

HAZUS-MH: Earthquake Event Report



Region Name: *Fremont County*

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

Print Date: *January 26, 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 1,532.46 square miles and contains 13 census tracts. There are over 15 thousand households in the region and has a total population of 46,145 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 14 thousand buildings in the region with a total building replacement value (excluding contents) of 1,948 (millions of dollars). Approximately 99.00 % of the buildings (and 89.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 1,265 and 407 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

HAZUS estimates that there are 14 thousand buildings in the region which have an aggregate total replacement value of 1,948 (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 57% 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 55 beds. There are 19 schools, 3 fire stations, 4 police stations and 0 emergency operation facilities. With respect to HPL facilities, there are 15 dams identified within the region. Of these, 4 of the dams are classified as 'high hazard'. The inventory also includes 3 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 1,672.00 (millions of dollars). This inventory includes over 238 kilometers of highways, 129 bridges, 6,939 kilometers of pipes.

Table 2: Transportation System Lifeline Inventory

System	Component	# locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	129	57.50
	Segments	20	919.40
	Tunnels	2	1.90
	Subtotal		978.70
Railways	Bridges	4	0.40
	Facilities	0	0.00
	Segments	125	114.30
	Tunnels	0	0.00
	Subtotal		114.70
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	5	150.70
	Subtotal		171.90
		Total	1,265.40

Table 3: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	69.40
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		69.40
Waste Water	Distribution Lines	NA	41.60
	Facilities	3	193.80
	Pipelines	0	0.00
	Subtotal		235.40
Natural Gas	Distribution Lines	NA	27.80
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		27.80
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		0.00
Electrical Power	Facilities	2	213.40
	Subtotal		213.40
Communication	Facilities	3	0.30
	Subtotal		0.30
	Total		546.30

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 989 buildings will be at least moderately damaged. This is over 7.00 % 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	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	52	0.45	12	0.69	11	1.31	4	2.56	1	4.67
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	3	0.02	1	0.05	1	0.11	0	0.24	0	0.42
Industrial	4	0.03	1	0.03	0	0.05	0	0.06	0	0.04
Other Residential	2,624	22.70	565	32.88	379	45.67	46	30.82	3	25.94
Religion	2	0.02	0	0.03	0	0.04	0	0.08	0	0.13
Single Family	8,877	76.78	1,140	66.33	438	52.81	98	66.24	8	68.81
Total	11,562		1,719		830		148		12	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	7,020	60.72	914	53.18	214	25.81	19	13.16	1	7.98
Steel	25	0.22	4	0.24	4	0.54	2	1.02	0	2.19
Concrete	29	0.25	5	0.32	4	0.53	1	0.89	0	1.09
Precast	8	0.07	2	0.10	2	0.26	1	0.71	0	0.93
RM	1,797	15.54	198	11.49	195	23.48	67	45.12	3	26.31
URM	209	1.81	58	3.40	43	5.23	15	10.43	4	38.48
MH	2,473	21.39	538	31.29	366	44.15	42	28.67	3	23.01
Total	11,562		1,719		830		148		12	

*Note:

RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 55 hospital beds available for use. On the day of the earthquake, the model estimates that only 21 hospital beds (39.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 73.00% of the beds will be back in service. By 30 days, 97.00% 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	19	0	0	19
EOCs	0	0	0	0
PoliceStations	4	0	0	4
FireStations	3	0	0	3

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	20	0	0	20	20
	Bridges	129	0	0	129	129
	Tunnels	2	0	0	2	2
Railways	Segments	125	0	0	125	125
	Bridges	4	0	0	4	4
	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	5	0	0	5	5

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	3	0	0	0	3
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	2	0	0	1	2
Communication	3	0	0	3	3

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

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	3,470	10	3
Waste Water	2,082	8	2
Natural Gas	1,388	9	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	15,232	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 0.01 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 54 people and burn about 3 (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 40 households to be displaced due to the earthquake. Of these, 11 people (out of a total population of 46,145) 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	6	1	0	0
	Single Family	9	1	0	0
	Total	16	2	0	0
2 PM	Commercial	9	2	0	0
	Commuting	0	0	0	0
	Educational	1	0	0	0
	Hotels	0	0	0	0
	Industrial	1	0	0	0
	Other-Residential	2	0	0	0
	Single Family	2	0	0	0
	Total	14	3	0	1
5 PM	Commercial	7	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	4	1	0	0
	Total	13	2	0	0

Economic Loss

The total economic loss estimated for the earthquake is 79.48 (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 41.53 (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 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	0.22	1.46	0.03	0.06	1.76
	Capital-Related	0.00	0.09	1.25	0.02	0.01	1.37
	Rental	0.79	0.67	0.86	0.00	0.04	2.36
	Relocation	0.08	0.02	0.05	0.00	0.01	0.16
	Subtotal	0.87	1.00	3.61	0.05	0.12	5.65
Capital Stock Losses							
	Structural	3.66	1.18	1.68	0.12	0.18	6.82
	Non_Structural	12.37	4.49	3.51	0.35	0.45	21.17
	Content	4.34	1.11	1.85	0.22	0.23	7.75
	Inventory	0.00	0.00	0.09	0.06	0.00	0.15
	Subtotal	20.37	6.78	7.12	0.75	0.86	35.88
	Total	21.25	7.78	10.73	0.80	0.97	41.53

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	919.39	\$0.00	0.00
	Bridges	57.47	\$0.35	0.61
	Tunnels	1.87	\$0.00	0.05
	Subtotal	978.70	0.40	
Railways	Segments	114.33	\$0.00	0.00
	Bridges	0.42	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	114.70	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	\$1.65	7.82
	Runways	150.74	\$0.00	0.00
	Subtotal	171.90	1.70	
	Total	1265.40	2.00	

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	69.40	\$0.05	0.07
	Subtotal	69.40	\$0.05	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	193.80	\$19.86	10.25
	Distribution Line	41.60	\$0.04	0.09
	Subtotal	235.44	\$19.90	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Line	27.80	\$0.04	0.14
	Subtotal	27.76	\$0.04	
Oil Systems	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Electrical Power	Facilities	213.40	\$15.94	7.47
	Subtotal	213.40	\$15.94	
Communication	Facilities	0.30	\$0.02	5.36
	Subtotal	0.29	\$0.02	
	Total	546.29	\$35.94	

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	0	-0.12
Second Year			
	Employment Impact	0	0.00
	Income Impact	(1)	-0.35
Third Year			
	Employment Impact	0	0.00
	Income Impact	(1)	-0.46
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	(1)	-0.46
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	(1)	-0.46
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	(1)	-0.46

Appendix A: County Listing for the Region

Fremont,CO

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Colorado	Fremont	46,145	1,727	221	1,948
Total State		46,145	1,727	221	1,948
Total Region		46,145	1,727	221	1,948

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Earthquake Scenario: *Goodpasture M6.0 CEUS Event*

Print Date: *January 26, 2006*

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Building Inventory

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Transportation and Utility Lifeline Inventory

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	Segments	20	919.40
	Tunnels	2	1.90
	Subtotal		978.70
Railways	Bridges	4	0.40
	Facilities	0	0.00
	Segments	125	114.30
	Tunnels	0	0.00
	Subtotal		114.70
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	5	150.70
	Subtotal		171.90
		Total	1,265.40

Table 3: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	69.40
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		69.40
Waste Water	Distribution Lines	NA	41.60
	Facilities	3	193.80
	Pipelines	0	0.00
	Subtotal		235.40
Natural Gas	Distribution Lines	NA	27.80
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		27.80
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		0.00
Electrical Power	Facilities	2	213.40
	Subtotal		213.40
Communication	Facilities	3	0.30
	Subtotal		0.30
	Total		546.30

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	Goodpasture M6.0 CEUS Event
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-104.91
Latitude of Epicenter	38.05
Earthquake Magnitude	6.00
Depth (Km)	10.00
Rupture Length (Km)	7.76
Rupture Orientation (degrees)	148.00
Attenuation Function	CEUS Event

Building Damage

Building Damage

HAZUS estimates that about 403 buildings will be at least moderately damaged. This is over 3.00 % of the total number of buildings in the region. There are an estimated 2 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	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	65	0.50	8	0.89	5	1.42	1	2.53	0	3.72
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	4	0.03	1	0.08	0	0.14	0	0.23	0	0.29
Industrial	4	0.03	0	0.04	0	0.07	0	0.11	0	0.10
Other Residential	3,135	24.09	304	35.62	164	46.34	14	28.30	1	22.41
Religion	2	0.02	0	0.04	0	0.05	0	0.09	0	0.11
Single Family	9,802	75.33	541	63.33	183	51.98	33	68.74	2	73.37
Total	13,013		854		353		48		2	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	7,669	58.94	414	48.46	80	22.55	6	12.14	0	10.69
Steel	30	0.23	3	0.31	2	0.57	0	0.85	0	1.25
Concrete	34	0.26	4	0.43	2	0.59	0	0.76	0	0.53
Precast	10	0.08	1	0.14	1	0.34	0	0.89	0	0.70
RM	2,039	15.67	109	12.76	89	25.12	22	46.44	0	13.89
URM	266	2.04	36	4.18	22	6.18	6	12.81	1	53.06
MH	2,964	22.78	288	33.72	158	44.66	12	26.11	0	19.88
Total	13,013		854		353		48		2	

*Note:

RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 55 hospital beds available for use. On the day of the earthquake, the model estimates that only 38 hospital beds (70.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 93.00% 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	19	0	0	19
EOCs	0	0	0	0
PoliceStations	4	0	0	4
FireStations	3	0	0	3

Transportation and Utility Lifeline Damage

Table 7 provides damage estimates for the transportation system.

Table 7: Expected Damage to the Transportation Systems

System	Component	Locations/ Segments	Number of Locations_			
			With at Least Mod. Damage	With Complete Damage	With Functionality > 50 %	
					After Day 1	After Day 7
Highway	Segments	20	0	0	20	20
	Bridges	129	0	0	129	129
	Tunnels	2	0	0	2	2
Railways	Segments	125	0	0	125	125
	Bridges	4	0	0	4	4
	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	5	0	0	5	5

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	3	0	0	0	3
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	2	0	0	2	2
Communication	3	0	0	3	3

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

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	3,470	2	1
Waste Water	2,082	2	0
Natural Gas	1,388	2	0
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	15,232	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 0.01 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 54 people and burn about 3 (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 11 households to be displaced due to the earthquake. Of these, 3 people (out of a total population of 46,145) 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	3	0	0	0
	Single Family	3	0	0	0
	Total	6	1	0	0
2 PM	Commercial	3	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	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	5	1	0	0

Economic Loss

The total economic loss estimated for the earthquake is 56.07 (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 19.18 (millions of dollars); 11 % 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 71 % 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	0.52	0.01	0.02	0.63
	Capital-Related	0.00	0.03	0.46	0.01	0.00	0.50
	Rental	0.30	0.26	0.34	0.00	0.01	0.92
	Relocation	0.03	0.01	0.02	0.00	0.00	0.06
	Subtotal	0.33	0.37	1.34	0.02	0.04	2.11
Capital Stock Losses							
	Structural	1.40	0.49	0.64	0.05	0.06	2.64
	Non_Structural	5.62	2.35	1.62	0.21	0.19	9.99
	Content	2.37	0.71	1.01	0.15	0.12	4.36
	Inventory	0.00	0.00	0.05	0.04	0.00	0.09
	Subtotal	9.40	3.55	3.32	0.44	0.36	17.08
	Total	9.73	3.93	4.66	0.47	0.40	19.18

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	919.39	\$0.00	0.00
	Bridges	57.47	\$0.12	0.21
	Tunnels	1.87	\$0.00	0.01
	Subtotal	978.70	0.10	
Railways	Segments	114.33	\$0.00	0.00
	Bridges	0.42	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	114.70	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	\$1.15	5.43
	Runways	150.74	\$0.00	0.00
	Subtotal	171.90	1.10	
	Total	1265.40	1.30	

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	69.40	\$0.01	0.01
	Subtotal	69.40	\$0.01	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	193.80	\$24.73	12.76
	Distribution Line	41.60	\$0.01	0.02
	Subtotal	235.44	\$24.74	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Line	27.80	\$0.01	0.03
	Subtotal	27.76	\$0.01	
Oil Systems	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Electrical Power	Facilities	213.40	\$10.86	5.09
	Subtotal	213.40	\$10.86	
Communication	Facilities	0.30	\$0.01	3.92
	Subtotal	0.29	\$0.01	
	Total	546.29	\$35.62	

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	-0.16
Third Year			
	Employment Impact	0	0.00
	Income Impact	(1)	-0.21
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	(1)	-0.21
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	(1)	-0.21
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	(1)	-0.21

Appendix A: County Listing for the Region

Fremont,CO

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Colorado	Fremont	46,145	1,727	221	1,948
Total State		46,145	1,727	221	1,948
Total Region		46,145	1,727	221	1,948

HAZUS-MH: Earthquake Event Report



Region Name: *Fremont County*

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

Print Date: *January 26, 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 1,532.46 square miles and contains 13 census tracts. There are over 15 thousand households in the region and has a total population of 46,145 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 14 thousand buildings in the region with a total building replacement value (excluding contents) of 1,948 (millions of dollars). Approximately 99.00 % of the buildings (and 89.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 1,265 and 407 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

HAZUS estimates that there are 14 thousand buildings in the region which have an aggregate total replacement value of 1,948 (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 57% 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 55 beds. There are 19 schools, 3 fire stations, 4 police stations and 0 emergency operation facilities. With respect to HPL facilities, there are 15 dams identified within the region. Of these, 4 of the dams are classified as 'high hazard'. The inventory also includes 3 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 1,672.00 (millions of dollars). This inventory includes over 238 kilometers of highways, 129 bridges, 6,939 kilometers of pipes.

Table 2: Transportation System Lifeline Inventory

System	Component	# locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	129	57.50
	Segments	20	919.40
	Tunnels	2	1.90
	Subtotal		978.70
Railways	Bridges	4	0.40
	Facilities	0	0.00
	Segments	125	114.30
	Tunnels	0	0.00
	Subtotal		114.70
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	5	150.70
	Subtotal		171.90
		Total	1,265.40

Table 3: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	69.40
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		69.40
Waste Water	Distribution Lines	NA	41.60
	Facilities	3	193.80
	Pipelines	0	0.00
	Subtotal		235.40
Natural Gas	Distribution Lines	NA	27.80
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		27.80
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		0.00
Electrical Power	Facilities	2	213.40
	Subtotal		213.40
Communication	Facilities	3	0.30
	Subtotal		0.30
	Total		546.30

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 4,901 buildings will be at least moderately damaged. This is over 34.00 % of the total number of buildings in the region. There are an estimated 596 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	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	15	0.25	9	0.30	17	0.60	17	1.25	19	3.27
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	1	0.01	0	0.01	1	0.03	1	0.09	2	0.32
Industrial	1	0.02	1	0.03	1	0.05	1	0.07	1	0.09
Other Residential	930	15.02	748	23.56	1,094	37.46	590	42.62	254	42.62
Religion	1	0.01	0	0.01	1	0.02	1	0.04	1	0.10
Single Family	5,244	84.68	2,417	76.09	1,807	61.84	774	55.93	320	53.60
Total	6,192		3,176		2,922		1,383		597	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	4,442	71.74	2125	66.91	1,252	42.85	303	21.87	47	7.91
Steel	7	0.12	4	0.12	7	0.25	7	0.50	10	1.65
Concrete	11	0.17	6	0.20	9	0.32	7	0.51	7	1.19
Precast	2	0.03	1	0.04	3	0.09	3	0.23	4	0.63
RM	798	12.89	279	8.77	520	17.80	435	31.47	227	38.02
URM	79	1.28	59	1.85	76	2.62	57	4.12	59	9.92
MH	853	13.77	702	22.12	1,053	36.06	571	41.30	243	40.68
Total	6,192		3,176		2,922		1,383		597	

*Note:

RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 55 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, 6.00% of the beds will be back in service. By 30 days, 34.00% 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	19	9	0	4
EOCs	0	0	0	0
PoliceStations	4	1	0	0
FireStations	3	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	20	0	0	20	20
	Bridges	129	12	0	117	122
	Tunnels	2	0	0	2	2
Railways	Segments	125	0	0	125	125
	Bridges	4	0	0	4	4
	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	2	0	2	4
	Runways	5	0	0	5	5

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	3	3	0	0	3
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	2	1	0	0	2
Communication	3	2	0	2	3

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

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	3,470	193	48
Waste Water	2,082	152	38
Natural Gas	1,388	163	41
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	15,232	13	0	0	0	0
Electric Power		790	510	221	45	1

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 3 ignitions that will burn about 0.01 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 36 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 629 households to be displaced due to the earthquake. Of these, 170 people (out of a total population of 46,145 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	4	1	0	0
	Industrial	1	0	0	0
	Other-Residential	75	17	2	3
	Single Family	108	29	5	9
	Total	191	48	7	13
2 PM	Commercial	127	39	7	13
	Commuting	0	0	0	0
	Educational	17	5	1	2
	Hotels	1	0	0	0
	Industrial	11	3	0	1
	Other-Residential	21	5	1	1
	Single Family	27	7	1	2
	Total	204	60	10	19
5 PM	Commercial	99	30	5	10
	Commuting	2	4	5	1
	Educational	0	0	0	0
	Hotels	1	0	0	0
	Industrial	7	2	0	1
	Other-Residential	28	6	1	1
	Single Family	42	11	2	3
	Total	180	54	13	16

Economic Loss

The total economic loss estimated for the earthquake is 393.64 (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 305.82 (millions of dollars); 13 % 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	1.70	10.04	0.26	0.38	12.38
	Capital-Related	0.00	0.73	8.90	0.15	0.08	9.86
	Rental	5.88	4.82	5.15	0.06	0.26	16.17
	Relocation	0.61	0.13	0.27	0.00	0.06	1.08
	Subtotal	6.49	7.38	24.36	0.48	0.78	39.49
Capital Stock Losses							
	Structural	27.55	9.56	12.90	1.12	1.45	52.59
	Non_Structural	87.49	34.01	34.26	3.64	4.34	163.73
	Content	22.52	6.76	15.29	2.18	1.91	48.66
	Inventory	0.00	0.00	0.73	0.59	0.02	1.34
	Subtotal	137.57	50.32	63.18	7.54	7.72	266.33
	Total	144.06	57.70	87.53	8.02	8.50	305.82

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	919.39	\$0.00	0.00
	Bridges	57.47	\$5.14	8.94
	Tunnels	1.87	\$0.01	0.40
	Subtotal	978.70	5.10	
Railways	Segments	114.33	\$0.00	0.00
	Bridges	0.42	\$0.01	2.09
	Tunnels	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	114.70	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	\$8.22	38.89
	Runways	150.74	\$0.00	0.00
	Subtotal	171.90	8.20	
	Total	1265.40	13.40	

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	69.40	\$0.87	1.25
	Subtotal	69.40	\$0.87	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	193.80	\$37.67	19.44
	Distribution Line	41.60	\$0.69	1.65
	Subtotal	235.44	\$38.35	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Line	27.80	\$0.73	2.64
	Subtotal	27.76	\$0.73	
Oil Systems	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Electrical Power	Facilities	213.40	\$34.41	16.13
	Subtotal	213.40	\$34.41	
Communication	Facilities	0.30	\$0.08	26.15
	Subtotal	0.29	\$0.08	
	Total	546.29	\$74.45	

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)	-0.90
Second Year			
	Employment Impact	0	0.00
	Income Impact	(8)	-2.74
Third Year			
	Employment Impact	0	0.00
	Income Impact	(10)	-3.53
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	(10)	-3.53
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	(10)	-3.53
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	(10)	-3.53

Appendix A: County Listing for the Region

Fremont,CO

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Colorado	Fremont	46,145	1,727	221	1,948
Total State		46,145	1,727	221	1,948
Total Region		46,145	1,727	221	1,948

HAZUS-MH: Earthquake Event Report



Region Name: *Fremont County*

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

Print Date: *January 26, 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 1,532.46 square miles and contains 13 census tracts. There are over 15 thousand households in the region and has a total population of 46,145 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 14 thousand buildings in the region with a total building replacement value (excluding contents) of 1,948 (millions of dollars). Approximately 99.00 % of the buildings (and 89.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 1,265 and 407 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

HAZUS estimates that there are 14 thousand buildings in the region which have an aggregate total replacement value of 1,948 (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 57% 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 55 beds. There are 19 schools, 3 fire stations, 4 police stations and 0 emergency operation facilities. With respect to HPL facilities, there are 15 dams identified within the region. Of these, 4 of the dams are classified as 'high hazard'. The inventory also includes 3 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 1,672.00 (millions of dollars). This inventory includes over 238 kilometers of highways, 129 bridges, 6,939 kilometers of pipes.

Table 2: Transportation System Lifeline Inventory

System	Component	# locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	129	57.50
	Segments	20	919.40
	Tunnels	2	1.90
	Subtotal		978.70
Railways	Bridges	4	0.40
	Facilities	0	0.00
	Segments	125	114.30
	Tunnels	0	0.00
	Subtotal		114.70
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	5	150.70
	Subtotal		171.90
		Total	1,265.40

Table 3: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	69.40
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		69.40
Waste Water	Distribution Lines	NA	41.60
	Facilities	3	193.80
	Pipelines	0	0.00
	Subtotal		235.40
Natural Gas	Distribution Lines	NA	27.80
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		27.80
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		0.00
Electrical Power	Facilities	2	213.40
	Subtotal		213.40
Communication	Facilities	3	0.30
	Subtotal		0.30
	Total		546.30

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 1,307 buildings will be at least moderately damaged. This is over 9.00 % of the total number of buildings in the region. There are an estimated 75 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	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	42	0.36	10	0.65	13	1.48	10	2.97	5	6.12
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	2	0.02	1	0.04	1	0.12	1	0.30	1	0.70
Industrial	4	0.03	1	0.04	0	0.05	0	0.04	0	0.02
Other Residential	2,382	20.71	537	36.86	496	54.54	161	49.92	41	53.74
Religion	2	0.02	0	0.02	0	0.04	0	0.09	0	0.18
Single Family	9,073	78.87	909	62.39	398	43.77	150	46.69	30	39.24
Total	11,505		1,458		910		322		76	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	7,290	63.37	708	48.58	156	17.12	14	4.28	1	1.06
Steel	18	0.16	4	0.25	5	0.60	5	1.48	3	4.30
Concrete	26	0.23	4	0.29	5	0.54	4	1.14	2	2.33
Precast	7	0.06	1	0.08	2	0.21	2	0.55	1	1.33
RM	1,712	14.88	172	11.80	218	24.00	130	40.22	27	36.04
URM	225	1.96	52	3.55	37	4.10	13	3.97	3	4.50
MH	2,226	19.35	517	35.45	486	53.43	156	48.35	38	50.44
Total	11,505		1,458		910		322		76	

*Note:

RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 55 hospital beds available for use. On the day of the earthquake, the model estimates that only 5 hospital beds (11.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 34.00% of the beds will be back in service. By 30 days, 80.00% 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	19	0	0	19
EOCs	0	0	0	0
PoliceStations	4	0	0	4
FireStations	3	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	20	0	0	20	20
	Bridges	129	1	0	128	129
	Tunnels	2	0	0	2	2
Railways	Segments	125	0	0	125	125
	Bridges	4	0	0	4	4
	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	5	0	0	5	5

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	3	0	0	3	3
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	2	0	0	2	2
Communication	3	0	0	3	3

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

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	3,470	51	13
Waste Water	2,082	40	10
Natural Gas	1,388	43	11
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	15,232	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 104 households to be displaced due to the earthquake. Of these, 28 people (out of a total population of 46,145) 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	14	3	0	0
	Single Family	13	3	0	1
	Total	29	6	1	1
2 PM	Commercial	29	8	1	3
	Commuting	0	0	0	0
	Educational	4	1	0	0
	Hotels	0	0	0	0
	Industrial	1	0	0	0
	Other-Residential	4	1	0	0
	Single Family	3	1	0	0
	Total	42	11	2	3
5 PM	Commercial	21	6	1	2
	Commuting	0	1	1	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	1	0	0	0
	Other-Residential	5	1	0	0
	Single Family	5	1	0	0
	Total	33	9	2	3

Economic Loss

The total economic loss estimated for the earthquake is 89.58 (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 65.89 (millions of dollars); 19 % 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 52 % 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	0.46	3.77	0.06	0.17	4.46
	Capital-Related	0.00	0.19	3.25	0.04	0.03	3.51
	Rental	1.02	1.21	1.90	0.01	0.12	4.26
	Relocation	0.11	0.03	0.10	0.00	0.02	0.27
	Subtotal	1.12	1.90	9.01	0.11	0.34	12.49
Capital Stock Losses							
	Structural	4.80	2.28	4.35	0.28	0.55	12.26
	Non_Structural	12.64	7.17	9.53	0.71	1.37	31.42
	Content	3.38	1.25	3.86	0.40	0.53	9.42
	Inventory	0.00	0.00	0.19	0.11	0.00	0.30
	Subtotal	20.82	10.70	17.91	1.50	2.46	53.39
	Total	21.94	12.60	26.93	1.61	2.80	65.89

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	919.39	\$0.00	0.00
	Bridges	57.47	\$1.57	2.73
	Tunnels	1.87	\$0.00	0.00
	Subtotal	978.70	1.60	
Railways	Segments	114.33	\$0.00	0.00
	Bridges	0.42	\$0.00	0.65
	Tunnels	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	114.70	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	\$2.10	9.92
	Runways	150.74	\$0.00	0.00
	Subtotal	171.90	2.10	
	Total	1265.40	3.70	

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	69.40	\$0.23	0.33
	Subtotal	69.40	\$0.23	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	193.80	\$10.60	5.47
	Distribution Line	41.60	\$0.18	0.44
	Subtotal	235.44	\$10.79	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Line	27.80	\$0.19	0.70
	Subtotal	27.76	\$0.19	
Oil Systems	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Electrical Power	Facilities	213.40	\$8.79	4.12
	Subtotal	213.40	\$8.79	
Communication	Facilities	0.30	\$0.01	4.64
	Subtotal	0.29	\$0.01	
	Total	546.29	\$20.02	

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)	-0.18
Second Year			
	Employment Impact	0	0.00
	Income Impact	(2)	-0.55
Third Year			
	Employment Impact	0	0.00
	Income Impact	(2)	-0.71
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	(2)	-0.71
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	(2)	-0.71
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	(2)	-0.71

Appendix A: County Listing for the Region

Fremont,CO

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Colorado	Fremont	46,145	1,727	221	1,948
Total State		46,145	1,727	221	1,948
Total Region		46,145	1,727	221	1,948

HAZUS-MH: Earthquake Event Report



Region Name: *Fremont County*

Earthquake Scenario: *Rampart M7.0 CEUS Event*

Print Date: *January 26, 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 1,532.46 square miles and contains 13 census tracts. There are over 15 thousand households in the region and has a total population of 46,145 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 14 thousand buildings in the region with a total building replacement value (excluding contents) of 1,948 (millions of dollars). Approximately 99.00 % of the buildings (and 89.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 1,265 and 407 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

HAZUS estimates that there are 14 thousand buildings in the region which have an aggregate total replacement value of 1,948 (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 57% 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 55 beds. There are 19 schools, 3 fire stations, 4 police stations and 0 emergency operation facilities. With respect to HPL facilities, there are 15 dams identified within the region. Of these, 4 of the dams are classified as 'high hazard'. The inventory also includes 3 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 1,672.00 (millions of dollars). This inventory includes over 238 kilometers of highways, 129 bridges, 6,939 kilometers of pipes.

Table 2: Transportation System Lifeline Inventory

System	Component	# locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	129	57.50
	Segments	20	919.40
	Tunnels	2	1.90
	Subtotal		978.70
Railways	Bridges	4	0.40
	Facilities	0	0.00
	Segments	125	114.30
	Tunnels	0	0.00
	Subtotal		114.70
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	5	150.70
	Subtotal		171.90
		Total	1,265.40

Table 3: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	69.40
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		69.40
Waste Water	Distribution Lines	NA	41.60
	Facilities	3	193.80
	Pipelines	0	0.00
	Subtotal		235.40
Natural Gas	Distribution Lines	NA	27.80
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		27.80
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		0.00
Electrical Power	Facilities	2	213.40
	Subtotal		213.40
Communication	Facilities	3	0.30
	Subtotal		0.30
	Total		546.30

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	Rampart M7.0 CEUS Event
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-104.92
Latitude of Epicenter	39.06
Earthquake Magnitude	7.00
Depth (Km)	10.00
Rupture Length (Km)	42.66
Rupture Orientation (degrees)	171.00
Attenuation Function	CEUS Event

Building Damage

Building Damage

HAZUS estimates that about 1,730 buildings will be at least moderately damaged. This is over 12.00 % of the total number of buildings in the region. There are an estimated 37 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	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	42	0.41	13	0.57	15	1.12	7	2.10	1	3.80
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	2	0.02	1	0.04	1	0.09	1	0.20	0	0.35
Industrial	3	0.03	1	0.03	1	0.05	0	0.08	0	0.08
Other Residential	2,167	21.23	717	30.69	606	44.25	115	35.65	13	33.93
Religion	2	0.02	1	0.02	1	0.04	0	0.08	0	0.12
Single Family	7,990	78.29	1,602	68.64	745	54.45	201	61.90	23	61.72
Total	10,205		2,334		1,369		324		37	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	6,368	62.40	1328	56.91	417	30.47	52	15.97	3	9.26
Steel	21	0.20	5	0.20	6	0.46	3	0.88	1	1.92
Concrete	24	0.24	7	0.29	6	0.47	3	0.78	0	1.02
Precast	6	0.06	2	0.08	3	0.20	2	0.56	0	0.83
RM	1,573	15.41	249	10.65	296	21.59	131	40.50	11	28.96
URM	176	1.72	64	2.76	56	4.07	25	7.58	10	26.71
MH	2,037	19.96	680	29.12	585	42.73	109	33.74	12	31.31
Total	10,205		2,334		1,369		324		37	

*Note:

RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 55 hospital beds available for use. On the day of the earthquake, the model estimates that only 13 hospital beds (25.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 58.00% of the beds will be back in service. By 30 days, 93.00% 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	19	0	0	6
EOCs	0	0	0	0
PoliceStations	4	0	0	1
FireStations	3	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	20	0	0	20	20
	Bridges	129	0	0	129	129
	Tunnels	2	0	0	2	2
Railways	Segments	125	0	0	125	125
	Bridges	4	0	0	4	4
	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	5	0	0	5	5

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	3	1	0	0	3
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	2	0	0	1	2
Communication	3	1	0	3	3

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

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	3,470	16	4
Waste Water	2,082	13	3
Natural Gas	1,388	14	3
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	15,232	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 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 48 people and burn about 3 (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 93 households to be displaced due to the earthquake. Of these, 25 people (out of a total population of 46,145) 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	13	2	0	0
	Single Family	19	3	0	1
	Total	33	5	1	1
2 PM	Commercial	18	4	1	1
	Commuting	0	0	0	0
	Educational	2	0	0	0
	Hotels	0	0	0	0
	Industrial	1	0	0	0
	Other-Residential	4	1	0	0
	Single Family	5	1	0	0
	Total	30	6	1	2
5 PM	Commercial	13	3	0	1
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	1	0	0	0
	Other-Residential	5	1	0	0
	Single Family	7	1	0	0
	Total	27	5	1	1

Economic Loss

The total economic loss estimated for the earthquake is 127.02 (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 74.07 (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 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	0.42	2.53	0.06	0.10	3.12
	Capital-Related	0.00	0.18	2.18	0.03	0.02	2.42
	Rental	1.48	1.29	1.52	0.01	0.06	4.37
	Relocation	0.15	0.03	0.08	0.00	0.01	0.29
	Subtotal	1.64	1.93	6.32	0.11	0.20	10.20
Capital Stock Losses							
	Structural	6.78	2.23	3.07	0.24	0.31	12.64
	Non_Structural	22.12	8.20	6.34	0.67	0.76	38.09
	Content	7.11	1.88	3.10	0.42	0.37	12.88
	Inventory	0.00	0.00	0.15	0.12	0.00	0.27
	Subtotal	36.01	12.31	12.66	1.45	1.45	63.87
	Total	37.64	14.24	18.98	1.56	1.65	74.07

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	919.39	\$0.00	0.00
	Bridges	57.47	\$1.11	1.93
	Tunnels	1.87	\$0.01	0.46
	Subtotal	978.70	1.10	
Railways	Segments	114.33	\$0.00	0.00
	Bridges	0.42	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	114.70	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	\$1.99	9.42
	Runways	150.74	\$0.00	0.00
	Subtotal	171.90	2.00	
	Total	1265.40	3.10	

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	69.40	\$0.07	0.10
	Subtotal	69.40	\$0.07	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	193.80	\$29.97	15.46
	Distribution Line	41.60	\$0.06	0.14
	Subtotal	235.44	\$30.02	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Line	27.80	\$0.06	0.22
	Subtotal	27.76	\$0.06	
Oil Systems	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Electrical Power	Facilities	213.40	\$19.66	9.21
	Subtotal	213.40	\$19.66	
Communication	Facilities	0.30	\$0.02	6.22
	Subtotal	0.29	\$0.02	
	Total	546.29	\$49.84	

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)	-0.21
Second Year			
	Employment Impact	0	0.00
	Income Impact	(2)	-0.64
Third Year			
	Employment Impact	0	0.00
	Income Impact	(2)	-0.83
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	(2)	-0.83
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	(2)	-0.83
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	(2)	-0.83

Appendix A: County Listing for the Region

Fremont,CO

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Colorado	Fremont	46,145	1,727	221	1,948
Total State		46,145	1,727	221	1,948
Total Region		46,145	1,727	221	1,948

HAZUS-MH: Earthquake Event Report



Region Name: *Fremont County*

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

Print Date: *January 26, 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 1,532.46 square miles and contains 13 census tracts. There are over 15 thousand households in the region and has a total population of 46,145 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 14 thousand buildings in the region with a total building replacement value (excluding contents) of 1,948 (millions of dollars). Approximately 99.00 % of the buildings (and 89.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 1,265 and 407 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

HAZUS estimates that there are 14 thousand buildings in the region which have an aggregate total replacement value of 1,948 (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 57% 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 55 beds. There are 19 schools, 3 fire stations, 4 police stations and 0 emergency operation facilities. With respect to HPL facilities, there are 15 dams identified within the region. Of these, 4 of the dams are classified as 'high hazard'. The inventory also includes 3 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 1,672.00 (millions of dollars). This inventory includes over 238 kilometers of highways, 129 bridges, 6,939 kilometers of pipes.

Table 2: Transportation System Lifeline Inventory

System	Component	# locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	129	57.50
	Segments	20	919.40
	Tunnels	2	1.90
	Subtotal		978.70
Railways	Bridges	4	0.40
	Facilities	0	0.00
	Segments	125	114.30
	Tunnels	0	0.00
	Subtotal		114.70
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	5	150.70
	Subtotal		171.90
		Total	1,265.40

Table 3: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	69.40
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		69.40
Waste Water	Distribution Lines	NA	41.60
	Facilities	3	193.80
	Pipelines	0	0.00
	Subtotal		235.40
Natural Gas	Distribution Lines	NA	27.80
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		27.80
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		0.00
Electrical Power	Facilities	2	213.40
	Subtotal		213.40
Communication	Facilities	3	0.30
	Subtotal		0.30
	Total		546.30

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 1,716 buildings will be at least moderately damaged. This is over 12.00 % of the total number of buildings in the region. There are an estimated 37 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	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	42	0.40	13	0.59	15	1.14	7	2.16	2	4.16
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	2	0.02	1	0.04	1	0.09	1	0.20	0	0.39
Industrial	3	0.03	1	0.03	1	0.05	0	0.06	0	0.05
Other Residential	2,173	21.09	708	31.47	606	44.74	117	36.09	12	32.92
Religion	2	0.02	1	0.02	1	0.04	0	0.07	0	0.12
Single Family	8,080	78.43	1,527	67.84	731	53.94	199	61.42	23	62.36
Total	10,302		2,251		1,355		325		37	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	6,457	62.67	1254	55.73	404	29.84	50	15.50	3	8.52
Steel	20	0.20	5	0.21	6	0.47	3	0.91	1	2.11
Concrete	24	0.24	7	0.30	6	0.47	3	0.79	0	1.11
Precast	6	0.06	2	0.08	3	0.20	2	0.55	0	0.86
RM	1,577	15.31	246	10.93	293	21.63	131	40.41	11	30.26
URM	177	1.72	64	2.83	55	4.09	25	7.58	10	26.84
MH	2,040	19.80	673	29.92	587	43.29	111	34.26	11	30.30
Total	10,302		2,251		1,355		325		37	

*Note:

RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 55 hospital beds available for use. On the day of the earthquake, the model estimates that only 13 hospital beds (24.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 57.00% of the beds will be back in service. By 30 days, 93.00% 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	19	0	0	10
EOCs	0	0	0	0
PoliceStations	4	0	0	2
FireStations	3	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	20	0	0	20	20
	Bridges	129	0	0	129	129
	Tunnels	2	0	0	2	2
Railways	Segments	125	0	0	125	125
	Bridges	4	0	0	4	4
	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	5	0	0	5	5

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	3	0	0	0	3
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	2	0	0	1	2
Communication	3	1	0	2	3

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

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	3,470	40	10
Waste Water	2,082	31	8
Natural Gas	1,388	34	8
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	15,232	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 2 ignitions that will burn about 0.01 sq. mi 0.00 % of the region's total area.) The model also estimates that the fires will displace about 39 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 88 households to be displaced due to the earthquake. Of these, 24 people (out of a total population of 46,145) 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	12	2	0	0
	Single Family	18	3	0	1
	Total	31	5	1	1
2 PM	Commercial	18	4	1	1
	Commuting	0	0	0	0
	Educational	2	1	0	0
	Hotels	0	0	0	0
	Industrial	1	0	0	0
	Other-Residential	3	1	0	0
	Single Family	4	1	0	0
	Total	29	6	1	2
5 PM	Commercial	14	3	0	1
	Commuting	0	0	1	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	1	0	0	0
	Other-Residential	4	1	0	0
	Single Family	7	1	0	0
	Total	26	6	1	1

Economic Loss

The total economic loss estimated for the earthquake is 120.48 (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 71.69 (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 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	0.40	2.55	0.05	0.11	3.11
	Capital-Related	0.00	0.17	2.21	0.03	0.02	2.44
	Rental	1.46	1.21	1.47	0.01	0.07	4.22
	Relocation	0.15	0.03	0.08	0.00	0.01	0.28
	Subtotal	1.62	1.82	6.31	0.10	0.21	10.05
Capital Stock Losses							
	Structural	6.69	2.14	3.00	0.23	0.33	12.38
	Non_Structural	21.64	7.52	6.15	0.60	0.79	36.70
	Content	7.01	1.64	2.91	0.37	0.37	12.30
	Inventory	0.00	0.00	0.14	0.10	0.00	0.25
	Subtotal	35.33	11.31	12.20	1.30	1.49	61.63
	Total	36.95	13.13	18.51	1.40	1.70	71.69

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	919.39	\$0.00	0.00
	Bridges	57.47	\$1.18	2.05
	Tunnels	1.87	\$0.00	0.04
	Subtotal	978.70	1.20	
Railways	Segments	114.33	\$0.00	0.00
	Bridges	0.42	\$0.00	0.89
	Tunnels	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	114.70	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	\$3.32	15.68
	Runways	150.74	\$0.00	0.00
	Subtotal	171.90	3.30	
	Total	1265.40	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	69.40	\$0.18	0.26
	Subtotal	69.40	\$0.18	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	193.80	\$24.75	12.77
	Distribution Line	41.60	\$0.14	0.34
	Subtotal	235.44	\$24.89	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Line	27.80	\$0.15	0.55
	Subtotal	27.76	\$0.15	
Oil Systems	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	\$0.00	
Electrical Power	Facilities	213.40	\$19.01	8.91
	Subtotal	213.40	\$19.01	
Communication	Facilities	0.30	\$0.07	24.26
	Subtotal	0.29	\$0.07	
	Total	546.29	\$44.30	

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)	-0.20
Second Year			
	Employment Impact	0	0.00
	Income Impact	(2)	-0.62
Third Year			
	Employment Impact	0	0.00
	Income Impact	(2)	-0.80
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	(2)	-0.80
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	(2)	-0.80
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	(2)	-0.80

Appendix A: County Listing for the Region

Fremont,CO

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Colorado	Fremont	46,145	1,727	221	1,948
Total State		46,145	1,727	221	1,948
Total Region		46,145	1,727	221	1,948

HAZUS-MH: Earthquake Event Report



Region Name: *Fremont County*

Earthquake Scenario: *Ute Pass M7.0 Fremont 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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Building Inventory

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Transportation and Utility Lifeline Inventory

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The total value of the lifeline inventory is over 1,672.00 (millions of dollars). This inventory includes over 238 kilometers of highways, 129 bridges, 6,939 kilometers of pipes.

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	Segments	20	919.40
	Tunnels	2	1.90
	Subtotal		978.70
Railways	Bridges	4	0.40
	Facilities	0	0.00
	Segments	125	114.30
	Tunnels	0	0.00
	Subtotal		114.70
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	5	150.70
	Subtotal		171.90
		Total	1,265.40

Table 3: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	69.40
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		69.40
Waste Water	Distribution Lines	NA	41.60
	Facilities	3	193.80
	Pipelines	0	0.00
	Subtotal		235.40
Natural Gas	Distribution Lines	NA	27.80
	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		27.80
Oil Systems	Facilities	0	0.00
	Pipelines	0	0.00
	Subtotal		0.00
Electrical Power	Facilities	2	213.40
	Subtotal		213.40
Communication	Facilities	3	0.30
	Subtotal		0.30
	Total		546.30

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	Ute Pass M7.0 Fremont CEUS Event
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-105.00
Latitude of Epicenter	38.92
Earthquake Magnitude	7.00
Depth (Km)	10.00
Rupture Length (Km)	42.66
Rupture Orientation (degrees)	152.00
Attenuation Function	CEUS Event

Building Damage

Building Damage

HAZUS estimates that about 2,489 buildings will be at least moderately damaged. This is over 17.00 % of the total number of buildings in the region. There are an estimated 84 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	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	34	0.38	14	0.48	18	0.97	10	1.86	3	3.45
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	2	0.02	1	0.03	1	0.08	1	0.17	0	0.33
Industrial	3	0.03	1	0.03	1	0.05	0	0.08	0	0.09
Other Residential	1,815	20.19	788	28.23	781	41.85	202	37.44	32	37.40
Religion	1	0.01	1	0.02	1	0.04	0	0.07	0	0.11
Single Family	7,136	79.37	1,986	71.20	1,063	57.01	326	60.37	50	58.61
Total	8,991		2,790		1,865		539		85	

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

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	5,723	63.65	1686	60.44	651	34.89	100	18.57	9	10.46
Steel	17	0.19	5	0.17	7	0.39	4	0.80	2	1.86
Concrete	21	0.23	7	0.26	8	0.42	4	0.71	1	1.04
Precast	5	0.06	2	0.06	3	0.17	2	0.45	1	0.77
RM	1,376	15.31	278	9.95	377	20.22	202	37.45	26	30.65
URM	145	1.61	68	2.42	67	3.57	34	6.36	17	20.32
MH	1,704	18.95	745	26.70	752	40.33	192	35.66	30	34.90
Total	8,991		2,790		1,865		539		85	

*Note:

RM Reinforced Masonry
URM Unreinforced Masonry
MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 55 hospital beds available for use. On the day of the earthquake, the model estimates that only 8 hospital beds (16.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 43.00% of the beds will be back in service. By 30 days, 86.00% 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	19	0	0	6
EOCs	0	0	0	0
PoliceStations	4	0	0	1
FireStations	3	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	20	0	0	20	20
	Bridges	129	4	0	125	129
	Tunnels	2	0	0	2	2
Railways	Segments	125	0	0	125	125
	Bridges	4	0	0	4	4
	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	5	0	0	5	5

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	3	3	0	0	3
Natural Gas	0	0	0	0	0
Oil Systems	0	0	0	0	0
Electrical Power	2	1	0	1	2
Communication	3	1	0	3	3

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

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	3,470	28	7
Waste Water	2,082	22	5
Natural Gas	1,388	23	6
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	15,232	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 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 48 people and burn about 3 (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 168 households to be displaced due to the earthquake. Of these, 46 people (out of a total population of 46,145) 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	22	4	0	1
	Single Family	32	6	1	1
	Total	56	10	1	2
2 PM	Commercial	30	7	1	2
	Commuting	0	0	0	0
	Educational	4	1	0	0
	Hotels	0	0	0	0
	Industrial	2	1	0	0
	Other-Residential	6	1	0	0
	Single Family	8	2	0	0
	Total	51	12	2	3
5 PM	Commercial	23	6	1	2
	Commuting	0	0	1	0
	Educational	0	0	0	0
	Hotels	0	0	0	0
	Industrial	2	0	0	0
	Other-Residential	8	1	0	0
	Single Family	12	2	0	1
	Total	46	10	2	3

Economic Loss

The total economic loss estimated for the earthquake is 183.77 (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 116.73 (millions of dollars); 13 % 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	0.68	3.77	0.09	0.15	4.68
	Capital-Related	0.00	0.29	3.25	0.05	0.03	3.63
	Rental	2.31	2.01	2.22	0.02	0.10	6.67
	Relocation	0.24	0.05	0.12	0.00	0.02	0.44
	Subtotal	2.55	3.03	9.36	0.17	0.30	15.42
Capital Stock Losses							
	Structural	10.57	3.47	4.67	0.38	0.48	19.57
	Non_Structural	35.25	13.10	10.18	1.11	1.22	60.86
	Content	11.27	3.00	4.89	0.71	0.58	20.44
	Inventory	0.00	0.00	0.24	0.19	0.01	0.44
	Subtotal	57.08	19.57	19.98	2.40	2.28	101.31
	Total	59.64	22.60	29.34	2.58	2.58	116.73

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	919.39	\$0.00	0.00
	Bridges	57.47	\$2.10	3.65
	Tunnels	1.87	\$0.03	1.85
	Subtotal	978.70	2.10	
Railways	Segments	114.33	\$0.00	0.00
	Bridges	0.42	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Subtotal	114.70	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	\$2.79	13.17
	Runways	150.74	\$0.00	0.00
	Subtotal	171.90	2.80	
	Total	1265.40	4.90	

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	69.40	\$0.12	0.18
	Subtotal	69.40	\$0.12	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	193.80	\$36.22	18.69
	Distribution Line	41.60	\$0.10	0.24
	Subtotal	235.44	\$36.32	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	0.00	\$0.00	0.00
	Distribution Line	27.80	\$0.10	0.38
	Subtotal	27.76	\$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	213.40	\$25.55	11.97
	Subtotal	213.40	\$25.55	
Communication	Facilities	0.30	\$0.02	7.73
	Subtotal	0.29	\$0.02	
	Total	546.29	\$62.13	

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

Fremont,CO

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Colorado	Fremont	46,145	1,727	221	1,948
Total State		46,145	1,727	221	1,948
Total Region		46,145	1,727	221	1,948