStations	2	0	0	2
FireStations	2	0	0	2

Transportation and Utility Lifeline Damage

Table 7 provides damage estimates for the transportation system.

Table 7: Expected Damage to the Transportation Systems

System	Component	Number of Locations_				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	16	0	0	16	16
	Bridges	59	0	0	59	59
	Tunnels	4	0	0	4	4
Railways	Segments	37	0	0	37	37
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	0	0	0	0	0
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	4	0	0	4	4
	Runways	4	0	0	4	4

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 8-10 provide information on the damage to the utility lifeline systems. Table 8 provides damage to the utility system facilities. Table 9 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, HAZUS performs a simplified system performance analysis. Table 10 provides a summary of the system performance information.

Table 8 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	4	0	0	3	4
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	4	0	0	4	4

Table 9 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	2,040	234	58
Waste Water	1,224	185	46
Natural Gas	816	198	49
Oil	0	0	0

Table 10: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	6,584	110	0	0	0	0
Electric Power		0	0	0	0	0

Induced Earthquake Damage

Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. HAZUS uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 1 ignitions that will burn about 0.02 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 1 people and burn about 0 (millions of dollars) of building value.

Debris Generation

HAZUS estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 0.00 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 0.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 0 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Social Impact

Shelter Requirement

HAZUS estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 189 households to be displaced due to the earthquake. Of these, 50 people (out of a total population of 16,242) will seek temporary shelter in public shelters.

Casualties

HAZUS estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

- Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
- Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
- Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
- Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 11 provides a summary of the casualties estimated for this earthquake

Table 11: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	1	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	4	1	0	0
	Industrial	1	0	0	0
	Other-Residential	27	6	1	1
	Single Family	28	8	1	3
	Total	60	16	2	4
2 PM	Commercial	63	19	3	6
	Commuting	0	0	0	0
	Educational	11	3	1	1
	Hotels	1	0	0	0
	Industrial	6	2	0	1
	Other-Residential	6	1	0	0
	Single Family	7	2	0	1
	Total	95	28	5	9
5 PM	Commercial	44	13	2	4
	Commuting	0	0	0	0
	Educational	1	0	0	0
	Hotels	1	0	0	0
	Industrial	4	1	0	0
	Other-Residential	10	2	0	0
	Single Family	11	3	0	1
	Total	70	20	3	6

Economic Loss

The total economic loss estimated for the earthquake is 133.36 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 115.41 (millions of dollars); 20 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 50 % of the total loss. Table 12 below provides a summary of the losses associated with the building damage.

Table 12: Building-Related Economic Loss Estimates
(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	1.51	6.67	0.18	0.31	8.68
	Capital-Related	0.00	0.65	6.61	0.11	0.06	7.42
	Rental	1.53	2.31	3.08	0.05	0.15	7.11
	Relocation	0.16	0.05	0.15	0.00	0.04	0.40
	Subtotal	1.69	4.51	16.50	0.34	0.55	23.60
Capital Stock Losses							
	Structural	7.29	3.72	6.95	0.70	0.81	19.48
	Non_Structural	20.28	12.90	17.65	2.03	2.26	55.13
	Content	4.89	2.39	7.13	1.16	0.96	16.54
	Inventory	0.00	0.00	0.32	0.33	0.01	0.66
	Subtotal	32.47	19.02	32.05	4.23	4.04	91.81
	Total	34.16	23.53	48.56	4.57	4.60	115.41

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, HAZUS computes the direct repair cost for each component only. There are no losses computed by HAZUS for business interruption due to lifeline outages. Tables 13 & 14 provide a detailed breakdown in the expected lifeline losses.

HAZUS estimates the long-term economic impacts to the region for 15 years after the earthquake. The model quantifies this information in terms of income and employment changes within the region. Table 15 presents the results of the region for the given earthquake.

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(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	778.13	\$0.00	0.00
	Bridges	17.38	\$0.21	1.22
	Tunnels	1.28	\$0.00	0.03
	Subtotal	796.80	0.20	
Railways	Segments	64.21	\$0.00	0.00
	Bridges	0.00	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	64.20	0.00	
Light Rail	Segments	0.00	\$0.00	0.00
	Bridges	0.00	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Bus	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Ferry	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Port	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Airport	Facilities	21.15	\$2.82	13.34
	Runways	120.59	\$0.00	0.00
	Subtotal	141.70	2.80	
	Total	1002.70	3.00	

Table 14: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Line	40.80	\$1.05	2.58
	Subtotal	40.80	\$1.05	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	258.40	\$12.12	4.69
	Distribution Line	24.50	\$0.83	3.40
	Subtotal	282.89	\$12.95	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Line	16.30	\$0.89	5.45
	Subtotal	16.32	\$0.89	
Oil Systems	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Electrical Power	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Communication	Facilities	0.40	\$0.02	5.90
	Subtotal	0.39	\$0.02	
	Total	340.40	\$14.91	

Table 15. Indirect Economic Impact with outside aid

(Employment as # of people and Income in millions of \$)

LOSS	Total	%

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Chaffee,CO

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State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Colorado	Chaffee	16,242	831	179	1,011
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Total Region		16,242	831	179	1,011

HAZUS-MH: Earthquake Event Report



Region Name: *Chaffee County*

Earthquake Scenario: *N Sawatch M7.0 CEUS Event*

Print Date: *January 24, 2006*

Disclaimer:

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Building and Lifeline Inventory

Building Inventory

HAZUS estimates that there are 7 thousand buildings in the region which have an aggregate total replacement value of 1,011 (millions of dollars). Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 60% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

HAZUS breaks critical facilities into two (2) groups: essential facilities and high potential loss (HPL) facilities. Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 1 hospitals in the region with a total bed capacity of 33 beds. There are 3 schools, 2 fire stations, 2 police stations and 1 emergency operation facilities. With respect to HPL facilities, there are 10 dams identified within the region. Of these, 1 of the dams are classified as 'high hazard'. The inventory also includes 1 hazardous material sites, 0 military installations and 0 nuclear power plants.

Transportation and Utility Lifeline Inventory

Within HAZUS, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 2 and 3.

The total value of the lifeline inventory is over 1,260.00 (millions of dollars). This inventory includes over 155 kilometers of highways, 59 bridges, 4,080 kilometers of pipes.

Table 2: Transportation System Lifeline Inventory

System	Component	# locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	59	17.40
	Segments	16	778.10
	Tunnels	4	1.30
	Subtotal		796.80
Railways	Bridges	0	0.00
	Facilities	0	0.00
	Segments	37	64.20
	Tunnels	0	0.00
	Subtotal		64.20
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
	Subtotal		0.00
Bus	Facilities	0	0.00
	Subtotal		0.00
Ferry	Facilities	0	0.00
	Subtotal		0.00
Port	Facilities	0	0.00
	Subtotal		0.00
Airport	Facilities	4	21.10
	Runways	4	120.60
	Subtotal		141.70
		Total	1,002.70

Table 3: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	40.80
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		40.80
Waste Water	Distribution Lines	NA	24.50
	Facilities	4	258.40
	Pipelines	0	0.00
	Subtotal		282.90
Natural Gas	Distribution Lines	NA	16.30
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		16.30
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		0.00
Electrical Power	Facilities	0	0.00
	Subtotal		0.00
Communication	Facilities	4	0.40
	Subtotal		0.40
	Total		340.40

Earthquake Scenario

HAZUS uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.

Scenario Name	N Sawatch M7.0 CEUS Event
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-106.39
Latitude of Epicenter	39.15
Earthquake Magnitude	7.00
Depth (Km)	10.00
Rupture Length (Km)	42.66
Rupture Orientation (degrees)	147.00
Attenuation Function	CEUS Event

Building Damage

Building Damage

HAZUS estimates that about 1,971 buildings will be at least moderately damaged. This is over 28.00 % of the total number of buildings in the region. There are an estimated 80 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the HAZUS technical manual. Table 4 below summaries the expected damage by general occupancy for the buildings in the region. Table 5 summaries the expected damage by general building type.

Table 4: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	0	0.01	0	0.02	0	0.02	0	0.03	0	0.05
Commercial	32	0.93	13	0.83	16	1.16	7	1.39	1	1.81
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	3	0.08	2	0.11	3	0.19	1	0.29	0	0.42
Industrial	2	0.06	1	0.06	1	0.09	0	0.09	0	0.10
Other Residential	414	12.01	330	20.50	491	35.66	220	42.65	38	47.16
Religion	1	0.04	1	0.04	1	0.05	0	0.07	0	0.10
Single Family	2,992	86.86	1,262	78.45	864	62.82	286	55.48	41	50.37
Total	3,444		1,608		1,376		515		81	

Table 5: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	2,407	69.90	1076	66.92	574	41.71	113	21.86	12	14.92
Steel	11	0.32	5	0.29	7	0.49	3	0.53	1	0.89
Concrete	9	0.25	4	0.27	5	0.39	2	0.45	0	0.44
Precast	4	0.11	1	0.09	2	0.17	2	0.30	0	0.33
RM	569	16.52	166	10.30	262	19.06	155	30.03	17	21.27
URM	60	1.74	36	2.22	40	2.93	23	4.55	12	15.38
MH	384	11.16	320	19.92	485	35.25	218	42.28	38	46.78
Total	3,444		1,608		1,376		515		81	

*Note:

RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 33 hospital beds available for use. On the day of the earthquake, the model estimates that only 14 hospital beds (44.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 78.00% of the beds will be back in service. By 30 days, 98.00% will be operational.

Table 6: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	1	0	0	0
Schools	3	1	0	2
EOCs	1	0	0	1
PoliceStations	2	0	0	1
FireStations	2	0	0	1

Transportation and Utility Lifeline Damage

Table 7 provides damage estimates for the transportation system.

Table 7: Expected Damage to the Transportation Systems

System	Component	Number of Locations_				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	16	0	0	16	16
	Bridges	59	1	0	58	59
	Tunnels	4	0	0	4	4
Railways	Segments	37	0	0	37	37
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	0	0	0	0	0
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	4	1	0	4	4
	Runways	4	0	0	4	4

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 8-10 provide information on the damage to the utility lifeline systems. Table 8 provides damage to the utility system facilities. Table 9 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, HAZUS performs a simplified system performance analysis. Table 10 provides a summary of the system performance information.

Table 8 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	4	3	0	0	4
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	4	2	0	4	4

Table 9 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	2,040	80	20
Waste Water	1,224	63	16
Natural Gas	816	68	17
Oil	0	0	0

Table 10: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	6,584	0	0	0	0	0
Electric Power		2,314	1,593	761	169	3

Induced Earthquake Damage

Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. HAZUS uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 1 ignitions that will burn about 0.00 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 0 people and burn about 0 (millions of dollars) of building value.

Debris Generation

HAZUS estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 0.00 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 0.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 0 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Social Impact

Shelter Requirement

HAZUS estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 72 households to be displaced due to the earthquake. Of these, 17 people (out of a total population of 16,242) will seek temporary shelter in public shelters.

Casualties

HAZUS estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

- Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
- Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
- Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
- Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 11 provides a summary of the casualties estimated for this earthquake

Table 11: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	0	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	2	0	0	0
	Industrial	0	0	0	0
	Other-Residential	11	2	0	0
	Single Family	21	4	0	1
	Total	34	6	1	1
2 PM	Commercial	16	4	1	1
	Commuting	0	0	0	0
	Educational	4	1	0	0
	Hotels	0	0	0	0
	Industrial	2	1	0	0
	Other-Residential	3	1	0	0
	Single Family	6	1	0	0
	Total	32	7	1	2
5 PM	Commercial	13	3	0	1
	Commuting	0	0	0	0
	Educational	1	0	0	0
	Hotels	0	0	0	0
	Industrial	1	0	0	0
	Other-Residential	4	1	0	0
	Single Family	8	2	0	0
	Total	28	6	1	1

Economic Loss

The total economic loss estimated for the earthquake is 152.75 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 99.31 (millions of dollars); 12 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 72 % of the total loss. Table 12 below provides a summary of the losses associated with the building damage.

Table 12: Building-Related Economic Loss Estimates
(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	0.83	2.65	0.10	0.28	3.85
	Capital-Related	0.00	0.35	2.61	0.06	0.05	3.08
	Rental	1.92	1.36	1.38	0.02	0.17	4.85
	Relocation	0.20	0.03	0.07	0.00	0.03	0.34
	Subtotal	2.12	2.58	6.71	0.17	0.55	12.12
Capital Stock Losses							
	Structural	8.65	2.31	2.60	0.37	0.79	14.71
	Non_Structural	32.64	8.95	6.53	1.25	2.26	51.63
	Content	12.22	2.31	3.69	0.79	1.41	20.41
	Inventory	0.00	0.00	0.17	0.22	0.03	0.42
	Subtotal	53.51	13.57	12.99	2.62	4.49	87.18
	Total	55.63	16.14	19.70	2.79	5.04	99.31

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, HAZUS computes the direct repair cost for each component only. There are no losses computed by HAZUS for business interruption due to lifeline outages. Tables 13 & 14 provide a detailed breakdown in the expected lifeline losses.

HAZUS estimates the long-term economic impacts to the region for 15 years after the earthquake. The model quantifies this information in terms of income and employment changes within the region. Table 15 presents the results of the region for the given earthquake.

Table 13: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	778.13	\$0.00	0.00
	Bridges	17.38	\$0.28	1.58
	Tunnels	1.28	\$0.12	9.34
	Subtotal	796.80	0.40	
Railways	Segments	64.21	\$0.00	0.00
	Bridges	0.00	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	64.20	0.00	
Light Rail	Segments	0.00	\$0.00	0.00
	Bridges	0.00	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Bus	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Ferry	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Port	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Airport	Facilities	21.15	\$4.11	19.43
	Runways	120.59	\$0.00	0.00
	Subtotal	141.70	4.10	
	Total	1002.70	4.50	

Table 14: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Line	40.80	\$0.36	0.88
	Subtotal	40.80	\$0.36	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	258.40	\$47.93	18.55
	Distribution Line	24.50	\$0.28	1.16
	Subtotal	282.89	\$48.22	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Line	16.30	\$0.30	1.86
	Subtotal	16.32	\$0.30	
Oil Systems	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Electrical Power	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Communication	Facilities	0.40	\$0.06	15.70
	Subtotal	0.39	\$0.06	
	Total	340.40	\$48.94	

Table 15. Indirect Economic Impact with outside aid
(Employment as # of people and Income in millions of \$)

	LOSS	Total	%
First Year			
	Employment Impact	0	0.00
	Income Impact	(1)	-0.50
Second Year			
	Employment Impact	0	0.00
	Income Impact	(2)	-1.52
Third Year			
	Employment Impact	0	0.00
	Income Impact	(3)	-1.95
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	(3)	-1.95
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	(3)	-1.95
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	(3)	-1.95

Appendix A: County Listing for the Region

Chaffee,CO

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Colorado	Chaffee	16,242	831	179	1,011
Total State		16,242	831	179	1,011
Total Region		16,242	831	179	1,011

HAZUS-MH: Earthquake Event Report



Region Name: *Chaffee County*

Earthquake Scenario: *S Sawatch M7.25 CEUS Event*

Print Date: *January 24, 2006*

Disclaimer:

The estimates of social and economic impacts contained in this report were produced using HAZUS loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific earthquake. These results can be improved by using enhanced inventory, geotechnical, and observed ground motion data.

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General Description of the Region

HAZUS is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of HAZUS is to provide a methodology and software application to develop earthquake losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from earthquakes and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes 1 county(ies) from the following state(s):

Colorado

Note:

Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 1,013.91 square miles and contains 4 census tracts. There are over 6 thousand households in the region and has a total population of 16,242 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 7 thousand buildings in the region with a total building replacement value (excluding contents) of 1,011 (millions of dollars). Approximately 99.00 % of the buildings (and 82.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 1,002 and 258 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

HAZUS estimates that there are 7 thousand buildings in the region which have an aggregate total replacement value of 1,011 (millions of dollars). Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 60% of the building inventory. The remaining percentage is distributed between the other general building types.

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HAZUS breaks critical facilities into two (2) groups: essential facilities and high potential loss (HPL) facilities. Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 1 hospitals in the region with a total bed capacity of 33 beds. There are 3 schools, 2 fire stations, 2 police stations and 1 emergency operation facilities. With respect to HPL facilities, there are 10 dams identified within the region. Of these, 1 of the dams are classified as 'high hazard'. The inventory also includes 1 hazardous material sites, 0 military installations and 0 nuclear power plants.

Transportation and Utility Lifeline Inventory

Within HAZUS, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 2 and 3.

The total value of the lifeline inventory is over 1,260.00 (millions of dollars). This inventory includes over 155 kilometers of highways, 59 bridges, 4,080 kilometers of pipes.

Table 2: Transportation System Lifeline Inventory

System	Component	# locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	59	17.40
	Segments	16	778.10
	Tunnels	4	1.30
	Subtotal		796.80
Railways	Bridges	0	0.00
	Facilities	0	0.00
	Segments	37	64.20
	Tunnels	0	0.00
	Subtotal		64.20
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
	Subtotal		0.00
Bus	Facilities	0	0.00
	Subtotal		0.00
Ferry	Facilities	0	0.00
	Subtotal		0.00
Port	Facilities	0	0.00
	Subtotal		0.00
Airport	Facilities	4	21.10
	Runways	4	120.60
	Subtotal		141.70
		Total	1,002.70

Table 3: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	40.80
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		40.80
Waste Water	Distribution Lines	NA	24.50
	Facilities	4	258.40
	Pipelines	0	0.00
	Subtotal		282.90
Natural Gas	Distribution Lines	NA	16.30
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		16.30
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		0.00
Electrical Power	Facilities	0	0.00
	Subtotal		0.00
Communication	Facilities	4	0.40
	Subtotal		0.40
	Total		340.40

Earthquake Scenario

HAZUS uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.

Scenario Name	S Sawatch M7.25 CEUS Event
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-106.18
Latitude of Epicenter	38.75
Earthquake Magnitude	7.25
Depth (Km)	10.00
Rupture Length (Km)	65.31
Rupture Orientation (degrees)	148.00
Attenuation Function	CEUS Event

Building Damage

Building Damage

HAZUS estimates that about 5,321 buildings will be at least moderately damaged. This is over 76.00 % of the total number of buildings in the region. There are an estimated 1,083 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the HAZUS technical manual. Table 4 below summaries the expected damage by general occupancy for the buildings in the region. Table 5 summaries the expected damage by general building type.

Table 4: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	0	0.01	0	0.01	0	0.01	0	0.02	0	0.02
Commercial	2	0.53	4	0.32	15	0.64	23	1.28	25	2.29
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	0	0.08	1	0.05	2	0.09	3	0.17	3	0.26
Industrial	0	0.04	0	0.03	1	0.05	2	0.09	2	0.15
Other Residential	29	6.67	107	8.47	352	14.62	550	30.01	454	41.92
Religion	0	0.04	0	0.03	1	0.03	1	0.05	1	0.07
Single Family	406	92.63	1,152	91.10	2,035	84.55	1,252	68.38	599	55.29
Total	438		1,265		2,407		1,831		1,083	

Table 5: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	326	74.45	1077	85.18	1,749	72.66	805	43.97	225	20.74
Steel	1	0.12	1	0.07	4	0.18	9	0.51	11	1.02
Concrete	1	0.15	1	0.10	5	0.20	7	0.39	7	0.65
Precast	0	0.05	0	0.03	2	0.07	3	0.17	4	0.38
RM	79	18.09	73	5.81	278	11.54	422	23.06	316	29.19
URM	4	1.01	12	0.98	34	1.43	46	2.53	74	6.84
MH	27	6.13	99	7.84	335	13.93	538	29.37	446	41.18
Total	438		1,265		2,407		1,831		1,083	

*Note:

RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 33 hospital beds available for use. On the day of the earthquake, the model estimates that only 0 hospital beds (1.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 7.00% of the beds will be back in service. By 30 days, 39.00% will be operational.

Table 6: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	1	1	0	0
Schools	3	3	0	0
EOCs	1	1	0	0
PoliceStations	2	2	0	0
FireStations	2	2	0	0

Transportation and Utility Lifeline Damage

Table 7 provides damage estimates for the transportation system.

Table 7: Expected Damage to the Transportation Systems

System	Component	Number of Locations_				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	16	0	0	16	16
	Bridges	59	3	1	58	58
	Tunnels	4	4	0	4	4
Railways	Segments	37	0	0	37	37
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	0	0	0	0	0
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	4	4	0	0	1
	Runways	4	0	0	4	4

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 8-10 provide information on the damage to the utility lifeline systems. Table 8 provides damage to the utility system facilities. Table 9 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, HAZUS performs a simplified system performance analysis. Table 10 provides a summary of the system performance information.

Table 8 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	4	4	0	0	0
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	4	4	0	0	2

Table 9 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	2,040	618	155
Waste Water	1,224	489	122
Natural Gas	816	523	131
Oil	0	0	0

Table 10: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	6,584	1,953	882	0	0	0
Electric Power		6,057	5,089	3,369	1,093	7

Induced Earthquake Damage

Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. HAZUS uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 4 ignitions that will burn about 0.04 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 38 people and burn about 2 (millions of dollars) of building value.

Debris Generation

HAZUS estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 0.00 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 0.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 0 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Social Impact

Shelter Requirement

HAZUS estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 919 households to be displaced due to the earthquake. Of these, 233 people (out of a total population of 16,242) will seek temporary shelter in public shelters.

Casualties

HAZUS estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

- Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
- Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
- Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
- Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 11 provides a summary of the casualties estimated for this earthquake

Table 11: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	2	1	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	13	4	1	1
	Industrial	2	1	0	0
	Other-Residential	76	18	2	3
	Single Family	153	41	6	12
	Total	246	65	8	16
2 PM	Commercial	157	49	8	17
	Commuting	0	0	0	0
	Educational	33	10	2	3
	Hotels	2	1	0	0
	Industrial	18	5	1	2
	Other-Residential	19	5	0	1
	Single Family	41	11	2	3
	Total	271	82	13	26
5 PM	Commercial	117	37	6	12
	Commuting	1	2	2	1
	Educational	3	1	0	0
	Hotels	4	1	0	0
	Industrial	11	3	1	1
	Other-Residential	28	7	1	1
	Single Family	60	16	2	4
	Total	224	67	13	20

Economic Loss

The total economic loss estimated for the earthquake is 665.16 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 482.15 (millions of dollars); 12 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 70 % of the total loss. Table 12 below provides a summary of the losses associated with the building damage.

Table 12: Building-Related Economic Loss Estimates
(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	4.31	12.64	0.44	0.94	18.33
	Capital-Related	0.00	1.84	12.49	0.25	0.19	14.77
	Rental	8.99	6.82	5.81	0.10	0.56	22.27
	Relocation	0.94	0.13	0.28	0.01	0.12	1.48
	Subtotal	9.93	13.10	31.22	0.79	1.82	56.85
Capital Stock Losses							
	Structural	42.31	10.57	13.99	1.74	2.89	71.52
	Non_Structural	157.30	46.45	43.28	7.16	9.55	263.74
	Content	45.64	11.04	21.49	4.46	5.07	87.69
	Inventory	0.00	0.00	0.97	1.27	0.10	2.35
	Subtotal	245.25	68.06	79.73	14.64	17.61	425.30
	Total	255.18	81.16	110.95	15.43	19.43	482.15

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, HAZUS computes the direct repair cost for each component only. There are no losses computed by HAZUS for business interruption due to lifeline outages. Tables 13 & 14 provide a detailed breakdown in the expected lifeline losses.

HAZUS estimates the long-term economic impacts to the region for 15 years after the earthquake. The model quantifies this information in terms of income and employment changes within the region. Table 15 presents the results of the region for the given earthquake.

Table 13: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	778.13	\$0.00	0.00
	Bridges	17.38	\$2.21	12.74
	Tunnels	1.28	\$0.23	18.29
	Subtotal	796.80	2.40	
Railways	Segments	64.21	\$0.00	0.00
	Bridges	0.00	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	64.20	0.00	
Light Rail	Segments	0.00	\$0.00	0.00
	Bridges	0.00	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Bus	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Ferry	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Port	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Airport	Facilities	21.15	\$14.97	70.81
	Runways	120.59	\$0.00	0.00
	Subtotal	141.70	15.00	
	Total	1002.70	17.40	

Table 14: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Line	40.80	\$2.78	6.82
	Subtotal	40.80	\$2.78	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	258.40	\$157.99	61.14
	Distribution Line	24.50	\$2.20	8.99
	Subtotal	282.89	\$160.20	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Line	16.30	\$2.35	14.41
	Subtotal	16.32	\$2.35	
Oil Systems	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Electrical Power	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Communication	Facilities	0.40	\$0.26	65.93
	Subtotal	0.39	\$0.26	
	Total	340.40	\$165.58	

Table 15. Indirect Economic Impact with outside aid
(Employment as # of people and Income in millions of \$)

	LOSS	Total	%
First Year			
	Employment Impact	0	0.00
	Income Impact	(4)	-2.52
Second Year			
	Employment Impact	0	0.00
	Income Impact	(12)	-7.66
Third Year			
	Employment Impact	0	0.00
	Income Impact	(16)	-9.87
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	(16)	-9.87
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	(16)	-9.87
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	(16)	-9.87

Appendix A: County Listing for the Region

Chaffee,CO

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Colorado	Chaffee	16,242	831	179	1,011
Total State		16,242	831	179	1,011
Total Region		16,242	831	179	1,011

HAZUS-MH: Earthquake Event Report



Region Name: *Chaffee County*

Earthquake Scenario: *S Sawatch M7.25 WUS*

Print Date: *January 24, 2006*

Disclaimer:

The estimates of social and economic impacts contained in this report were produced using HAZUS loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific earthquake. These results can be improved by using enhanced inventory, geotechnical, and observed ground motion data.

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General Description of the Region

HAZUS is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of HAZUS is to provide a methodology and software application to develop earthquake losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from earthquakes and to prepare for emergency response and recovery.

The earthquake loss estimates provided in this report was based on a region that includes 1 county(ies) from the following state(s):

Colorado

Note:

Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 1,013.91 square miles and contains 4 census tracts. There are over 6 thousand households in the region and has a total population of 16,242 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 7 thousand buildings in the region with a total building replacement value (excluding contents) of 1,011 (millions of dollars). Approximately 99.00 % of the buildings (and 82.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 1,002 and 258 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

HAZUS estimates that there are 7 thousand buildings in the region which have an aggregate total replacement value of 1,011 (millions of dollars). Appendix B provides a general distribution of the building value by State and County.

In terms of building construction types found in the region, wood frame construction makes up 60% of the building inventory. The remaining percentage is distributed between the other general building types.

Critical Facility Inventory

HAZUS breaks critical facilities into two (2) groups: essential facilities and high potential loss (HPL) facilities. Essential facilities include hospitals, medical clinics, schools, fire stations, police stations and emergency operations facilities. High potential loss facilities include dams, levees, military installations, nuclear power plants and hazardous material sites.

For essential facilities, there are 1 hospitals in the region with a total bed capacity of 33 beds. There are 3 schools, 2 fire stations, 2 police stations and 1 emergency operation facilities. With respect to HPL facilities, there are 10 dams identified within the region. Of these, 1 of the dams are classified as 'high hazard'. The inventory also includes 1 hazardous material sites, 0 military installations and 0 nuclear power plants.

Transportation and Utility Lifeline Inventory

Within HAZUS, the lifeline inventory is divided between transportation and utility lifeline systems. There are seven (7) transportation systems that include highways, railways, light rail, bus, ports, ferry and airports. There are six (6) utility systems that include potable water, wastewater, natural gas, crude & refined oil, electric power and communications. The lifeline inventory data are provided in Tables 2 and 3.

The total value of the lifeline inventory is over 1,260.00 (millions of dollars). This inventory includes over 155 kilometers of highways, 59 bridges, 4,080 kilometers of pipes.

Table 2: Transportation System Lifeline Inventory

System	Component	# locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	59	17.40
	Segments	16	778.10
	Tunnels	4	1.30
	Subtotal		796.80
Railways	Bridges	0	0.00
	Facilities	0	0.00
	Segments	37	64.20
	Tunnels	0	0.00
	Subtotal		64.20
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
	Subtotal		0.00
Bus	Facilities	0	0.00
	Subtotal		0.00
Ferry	Facilities	0	0.00
	Subtotal		0.00
Port	Facilities	0	0.00
	Subtotal		0.00
Airport	Facilities	4	21.10
	Runways	4	120.60
	Subtotal		141.70
		Total	1,002.70

Table 3: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	40.80
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		40.80
Waste Water	Distribution Lines	NA	24.50
	Facilities	4	258.40
	Pipelines	0	0.00
	Subtotal		282.90
Natural Gas	Distribution Lines	NA	16.30
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		16.30
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		0.00
Electrical Power	Facilities	0	0.00
	Subtotal		0.00
Communication	Facilities	4	0.40
	Subtotal		0.40
	Total		340.40

Earthquake Scenario

HAZUS uses the following set of information to define the earthquake parameters used for the earthquake loss estimate provided in this report.

Scenario Name	S Sawatch M7.25 WUS
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-106.18
Latitude of Epicenter	38.75
Earthquake Magnitude	7.25
Depth (Km)	10.00
Rupture Length (Km)	65.31
Rupture Orientation (degrees)	148.00
Attenuation Function	WUS Shallow Crustal Event - Extensional

Building Damage

Building Damage

HAZUS estimates that about 4,476 buildings will be at least moderately damaged. This is over 64.00 % of the total number of buildings in the region. There are an estimated 752 buildings that will be damaged beyond repair. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the HAZUS technical manual. Table 4 below summaries the expected damage by general occupancy for the buildings in the region. Table 5 summaries the expected damage by general building type.

Table 4: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	0	0.02	0	0.01	0	0.01	0	0.02	0	0.01
Commercial	4	0.43	5	0.33	17	0.76	22	1.53	21	2.82
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	1	0.09	1	0.06	3	0.12	3	0.19	2	0.24
Industrial	0	0.03	0	0.03	1	0.06	2	0.11	1	0.16
Other Residential	58	6.53	152	9.21	418	18.50	520	35.47	344	45.64
Religion	0	0.04	0	0.03	1	0.04	1	0.06	1	0.07
Single Family	832	92.87	1,492	90.33	1,818	80.51	918	62.63	384	51.05
Total	895		1,652		2,258		1,466		753	

Table 5: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	704	78.59	1394	84.36	1,498	66.34	493	33.63	94	12.45
Steel	1	0.13	1	0.09	5	0.24	9	0.60	9	1.22
Concrete	1	0.14	2	0.11	5	0.24	7	0.46	6	0.76
Precast	0	0.04	0	0.03	2	0.08	3	0.21	4	0.47
RM	128	14.29	97	5.87	306	13.57	397	27.11	240	31.90
URM	7	0.83	16	1.00	39	1.73	46	3.14	63	8.35
MH	54	5.98	141	8.54	402	17.80	511	34.85	338	44.85
Total	895		1,652		2,258		1,466		753	

*Note:

RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 33 hospital beds available for use. On the day of the earthquake, the model estimates that only 0 hospital beds (1.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 7.00% of the beds will be back in service. By 30 days, 39.00% will be operational.

Table 6: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	1	1	0	0
Schools	3	2	0	0
EOCs	1	1	0	0
PoliceStations	2	1	0	0
FireStations	2	1	0	0

Transportation and Utility Lifeline Damage

Table 7 provides damage estimates for the transportation system.

Table 7: Expected Damage to the Transportation Systems

System	Component	Number of Locations_				
		Locations/ Segments	With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	16	0	0	16	16
	Bridges	59	1	0	58	58
	Tunnels	4	0	0	4	4
Railways	Segments	37	0	0	37	37
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Light Rail	Segments	0	0	0	0	0
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	0	0	0	0	0
Bus	Facilities	0	0	0	0	0
Ferry	Facilities	0	0	0	0	0
Port	Facilities	0	0	0	0	0
Airport	Facilities	4	3	0	2	4
	Runways	4	0	0	4	4

Note: Roadway segments, railroad tracks and light rail tracks are assumed to be damaged by ground failure only. If ground failure maps are not provided, damage estimates to these components will not be computed.

Tables 8-10 provide information on the damage to the utility lifeline systems. Table 8 provides damage to the utility system facilities. Table 9 provides estimates on the number of leaks and breaks by the pipelines of the utility systems. For electric power and potable water, HAZUS performs a simplified system performance analysis. Table 10 provides a summary of the system performance information.

Table 8 : Expected Utility System Facility Damage

System	# of Locations				
	Total #	With at Least Moderate Damage	With Complete Damage	with Functionality > 50 %	
				After Day 1	After Day 7
Potable Water	0	0	0	0	0
Waste Water	4	4	0	0	4
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	0	0	0	0	0
Communication	4	4	0	1	4

Table 9 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	2,040	439	110
Waste Water	1,224	347	87
Natural Gas	816	371	93
Oil	0	0	0

Table 10: Expected Potable Water and Electric Power System Performance

	Total # of Households	Number of Households without Service				
		At Day 1	At Day 3	At Day 7	At Day 30	At Day 90
Potable Water	6,584	993	124	0	0	0
Electric Power		4,521	2,655	1,010	181	7

Induced Earthquake Damage

Fire Following Earthquake

Fires often occur after an earthquake. Because of the number of fires and the lack of water to fight the fires, they can often burn out of control. HAZUS uses a Monte Carlo simulation model to estimate the number of ignitions and the amount of burnt area. For this scenario, the model estimates that there will be 2 ignitions that will burn about 0.03 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 2 people and burn about 0 (millions of dollars) of building value.

Debris Generation

HAZUS estimates the amount of debris that will be generated by the earthquake. The model breaks the debris into two general categories: a) Brick/Wood and b) Reinforced Concrete/Steel. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 0.00 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 0.00% of the total, with the remainder being Reinforced Concrete/Steel. If the debris tonnage is converted to an estimated number of truckloads, it will require 0 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

Social Impact

Shelter Requirement

HAZUS estimates the number of households that are expected to be displaced from their homes due to the earthquake and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 635 households to be displaced due to the earthquake. Of these, 162 people (out of a total population of 16,242) will seek temporary shelter in public shelters.

Casualties

HAZUS estimates the number of people that will be injured and killed by the earthquake. The casualties are broken down into four (4) severity levels that describe the extent of the injuries. The levels are described as follows;

- Severity Level 1: Injuries will require medical attention but hospitalization is not needed.
- Severity Level 2: Injuries will require hospitalization but are not considered life-threatening
- Severity Level 3: Injuries will require hospitalization and can become life threatening if not promptly treated.
- Severity Level 4: Victims are killed by the earthquake.

The casualty estimates are provided for three (3) times of day: 2:00 AM, 2:00 PM and 5:00 PM. These times represent the periods of the day that different sectors of the community are at their peak occupancy loads. The 2:00 AM estimate considers that the residential occupancy load is maximum, the 2:00 PM estimate considers that the educational, commercial and industrial sector loads are maximum and 5:00 PM represents peak commute time.

Table 11 provides a summary of the casualties estimated for this earthquake

Table 11: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	2	1	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	10	3	0	1
	Industrial	2	1	0	0
	Other-Residential	61	15	1	2
	Single Family	111	30	4	9
	Total	186	49	6	13
2 PM	Commercial	135	42	7	14
	Commuting	0	0	0	0
	Educational	26	8	1	3
	Hotels	2	1	0	0
	Industrial	15	4	1	1
	Other-Residential	15	4	0	1
	Single Family	29	8	1	2
	Total	223	67	11	21
5 PM	Commercial	99	31	5	10
	Commuting	1	1	2	0
	Educational	2	1	0	0
	Hotels	3	1	0	0
	Industrial	9	3	0	1
	Other-Residential	22	5	0	1
	Single Family	43	12	2	3
	Total	179	53	10	16

Economic Loss

The total economic loss estimated for the earthquake is 425.99 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 338.87 (millions of dollars); 14 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 66 % of the total loss. Table 12 below provides a summary of the losses associated with the building damage.

Table 12: Building-Related Economic Loss Estimates
(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	3.51	11.42	0.37	0.77	16.07
	Capital-Related	0.00	1.50	11.28	0.22	0.15	13.15
	Rental	6.61	5.53	5.28	0.09	0.44	17.95
	Relocation	0.69	0.11	0.26	0.00	0.10	1.16
	Subtotal	7.30	10.65	28.24	0.68	1.46	48.33
Capital Stock Losses							
	Structural	30.75	8.58	12.48	1.49	2.25	55.54
	Non_Structural	100.93	33.42	35.09	5.20	6.53	181.17
	Content	23.69	6.76	15.61	3.07	3.06	52.20
	Inventory	0.00	0.00	0.71	0.87	0.05	1.63
	Subtotal	155.37	48.76	63.88	10.63	11.89	290.54
	Total	162.67	59.42	92.12	11.31	13.35	338.87

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, HAZUS computes the direct repair cost for each component only. There are no losses computed by HAZUS for business interruption due to lifeline outages. Tables 13 & 14 provide a detailed breakdown in the expected lifeline losses.

HAZUS estimates the long-term economic impacts to the region for 15 years after the earthquake. The model quantifies this information in terms of income and employment changes within the region. Table 15 presents the results of the region for the given earthquake.

Table 13: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	778.13	\$0.00	0.00
	Bridges	17.38	\$1.75	10.10
	Tunnels	1.28	\$0.03	2.44
	Subtotal	796.80	1.80	
Railways	Segments	64.21	\$0.00	0.00
	Bridges	0.00	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	64.20	0.00	
Light Rail	Segments	0.00	\$0.00	0.00
	Bridges	0.00	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Bus	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Ferry	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Port	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Airport	Facilities	21.15	\$8.74	41.34
	Runways	120.59	\$0.00	0.00
	Subtotal	141.70	8.70	
	Total	1002.70	10.50	

Table 14: Utility System Economic Losses

(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Potable Water	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Line	40.80	\$1.98	4.84
	Subtotal	40.80	\$1.98	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	258.40	\$71.26	27.58
	Distribution Line	24.50	\$1.56	6.38
	Subtotal	282.89	\$72.82	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Line	16.30	\$1.67	10.24
	Subtotal	16.32	\$1.67	
Oil Systems	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Electrical Power	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Communication	Facilities	0.40	\$0.13	33.32
	Subtotal	0.39	\$0.13	
	Total	340.40	\$76.60	

Table 15. Indirect Economic Impact with outside aid
(Employment as # of people and Income in millions of \$)

	LOSS	Total	%
First Year			
	Employment Impact	0	0.00
	Income Impact	(3)	-1.78
Second Year			
	Employment Impact	0	0.00
	Income Impact	(9)	-5.41
Third Year			
	Employment Impact	0	0.00
	Income Impact	(11)	-6.97
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	(11)	-6.97
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	(11)	-6.97
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	(11)	-6.97

Appendix A: County Listing for the Region

Chaffee,CO

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Colorado	Chaffee	16,242	831	179	1,011
Total State		16,242	831	179	1,011
Total Region		16,242	831	179	1,011