

Appendix F – HAZUS Reports

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HAZUS-MH: Flood Event Report

Region Name: Erie_Flood

Flood Scenario: Erie_Flood_100yr

Print Date: Thursday, January 06, 2011

Disclaimer:

Totals only reflect data for those census tracts/blocks included in the user's study region.

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

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General Description of the Region

HAZUS is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) and the National Institute of Building Sciences (NIBS). The primary purpose of HAZUS is to provide a methodology and software application to develop multi-hazard 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 multi-hazards and to prepare for emergency response and recovery.

The flood loss estimates provided in this report were based on a region that included 1 county(ies) from the following state(s):

- Pennsylvania

Note:

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

The geographical size of the region is 802 square miles and contains 6,076 census blocks. The region contains over 107 thousand households and has a total population of 280,843 people (2000 Census Bureau data). The distribution of population by State and County for the study region is provided in Appendix B.

There are an estimated 99,261 buildings in the region with a total building replacement value (excluding contents) of 20,943 million dollars (2006 dollars). Approximately 90.50% of the buildings (and 68.08% of the building value) are associated with residential housing.

General Building Stock

HAZUS estimates that there are 99,261 buildings in the region which have an aggregate total replacement value of 20,943 million (2006 dollars). Table 1 and Table 2 present the relative distribution of the value with respect to the general occupancies by Study Region and Scenario respectively. Appendix B provides a general distribution of the building value by State and County.

**Table 1
Building Exposure by Occupancy Type for the Study Region**

Occupancy	Exposure (\$1000)	Percent of Total
Residential	14,258,358	68.1%
Commercial	3,986,938	19.0%
Industrial	1,647,510	7.9%
Agricultural	73,303	0.4%
Religion	564,153	2.7%
Government	125,085	0.6%
Education	287,359	1.4%
Total	20,942,706	100.00%

**Table 2
Building Exposure by Occupancy Type for the Scenario**

Occupancy	Exposure (\$1000)	Percent of Total
Residential	1,386,283	60.6%
Commercial	534,186	23.4%
Industrial	256,635	11.2%
Agricultural	13,343	0.6%
Religion	53,593	2.3%
Government	12,157	0.5%
Education	30,986	1.4%
Total	2,287,183	100.00%

Essential Facility Inventory

For essential facilities, there are 10 hospitals in the region with a total bed capacity of 1,403 beds. There are 120 schools, 31 fire stations, 12 police stations and 2 emergency operation center.

Flood Scenario Parameters

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

Study Region Name:	Erie_Flood
Scenario Name:	Erie_Flood_100yr
Return Period Analyzed:	100
Analysis Options Analyzed:	No What-ifs

General Building Stock Damage

HAZUS estimates that about 98 buildings will be at least moderately damaged. This is over 8% of the total number of buildings in the scenario. There are an estimated 31 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the HAZUS Flood technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 summarizes the expected damage by general building type.

Table 3: Expected Building Damage by Occupancy

Occupancy	1-10		11-20		21-30		31-40		41-50		Substantially	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	0	0.00	0	0.00	3	60.00	2	40.00	0	0.00	0	0.00
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	0	0.00	2	50.00	2	50.00	0	0.00	0	0.00	0	0.00
Religion	0	0.00	1	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Residential	0	0.00	3	3.41	11	12.50	22	25.00	21	23.86	31	35.23
Total	0		6		16		24		21		31	

Table 4: Expected Building Damage by Building Type

Building Type	1-10		11-20		21-30		31-40		41-50		Substantially	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	0	0.00	0	0.00	1	50.00	1	50.00	0	0.00	0	0.00
ManufHousing	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	7	100.00
Masonry	0	0.00	1	7.14	2	14.29	4	28.57	3	21.43	4	28.57
Steel	0	0.00	1	16.67	4	66.67	1	16.67	0	0.00	0	0.00
Wood	0	0.00	3	4.35	10	14.49	18	26.09	18	26.09	20	28.99

Essential Facility Damage

Before the flood analyzed in this scenario, the region had hospital beds available for use. On the day of the scenario flood event, the model estimates that hospital beds are available in the region.

Table 5: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate	At Least Substantial	Loss of Use
Fire Stations	31	0	0	0
Hospitals	10	0	0	0
Police Stations	12	0	0	0
Schools	120	0	0	0

If this report displays all zeros or is blank, two possibilities can explain this.

- (1) None of your facilities were flooded. This can be checked by mapping the inventory data on the depth grid.
- (2) The analysis was not run. This can be tested by checking the run box on the Analysis Menu and seeing if a message box asks you to replace the existing results.

Induced Flood Damage

Debris Generation

HAZUS estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). 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 16,879 tons of debris will be generated. Of the total amount, Finishes comprises 41% of the total, Structure comprises 33% of the total. If the debris tonnage is converted into an estimated number of truckloads, it will require 675 truckloads (@25 tons/truck) to remove the debris generated by the flood.

Social Impact

Shelter Requirements

HAZUS estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. HAZUS also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 1,402 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 2,159 people (out of a total population of 280,843) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the flood is 274.42 million dollars, which represents 12.00 % of the total replacement value of the scenario buildings.

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 flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood.

The total building-related losses were 272.08 million dollars. 1% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 28.20% of the total loss. Table 6 below provides a summary of the losses associated with the building damage.

Table 6: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
<u>Building Loss</u>						
	Building	47.67	41.29	11.84	2.43	103.23
	Content	29.64	89.12	30.78	12.87	162.41
	Inventory	0.00	1.32	4.91	0.21	6.44
	Subtotal	77.31	131.73	47.53	15.51	272.08
<u>Business Interruption</u>						
	Income	0.01	0.51	0.00	0.02	0.54
	Relocation	0.05	0.22	0.01	0.00	0.28
	Rental Income	0.02	0.05	0.00	0.00	0.07
	Wage	0.01	0.75	0.01	0.68	1.45
	Subtotal	0.08	1.54	0.02	0.70	2.35
ALL	Total	77.40	133.27	47.55	16.21	274.42

Appendix A: County Listing for the Region

Pennsylvania

- Erie

Appendix B: Regional Population and Building Value Data

	Building Value (thousands of dollars)			Total
	Population	Residential	Non-Residential	
Pennsylvania				
Erie	280,843	14,258,358	6,684,348	20,942,706
Total	280,843	14,258,358	6,684,348	20,942,706
Total Study Region	280,843	14,258,358	6,684,348	20,942,706

HAZUS-MH: Flood Event Report

Region Name: Erie_Flood

Flood Scenario: Erie Coastal 100 Year

Print Date: Wednesday, May 04, 2011

Disclaimer:

Totals only reflect data for those census tracts/blocks included in the user's study region.

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

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General Description of the Region

HAZUS is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) and the National Institute of Building Sciences (NIBS). The primary purpose of HAZUS is to provide a methodology and software application to develop multi-hazard 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 multi-hazards and to prepare for emergency response and recovery.

The flood loss estimates provided in this report were based on a region that included 1 county(ies) from the following state(s):

- Pennsylvania

Note:

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

The geographical size of the region is 802 square miles and contains 6,076 census blocks. The region contains over 107 thousand households and has a total population of 280,843 people (2000 Census Bureau data). The distribution of population by State and County for the study region is provided in Appendix B.

There are an estimated 99,261 buildings in the region with a total building replacement value (excluding contents) of 20,943 million dollars (2006 dollars). Approximately 90.50% of the buildings (and 68.08% of the building value) are associated with residential housing.

General Building Stock

HAZUS estimates that there are 99,261 buildings in the region which have an aggregate total replacement value of 20,943 million (2006 dollars). Table 1 and Table 2 present the relative distribution of the value with respect to the general occupancies by Study Region and Scenario respectively. Appendix B provides a general distribution of the building value by State and County.

Table 1
Building Exposure by Occupancy Type for the Study Region

Occupancy	Exposure (\$1000)	Percent of Total
Residential	14,258,358	68.1%
Commercial	3,986,938	19.0%
Industrial	1,647,510	7.9%
Agricultural	73,303	0.4%
Religion	564,153	2.7%
Government	125,085	0.6%
Education	287,359	1.4%
Total	20,942,706	100.00%

Table 2
Building Exposure by Occupancy Type for the Scenario

Occupancy	Exposure (\$1000)	Percent of Total
Residential	530,077	81.0%
Commercial	69,395	10.6%
Industrial	25,788	3.9%
Agricultural	1,088	0.2%
Religion	6,036	0.9%
Government	3,948	0.6%
Education	18,394	2.8%
Total	654,726	100.00%

Essential Facility Inventory

For essential facilities, there are 10 hospitals in the region with a total bed capacity of 1,403 beds. There are 120 schools, 31 fire stations, 12 police stations and 2 emergency operation center.

Flood Scenario Parameters

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

Study Region Name:	Erie_Flood
Scenario Name:	Erie Coastal 100 Year
Return Period Analyzed:	100
Analysis Options Analyzed:	No What-Ifs

General Building Stock Damage

HAZUS estimates that about 75 buildings will be at least moderately damaged. This is over 87% of the total number of buildings in the scenario. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 5 of the HAZUS Flood technical manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 summarizes the expected damage by general building type.

Table 3: Expected Building Damage by Occupancy

Occupancy	1-10		11-20		21-30		31-40		41-50		Substantially	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Religion	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Residential	0	0.00	12	16.00	54	72.00	0	0.00	9	12.00	0	0.00
Total	0		12		54		0		9		0	

Table 4: Expected Building Damage by Building Type

Building Type	1-10		11-20		21-30		31-40		41-50		Substantially	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
ManufHousing	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Masonry	0	0.00	2	11.11	15	83.33	0	0.00	1	5.56	0	0.00
Steel	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Wood	0	0.00	10	17.54	39	68.42	0	0.00	8	14.04	0	0.00

Essential Facility Damage

Before the flood analyzed in this scenario, the region had hospital beds available for use. On the day of the scenario flood event, the model estimates that hospital beds are available in the region.

Table 5: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate	At Least Substantial	Loss of Use
Fire Stations	31	0	0	0
Hospitals	10	0	0	0
Police Stations	12	0	0	0
Schools	120	0	0	0

If this report displays all zeros or is blank, two possibilities can explain this.

- (1) None of your facilities were flooded. This can be checked by mapping the inventory data on the depth grid.
- (2) The analysis was not run. This can be tested by checking the run box on the Analysis Menu and seeing if a message box asks you to replace the existing results.

Induced Flood Damage

Debris Generation

HAZUS estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). 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 10,679 tons of debris will be generated. Of the total amount, Finishes comprises 74% of the total, Structure comprises 11% of the total. If the debris tonnage is converted into an estimated number of truckloads, it will require 427 truckloads (@25 tons/truck) to remove the debris generated by the flood.

Social Impact

Shelter Requirements

HAZUS estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. HAZUS also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 154 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 222 people (out of a total population of 280,843) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the flood is 49.64 million dollars, which represents 1.69 % of the total replacement value of the scenario buildings.

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 flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood.

The total building-related losses were 24.62 million dollars. 1% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 64.18% of the total loss. Table 6 below provides a summary of the losses associated with the building damage.

Table 6: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
<u>Building Loss</u>						
	Building	8.63	0.97	0.18	0.60	10.39
	Content	7.28	2.84	0.45	3.52	14.09
	Inventory	0.00	0.03	0.10	0.01	0.14
	Subtotal	15.91	3.84	0.73	4.13	24.62
<u>Business Interruption</u>						
	Income	0.00	0.02	0.00	0.03	0.06
	Relocation	0.01	0.00	0.00	0.00	0.01
	Rental Income	0.00	0.00	0.00	0.00	0.00
	Wage	0.00	0.01	0.00	0.12	0.13
	Subtotal	0.02	0.04	0.00	0.15	0.21
ALL	Total	15.93	3.88	0.73	4.28	24.82

Appendix A: County Listing for the Region

Pennsylvania

- Erie

Appendix B: Regional Population and Building Value Data

	Building Value (thousands of dollars)			Total
	Population	Residential	Non-Residential	
Pennsylvania				
Erie	280,843	14,258,358	6,684,348	20,942,706
Total	280,843	14,258,358	6,684,348	20,942,706
Total Study Region	280,843	14,258,358	6,684,348	20,942,706

HAZUS-MH: Earthquake Event Report

Region Name: Erie Earthquake

Earthquake Scenario: Erie_Sept27_1921_EQ_ArbitraryEvent

Print Date: April 01, 2011

Totals only reflect data for those census tracts/blocks included in the user's study region.

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):

Pennsylvania

Note:

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

The geographical size of the region is 802.95 square miles and contains 72 census tracts. There are over 106 thousand households in the region and has a total population of 280,843 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 99 thousand buildings in the region with a total building replacement value (excluding contents) of 20,942 (millions of dollars). Approximately 90.00 % of the buildings (and 68.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 4,068 and 2,821 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

HAZUS estimates that there are 99 thousand buildings in the region which have an aggregate total replacement value of 20,942 (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 56% 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 10 hospitals in the region with a total bed capacity of 1,403 beds. There are 120 schools, 31 fire stations, 12 police stations and 2 emergency operation facilities. With respect to HPL facilities, there are 10 dams identified within the region. Of these, 6 of the dams are classified as 'high hazard'. The inventory also includes 157 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 1 and 2.

The total value of the lifeline inventory is over 6,889.00 (millions of dollars). This inventory includes over 645 kilometers of highways, 375 bridges, 8,982 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

System	Component	# locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	375	321.50
	Segments	244	3,236.30
	Tunnels	0	0.00
	Subtotal		3,557.80
Railways	Bridges	0	0.00
	Facilities	2	5.30
	Segments	231	343.50
	Tunnels	0	0.00
	Subtotal		348.80
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
	Subtotal		0.00
Bus	Facilities	7	8.30
	Subtotal		8.30
Ferry	Facilities	0	0.00
	Subtotal		0.00
Port	Facilities	9	18.00
	Subtotal		18.00
Airport	Facilities	2	21.30
	Runways	3	113.90
	Subtotal		135.20
		Total	4,068.10

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	89.80
	Facilities	1	36.30
	Pipelines	0	0.00
		Subtotal	126.10
Waste Water	Distribution Lines	NA	53.90
	Facilities	35	2,540.80
	Pipelines	0	0.00
		Subtotal	2,594.70
Natural Gas	Distribution Lines	NA	35.90
	Facilities	2	2.40
	Pipelines	0	0.00
		Subtotal	38.30
Oil Systems	Facilities	1	0.10
	Pipelines	0	0.00
		Subtotal	0.10
Electrical Power	Facilities	2	239.80
		Subtotal	239.80
Communication	Facilities	24	2.60
		Subtotal	2.60
		Total	3,001.60

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	Erie_Sept27_1921_EQ_ArbitraryEvent
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-80.10
Latitude of Epicenter	42.10
Earthquake Magnitude	5.00
Depth (Km)	10.00
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	CEUS Event

Building Damage

Building Damage

HAZUS estimates that about 5,695 buildings will be at least moderately damaged. This is over 6.00 % of the total number of buildings in the region. There are an estimated 144 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 3 below summaries the expected damage by general occupancy for the buildings in the region. Table 4 summaries the expected damage by general building type.

Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	398	0.48	29	0.26	11	0.23	2	0.21	0	0.12
Commercial	5,025	6.10	619	5.56	330	7.11	71	7.79	8	5.81
Education	150	0.18	17	0.15	9	0.20	2	0.20	0	0.17
Government	152	0.18	15	0.14	8	0.18	2	0.17	0	0.11
Industrial	1,703	2.07	170	1.53	93	2.00	18	2.00	2	1.24
Other Residential	20,761	25.18	2,760	24.80	1,232	26.60	181	19.78	23	15.72
Religion	487	0.59	67	0.60	35	0.75	8	0.89	1	0.83
Single Family	53,758	65.21	7,453	66.96	2,917	62.94	632	68.95	110	76.01
Total	82,435		11,131		4,634		917		144	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	48,533	58.87	5485	49.28	1,122	24.20	83	9.08	3	2.25
Steel	4,152	5.04	371	3.34	201	4.35	30	3.26	1	0.99
Concrete	1,134	1.38	122	1.10	68	1.48	8	0.84	0	0.26
Precast	251	0.30	32	0.29	31	0.66	10	1.04	0	0.20
RM	1,978	2.40	178	1.60	146	3.15	36	3.88	0	0.27
URM	20,152	24.45	4109	36.91	2,612	56.36	725	79.05	138	95.50
MH	6,234	7.56	834	7.49	454	9.80	26	2.86	1	0.53
Total	82,435		11,131		4,634		917		144	

*Note:

RM Reinforced Masonry
 URM Unreinforced Masonry
 MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 1,403 hospital beds available for use. On the day of the earthquake, the model estimates that only 1,243 hospital beds (89.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 96.00% of the beds will be back in service. By 30 days, 100.00% will be operational.

Table 5: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	10	0	0	10
Schools	120	0	0	120
EOCs	2	0	0	2
PoliceStations	12	0	0	12
FireStations	31	0	0	31

Transportation and Utility Lifeline Damage

Table 6 provides damage estimates for the transportation system.

Table 6: 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	244	0	0	244	244
	Bridges	375	0	0	375	375
	Tunnels	0	0	0	0	0
Railways	Segments	231	0	0	231	231
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	2	2	0	2	2
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	7	4	0	7	7
Ferry	Facilities	0	0	0	0	0
Port	Facilities	9	0	0	9	9
Airport	Facilities	2	0	0	2	2
	Runways	3	0	0	3	3

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 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 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 9 provides a summary of the system performance information.

Table 7 : 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	1	0	0	1	1
Waste Water	35	11	0	15	35
Natural Gas	2	1	0	1	2
Oil Systems	1	1	0	0	1
Electrical Power	2	0	0	2	2
Communication	24	14	0	24	24

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	4,491	19	5
Waste Water	2,695	15	4
Natural Gas	1,796	16	4
Oil	0	0	0

Table 9: 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	106,507	0	0	0	0	0
Electric Power		52,553	29,549	9,514	1,335	70

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 16 ignitions that will burn about 0.93 sq. mi (0.11 % of the region's total area.) The model also estimates that the fires will displace about 2,990 people and burn about 223 (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 0.200 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 68.00% 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 7,800 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 442 households to be displaced due to the earthquake. Of these, 319 people (out of a total population of 280,843) 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 10 provides a summary of the casualties estimated for this earthquake

Table 10: Casualty Estimates

		Level 1	Level 2	Level 3	Level 4
2 AM	Commercial	1	0	0	0
	Commuting	0	0	0	0
	Educational	0	0	0	0
	Hotels	1	0	0	0
	Industrial	1	0	0	0
	Other-Residential	43	7	1	1
	Single Family	112	20	2	5
	Total	157	28	3	6
2 PM	Commercial	47	8	1	2
	Commuting	0	0	0	0
	Educational	13	2	0	0
	Hotels	0	0	0	0
	Industrial	6	1	0	0
	Other-Residential	10	2	0	0
	Single Family	24	4	1	1
	Total	100	17	2	4
5 PM	Commercial	35	6	1	1
	Commuting	0	0	0	0
	Educational	2	0	0	0
	Hotels	0	0	0	0
	Industrial	4	1	0	0
	Other-Residential	17	3	0	1
	Single Family	45	8	1	2
	Total	103	18	2	4

Economic Loss

The total economic loss estimated for the earthquake is 1,111.97 (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 828.23 (millions of dollars); 12 % of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 55 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Table 11: Building-Related Economic Loss Estimates
(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	0.96	16.61	0.68	1.04	19.29
	Capital-Related	0.00	0.41	12.34	0.43	0.26	13.43
	Rental	5.55	7.17	7.51	0.31	0.40	20.94
	Relocation	20.55	5.53	12.46	1.43	3.57	43.53
	Subtotal	26.09	14.06	48.92	2.85	5.26	97.19
Capital Stock Losses							
	Structural	31.41	9.68	12.43	3.15	3.13	59.81
	Non_Structural	154.18	95.96	93.04	38.12	21.20	402.51
	Content	85.14	40.46	82.50	32.65	18.52	259.27
	Inventory	0.00	0.00	1.86	7.47	0.11	9.45
	Subtotal	270.73	146.11	189.84	81.39	42.96	731.04
	Total	296.83	160.17	238.76	84.24	48.22	828.23

Transportation and Utility Lifeline Losses

For the transportation and utility lifeline systems, HAZUS computes the direct repair cost for each component only. There are no losses computed by HAZUS for business interruption due to lifeline outages. Tables 12 & 13 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 14 presents the results of the region for the given earthquake.

Table 12: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	3,236.28	\$0.00	0.00
	Bridges	321.52	\$0.32	0.10
	Tunnels	0.00	\$0.00	0.00
	Subtotal	3557.80	0.30	
Railways	Segments	343.51	\$0.00	0.00
	Bridges	0.00	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	5.33	\$1.94	36.33
	Subtotal	348.80	1.90	
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	8.32	\$2.03	24.40
	Subtotal	8.30	2.00	
Ferry	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Port	Facilities	17.97	\$5.95	33.11
	Subtotal	18.00	6.00	
Airport	Facilities	21.30	\$3.65	17.13
	Runways	113.89	\$0.00	0.00
	Subtotal	135.20	3.60	
	Total	4068.10	13.90	

Table 13: 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	36.30	\$1.37	3.77
	Distribution Lines	89.80	\$0.09	0.10
	Subtotal	126.12	\$1.46	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	2,540.80	\$257.78	10.15
	Distribution Lines	53.90	\$0.07	0.13
	Subtotal	2,594.68	\$257.85	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	2.40	\$0.24	9.98
	Distribution Lines	35.90	\$0.07	0.21
	Subtotal	38.30	\$0.31	
Oil Systems	Pipelines	0.00	\$0.00	0.00
	Facilities	0.10	\$0.02	16.15
	Subtotal	0.11	\$0.02	
Electrical Power	Facilities	239.80	\$9.81	4.09
	Subtotal	239.80	\$9.81	
Communication	Facilities	2.60	\$0.40	15.39
	Subtotal	2.62	\$0.40	
	Total	3,001.63	\$269.85	

Table 14. Indirect Economic Impact with outside aid
 (Employment as # of people and Income in millions of \$)

	LOSS	Total	%
First Year			
	Employment Impact	134	0.18
	Income Impact	(5)	-0.11
Second Year			
	Employment Impact	29	0.04
	Income Impact	(16)	-0.39
Third Year			
	Employment Impact	0	0.00
	Income Impact	(22)	-0.51
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	(22)	-0.51
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	(22)	-0.51
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	(22)	-0.51

Appendix A: County Listing for the Region

Erie,PA

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Pennsylvania	Erie	280,843	14,258	6,684	20,942
Total State		280,843	14,258	6,684	20,942
Total Region		280,843	14,258	6,684	20,942

HAZUS-MH: Earthquake Event Report

Region Name: Erie Earthquake

Earthquake Scenario: Erie_EQ_ArbitraryEvent_Mag5_Oct29_1934

Print Date: April 11, 2011

Totals only reflect data for those census tracts/blocks included in the user's study region.

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):

Pennsylvania

Note:

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

The geographical size of the region is 802.95 square miles and contains 72 census tracts. There are over 106 thousand households in the region and has a total population of 280,843 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 99 thousand buildings in the region with a total building replacement value (excluding contents) of 20,942 (millions of dollars). Approximately 90.00 % of the buildings (and 68.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 4,068 and 2,821 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

HAZUS estimates that there are 99 thousand buildings in the region which have an aggregate total replacement value of 20,942 (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 56% 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 10 hospitals in the region with a total bed capacity of 1,403 beds. There are 120 schools, 31 fire stations, 12 police stations and 2 emergency operation facilities. With respect to HPL facilities, there are 10 dams identified within the region. Of these, 6 of the dams are classified as 'high hazard'. The inventory also includes 157 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 1 and 2.

The total value of the lifeline inventory is over 6,889.00 (millions of dollars). This inventory includes over 645 kilometers of highways, 375 bridges, 8,982 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

System	Component	# locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	375	321.50
	Segments	244	3,236.30
	Tunnels	0	0.00
	Subtotal		3,557.80
Railways	Bridges	0	0.00
	Facilities	2	5.30
	Segments	231	343.50
	Tunnels	0	0.00
	Subtotal		348.80
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
	Subtotal		0.00
Bus	Facilities	7	8.30
	Subtotal		8.30
Ferry	Facilities	0	0.00
	Subtotal		0.00
Port	Facilities	9	18.00
	Subtotal		18.00
Airport	Facilities	2	21.30
	Runways	3	113.90
	Subtotal		135.20
		Total	4,068.10

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	89.80
	Facilities	1	36.30
	Pipelines	0	0.00
		Subtotal	126.10
Waste Water	Distribution Lines	NA	53.90
	Facilities	35	2,540.80
	Pipelines	0	0.00
		Subtotal	2,594.70
Natural Gas	Distribution Lines	NA	35.90
	Facilities	2	2.40
	Pipelines	0	0.00
		Subtotal	38.30
Oil Systems	Facilities	1	0.10
	Pipelines	0	0.00
		Subtotal	0.10
Electrical Power	Facilities	2	239.80
		Subtotal	239.80
Communication	Facilities	24	2.60
		Subtotal	2.60
		Total	3,001.60

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	Erie_EQ_ArbitraryEvent_Mag5_Oct29_1934
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-80.40
Latitude of Epicenter	41.90
Earthquake Magnitude	5.00
Depth (Km)	10.00
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	CEUS Event

Building Damage

Building Damage

HAZUS estimates that about 1,183 buildings will be at least moderately damaged. This is over 1.00 % of the total number of buildings in the region. There are an estimated 15 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 3 below summaries the expected damage by general occupancy for the buildings in the region. Table 4 summaries the expected damage by general building type.

Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	423	0.44	12	0.42	4	0.39	1	0.47	0	0.32
Commercial	5,826	6.12	159	5.49	59	5.71	9	6.61	1	5.13
Education	172	0.18	4	0.14	1	0.14	0	0.16	0	0.14
Government	171	0.18	4	0.14	1	0.14	0	0.15	0	0.11
Industrial	1,909	2.01	53	1.84	21	2.01	3	2.24	0	1.51
Other Residential	23,692	24.89	877	30.31	357	34.75	30	21.31	2	14.40
Religion	574	0.60	16	0.56	6	0.61	1	0.73	0	0.69
Single Family	62,416	65.57	1,768	61.10	578	56.25	96	68.33	12	77.72
Total	95,185		2,893		1,028		140		16	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	54,267	57.01	841	29.06	112	10.91	6	4.43	0	0.48
Steel	4,631	4.86	91	3.15	31	3.01	3	2.48	0	0.57
Concrete	1,297	1.36	26	0.91	8	0.82	1	0.44	0	0.13
Precast	305	0.32	11	0.37	7	0.67	1	1.00	0	0.13
RM	2,263	2.38	47	1.62	25	2.43	4	2.90	0	0.14
URM	25,627	26.92	1373	47.47	607	59.06	112	80.39	15	96.42
MH	6,795	7.14	504	17.43	238	23.11	12	8.36	0	2.14
Total	95,185		2,893		1,028		140		16	

*Note:

RM Reinforced Masonry
 URM Unreinforced Masonry
 MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 1,403 hospital beds available for use. On the day of the earthquake, the model estimates that only 1,398 hospital beds (100.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 100.00% of the beds will be back in service. By 30 days, 100.00% will be operational.

Table 5: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	10	0	0	10
Schools	120	0	0	120
EOCs	2	0	0	2
PoliceStations	12	0	0	12
FireStations	31	0	0	31

Transportation and Utility Lifeline Damage

Table 6 provides damage estimates for the transportation system.

Table 6: 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	244	0	0	244	244
	Bridges	375	0	0	375	375
	Tunnels	0	0	0	0	0
Railways	Segments	231	0	0	231	231
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	2	0	0	2	2
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	7	0	0	7	7
Ferry	Facilities	0	0	0	0	0
Port	Facilities	9	0	0	9	9
Airport	Facilities	2	0	0	2	2
	Runways	3	0	0	3	3

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 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 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 9 provides a summary of the system performance information.

Table 7 : 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	1	0	0	1	1
Waste Water	35	3	0	26	35
Natural Gas	2	0	0	2	2
Oil Systems	1	0	0	1	1
Electrical Power	2	0	0	2	2
Communication	24	1	0	24	24

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	4,491	8	2
Waste Water	2,695	6	2
Natural Gas	1,796	7	2
Oil	0	0	0

Table 9: 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	106,507	0	0	0	0	0
Electric Power		4,630	2,455	725	95	6

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 10 ignitions that will burn about 0.32 sq. mi (0.04 % of the region's total area.) The model also estimates that the fires will displace about 900 people and burn about 66 (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 0.030 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 77.00% 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 1,280 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 36 households to be displaced due to the earthquake. Of these, 27 people (out of a total population of 280,843) 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 10 provides a summary of the casualties estimated for this earthquake

Table 10: 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	7	1	0	0
	Single Family	19	3	0	1
	Total	26	4	0	1
2 PM	Commercial	5	1	0	0
	Commuting	0	0	0	0
	Educational	2	0	0	0
	Hotels	0	0	0	0
	Industrial	1	0	0	0
	Other-Residential	2	0	0	0
	Single Family	4	1	0	0
	Total	13	2	0	0
5 PM	Commercial	4	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	3	0	0	0
	Single Family	7	1	0	0
	Total	15	2	0	0

Economic Loss

The total economic loss estimated for the earthquake is 249.16 (millions of dollars), which includes building and lifeline related losses based on the region's available inventory. The following three sections provide more detailed information about these losses.

Building-Related Losses

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

The total building-related losses were 96.46 (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 59 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	0.12	1.74	0.10	0.17	2.14
	Capital-Related	0.00	0.05	1.45	0.07	0.04	1.61
	Rental	0.97	0.73	0.99	0.06	0.05	2.79
	Relocation	3.59	0.76	1.34	0.27	0.45	6.40
	Subtotal	4.56	1.66	5.52	0.49	0.70	12.94
Capital Stock Losses							
	Structural	5.56	1.34	1.45	0.58	0.45	9.39
	Non_Structural	21.68	8.11	8.00	6.19	2.22	46.20
	Content	10.88	3.00	6.07	5.01	1.74	26.71
	Inventory	0.00	0.00	0.16	1.04	0.04	1.23
	Subtotal	38.12	12.45	15.68	12.82	4.45	83.53
	Total	42.67	14.12	21.21	13.31	5.15	96.46

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 12 & 13 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 14 presents the results of the region for the given earthquake.

Table 12: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	3,236.28	\$0.00	0.00
	Bridges	321.52	\$0.08	0.02
	Tunnels	0.00	\$0.00	0.00
	Subtotal	3557.80	0.10	
Railways	Segments	343.51	\$0.00	0.00
	Bridges	0.00	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	5.33	\$0.30	5.59
	Subtotal	348.80	0.30	
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	8.32	\$0.88	10.62
	Subtotal	8.30	0.90	
Ferry	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Port	Facilities	17.97	\$0.79	4.42
	Subtotal	18.00	0.80	
Airport	Facilities	21.30	\$1.00	4.69
	Runways	113.89	\$0.00	0.00
	Subtotal	135.20	1.00	
	Total	4068.10	3.00	

Table 13: 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	36.30	\$0.05	0.15
	Distribution Lines	89.80	\$0.04	0.04
	Subtotal	126.12	\$0.09	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	2,540.80	\$149.06	5.87
	Distribution Lines	53.90	\$0.03	0.05
	Subtotal	2,594.68	\$149.08	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	2.40	\$0.01	0.36
	Distribution Lines	35.90	\$0.03	0.09
	Subtotal	38.30	\$0.04	
Oil Systems	Pipelines	0.00	\$0.00	0.00
	Facilities	0.10	\$0.00	0.55
	Subtotal	0.11	\$0.00	
Electrical Power	Facilities	239.80	\$0.37	0.16
	Subtotal	239.80	\$0.37	
Communication	Facilities	2.60	\$0.07	2.53
	Subtotal	2.62	\$0.07	
	Total	3,001.63	\$149.65	

Table 14. 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	-0.01
Second Year			
	Employment Impact	0	0.00
	Income Impact	(2)	-0.05
Third Year			
	Employment Impact	0	0.00
	Income Impact	(3)	-0.06
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	(3)	-0.06
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	(3)	-0.06
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	(3)	-0.06

Appendix A: County Listing for the Region

Erie,PA

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Pennsylvania	Erie	280,843	14,258	6,684	20,942
Total State		280,843	14,258	6,684	20,942
Total Region		280,843	14,258	6,684	20,942

HAZUS-MH: Earthquake Event Report

Region Name: Erie Earthquake

Earthquake Scenario: Erie_EQ_ArbitraryEvent_Mag5_Dec_17_1990

Print Date: April 01, 2011

Totals only reflect data for those census tracts/blocks included in the user's study region.

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):

Pennsylvania

Note:

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

The geographical size of the region is 802.95 square miles and contains 72 census tracts. There are over 106 thousand households in the region and has a total population of 280,843 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 99 thousand buildings in the region with a total building replacement value (excluding contents) of 20,942 (millions of dollars). Approximately 90.00 % of the buildings (and 68.00% of the building value) are associated with residential housing.

The replacement value of the transportation and utility lifeline systems is estimated to be 4,068 and 2,821 (millions of dollars) , respectively.

Building and Lifeline Inventory

Building Inventory

HAZUS estimates that there are 99 thousand buildings in the region which have an aggregate total replacement value of 20,942 (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 56% 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 10 hospitals in the region with a total bed capacity of 1,403 beds. There are 120 schools, 31 fire stations, 12 police stations and 2 emergency operation facilities. With respect to HPL facilities, there are 10 dams identified within the region. Of these, 6 of the dams are classified as 'high hazard'. The inventory also includes 157 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 1 and 2.

The total value of the lifeline inventory is over 6,889.00 (millions of dollars). This inventory includes over 645 kilometers of highways, 375 bridges, 8,982 kilometers of pipes.

Table 1: Transportation System Lifeline Inventory

System	Component	# locations/ # Segments	Replacement value (millions of dollars)
Highway	Bridges	375	321.50
	Segments	244	3,236.30
	Tunnels	0	0.00
	Subtotal		3,557.80
Railways	Bridges	0	0.00
	Facilities	2	5.30
	Segments	231	343.50
	Tunnels	0	0.00
	Subtotal		348.80
Light Rail	Bridges	0	0.00
	Facilities	0	0.00
	Segments	0	0.00
	Tunnels	0	0.00
	Subtotal		0.00
Bus	Facilities	7	8.30
	Subtotal		8.30
Ferry	Facilities	0	0.00
	Subtotal		0.00
Port	Facilities	9	18.00
	Subtotal		18.00
Airport	Facilities	2	21.30
	Runways	3	113.90
	Subtotal		135.20
		Total	4,068.10

Table 2: Utility System Lifeline Inventory

System	Component	# Locations / Segments	Replacement value (millions of dollars)
Potable Water	Distribution Lines	NA	89.80
	Facilities	1	36.30
	Pipelines	0	0.00
		Subtotal	126.10
Waste Water	Distribution Lines	NA	53.90
	Facilities	35	2,540.80
	Pipelines	0	0.00
		Subtotal	2,594.70
Natural Gas	Distribution Lines	NA	35.90
	Facilities	2	2.40
	Pipelines	0	0.00
		Subtotal	38.30
Oil Systems	Facilities	1	0.10
	Pipelines	0	0.00
		Subtotal	0.10
Electrical Power	Facilities	2	239.80
		Subtotal	239.80
Communication	Facilities	24	2.60
		Subtotal	2.60
		Total	3,001.60

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	Erie_EQ_ArbitraryEvent_Mag5_Dec_17_1990
Type of Earthquake	Arbitrary
Fault Name	NA
Historical Epicenter ID #	NA
Probabilistic Return Period	NA
Longitude of Epicenter	-80.12
Latitude of Epicenter	41.95
Earthquake Magnitude	5.00
Depth (Km)	10.00
Rupture Length (Km)	NA
Rupture Orientation (degrees)	NA
Attenuation Function	CEUS Event

Building Damage

Building Damage

HAZUS estimates that about 2,818 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 45 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 3 below summaries the expected damage by general occupancy for the buildings in the region. Table 4 summaries the expected damage by general building type.

Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	406	0.45	24	0.37	8	0.35	1	0.37	0	0.23
Commercial	5,500	6.11	369	5.69	155	6.49	27	7.12	2	5.27
Education	163	0.18	10	0.15	4	0.17	1	0.18	0	0.15
Government	164	0.18	9	0.14	4	0.15	1	0.15	0	0.09
Industrial	1,815	2.02	112	1.73	49	2.07	8	2.14	1	1.38
Other Residential	22,445	24.95	1,724	26.58	712	29.74	71	18.74	6	13.07
Religion	539	0.60	39	0.60	17	0.69	3	0.82	0	0.76
Single Family	58,923	65.50	4,200	64.75	1,445	60.34	267	70.48	36	79.05
Total	89,956		6,487		2,395		378		45	

Table 4: Expected Building Damage by Building Type (All Design Levels)

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Wood	52,402	58.25	2458	37.90	345	14.40	20	5.38	0	0.48
Steel	4,444	4.94	216	3.33	86	3.59	10	2.66	0	0.60
Concrete	1,241	1.38	65	1.01	24	1.02	2	0.48	0	0.10
Precast	280	0.31	22	0.34	17	0.71	4	1.05	0	0.15
RM	2,152	2.39	107	1.65	67	2.81	12	3.13	0	0.09
URM	23,099	25.68	2826	43.57	1,455	60.78	311	82.11	44	97.41
MH	6,338	7.05	791	12.20	400	16.69	20	5.19	1	1.18
Total	89,956		6,487		2,395		378		45	

*Note:

RM Reinforced Masonry
 URM Unreinforced Masonry
 MH Manufactured Housing

Essential Facility Damage

Before the earthquake, the region had 1,403 hospital beds available for use. On the day of the earthquake, the model estimates that only 1,371 hospital beds (98.00%) are available for use by patients already in the hospital and those injured by the earthquake. After one week, 99.00% of the beds will be back in service. By 30 days, 100.00% will be operational.

Table 5: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	10	0	0	10
Schools	120	0	0	120
EOCs	2	0	0	2
PoliceStations	12	0	0	12
FireStations	31	0	0	31

Transportation and Utility Lifeline Damage

Table 6 provides damage estimates for the transportation system.

Table 6: 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	244	0	0	244	244
	Bridges	375	0	0	375	375
	Tunnels	0	0	0	0	0
Railways	Segments	231	0	0	231	231
	Bridges	0	0	0	0	0
	Tunnels	0	0	0	0	0
	Facilities	2	0	0	2	2
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	7	0	0	7	7
Ferry	Facilities	0	0	0	0	0
Port	Facilities	9	0	0	9	9
Airport	Facilities	2	0	0	2	2
	Runways	3	0	0	3	3

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 7-9 provide information on the damage to the utility lifeline systems. Table 7 provides damage to the utility system facilities. Table 8 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 9 provides a summary of the system performance information.

Table 7 : 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	1	0	0	1	1
Waste Water	35	13	0	14	35
Natural Gas	2	0	0	2	2
Oil Systems	1	0	0	1	1
Electrical Power	2	0	0	2	2
Communication	24	12	0	24	24

Table 8 : Expected Utility System Pipeline Damage (Site Specific)

System	Total Pipelines Length (kms)	Number of Leaks	Number of Breaks
Potable Water	4,491	14	3
Waste Water	2,695	11	3
Natural Gas	1,796	12	3
Oil	0	0	0

Table 9: 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	106,507	0	0	0	0	0
Electric Power		10,220	5,205	1,445	181	15

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 12 ignitions that will burn about 0.56 sq. mi (0.07 % of the region's total area.) The model also estimates that the fires will displace about 1,231 people and burn about 82 (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 0.090 million tons of debris will be generated. Of the total amount, Brick/Wood comprises 74.00% 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 3,400 truckloads (@25 tons/truck) to remove the debris generated by the earthquake.

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 126 households to be displaced due to the earthquake. Of these, 89 people (out of a total population of 280,843) 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 10 provides a summary of the casualties estimated for this earthquake

Table 10: 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	16	2	0	0
	Single Family	49	8	1	2
	Total	65	10	1	2
2 PM	Commercial	15	2	0	0
	Commuting	0	0	0	0
	Educational	6	1	0	0
	Hotels	0	0	0	0
	Industrial	2	0	0	0
	Other-Residential	3	0	0	0
	Single Family	10	2	0	0
	Total	36	5	1	1
5 PM	Commercial	13	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	6	1	0	0
	Single Family	19	3	0	1
	Total	41	6	1	1

Economic Loss

The total economic loss estimated for the earthquake is 639.54 (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 334.53 (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 56 % of the total loss. Table 11 below provides a summary of the losses associated with the building damage.

Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.00	0.41	5.95	0.28	0.48	7.12
	Capital-Related	0.00	0.17	4.80	0.18	0.11	5.27
	Rental	2.53	2.36	2.98	0.14	0.15	8.17
	Relocation	9.36	2.04	4.37	0.68	1.43	17.88
	Subtotal	11.89	4.99	18.10	1.28	2.17	38.44
Capital Stock Losses							
	Structural	14.83	3.75	4.58	1.45	1.35	25.97
	Non_Structural	69.15	32.78	35.03	18.53	8.85	164.34
	Content	37.08	13.10	28.93	15.16	7.41	101.67
	Inventory	0.00	0.00	0.76	3.27	0.09	4.12
	Subtotal	121.05	49.63	69.30	38.41	17.70	296.09
	Total	132.94	54.62	87.41	39.69	19.87	334.53

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 12 & 13 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 14 presents the results of the region for the given earthquake.

Table 12: Transportation System Economic Losses
(Millions of dollars)

System	Component	Inventory Value	Economic Loss	Loss Ratio (%)
Highway	Segments	3,236.28	\$0.00	0.00
	Bridges	321.52	\$0.14	0.04
	Tunnels	0.00	\$0.00	0.00
	Subtotal	3557.80	0.10	
Railways	Segments	343.51	\$0.00	0.00
	Bridges	0.00	\$0.00	0.00
	Tunnels	0.00	\$0.00	0.00
	Facilities	5.33	\$0.89	16.63
	Subtotal	348.80	0.90	
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	8.32	\$1.57	18.84
	Subtotal	8.30	1.60	
Ferry	Facilities	0.00	\$0.00	0.00
	Subtotal	0.00	0.00	
Port	Facilities	17.97	\$2.20	12.23
	Subtotal	18.00	2.20	
Airport	Facilities	21.30	\$2.57	12.05
	Runways	113.89	\$0.00	0.00
	Subtotal	135.20	2.60	
	Total	4068.10	7.40	

Table 13: 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	36.30	\$0.40	1.11
	Distribution Lines	89.80	\$0.06	0.07
	Subtotal	126.12	\$0.47	
Waste Water	Pipelines	0.00	\$0.00	0.00
	Facilities	2,540.80	\$293.99	11.57
	Distribution Lines	53.90	\$0.05	0.09
	Subtotal	2,594.68	\$294.04	
Natural Gas	Pipelines	0.00	\$0.00	0.00
	Facilities	2.40	\$0.08	3.20
	Distribution Lines	35.90	\$0.05	0.15
	Subtotal	38.30	\$0.13	
Oil Systems	Pipelines	0.00	\$0.00	0.00
	Facilities	0.10	\$0.01	5.41
	Subtotal	0.11	\$0.01	
Electrical Power	Facilities	239.80	\$2.67	1.11
	Subtotal	239.80	\$2.67	
Communication	Facilities	2.60	\$0.34	13.14
	Subtotal	2.62	\$0.34	
	Total	3,001.63	\$297.65	

Table 14. Indirect Economic Impact with outside aid
 (Employment as # of people and Income in millions of \$)

	LOSS	Total	%
First Year			
	Employment Impact	90	0.12
	Income Impact	(2)	-0.04
Second Year			
	Employment Impact	5	0.01
	Income Impact	(7)	-0.16
Third Year			
	Employment Impact	0	0.00
	Income Impact	(9)	-0.21
Fourth Year			
	Employment Impact	0	0.00
	Income Impact	(9)	-0.21
Fifth Year			
	Employment Impact	0	0.00
	Income Impact	(9)	-0.21
Years 6 to 15			
	Employment Impact	0	0.00
	Income Impact	(9)	-0.21

Appendix A: County Listing for the Region

Erie,PA

Appendix B: Regional Population and Building Value Data

State	County Name	Population	Building Value (millions of dollars)		
			Residential	Non-Residential	Total
Pennsylvania	Erie	280,843	14,258	6,684	20,942
Total State		280,843	14,258	6,684	20,942
Total Region		280,843	14,258	6,684	20,942