

# HAZUS-MH: Flood Event Report

**Region Name:** LehighMR2

**Flood Study Case:** LehighMR2

**Print Date:** Monday, February 05, 2007

***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 Flood. These results can be improved by using enhanced inventory data and flood hazard information.*

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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 347 square miles and contains 9,424 census blocks. There are over 122 thousand households in the region and has a total population of 312,090 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 90,783 buildings in the region with a total building replacement value (excluding contents of 18,923 million dollars (2002 dollars). Approximately 98.43% of the buildings (and 82.89% of the building value) are associated with residential housing.

## Building Inventory

### General Building Stock

HAZUS estimates that there are 90,783 buildings in the region which have an aggregate total replacement value of 18,923 million (2002 dollars). Table 1 and Table 2 present the relative distribution of the value with respect to the general occupancies by Study Region and Study Case 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**

| <b>Occupancy</b> | <b>Exposure (\$1000)</b> | <b>Percent of Total</b> |
|------------------|--------------------------|-------------------------|
| Residential      | 15,685,835               | 82.9%                   |
| Commercial       | 2,336,160                | 12.3%                   |
| Industrial       | 605,751                  | 3.2%                    |
| Agricultural     | 19,718                   | 0.1%                    |
| Religion         | 104,957                  | 0.6%                    |
| Government       | 21,882                   | 0.1%                    |
| Education        | 149,145                  | 0.8%                    |
| Total            | 18,923,448               | 100.00%                 |

**Table 2**  
**Building Exposure by Occupancy Type for the Study Case**

| <b>Occupancy</b> | <b>Exposure (\$1000)</b> | <b>Percent of Total</b> |
|------------------|--------------------------|-------------------------|
| Residential      | 1,458,549                | 86.6%                   |
| Commercial       | 164,423                  | 9.8%                    |
| Industrial       | 44,706                   | 2.7%                    |
| Agricultural     | 1,532                    | 0.1%                    |
| Religion         | 6,166                    | 0.4%                    |
| Government       | 898                      | 0.1%                    |
| Education        | 7,633                    | 0.5%                    |
| Total            | 1,683,907                | 100.00%                 |

### Essential Facility Inventory

For essential facilities, there are 8 hospitals in the region with a total bed capacity of 2,207 beds. There are 126 schools, 16 fire stations, 32 police stations and no emergency operation centers.

## Flood Scenario Parameters

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

|                                   |           |
|-----------------------------------|-----------|
| <b>Study Region Name:</b>         | LehighMR2 |
| <b>Scenario Name:</b>             | LehighMR2 |
| <b>Return Period Analyzed:</b>    | 500       |
| <b>Analysis Options Analyzed:</b> | 0         |

## General Building Stock Damage

HAZUS estimates that about 454 buildings will be at least moderately damaged. This is over 26% of the total number of buildings in the region. There are an estimated 1 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 6 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   | 5          | 100.00 | 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  | 404        | 89.18  | 36        | 7.95 | 9        | 1.99 | 2        | 0.44 | 1        | 0.22 | 1             | 0.22 |
| <b>Total</b> | <b>409</b> |        | <b>36</b> |      | <b>9</b> |      | <b>2</b> |      | <b>1</b> |      | <b>1</b>      |      |

**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       | 128   | 90.78  | 10    | 7.09 | 3     | 2.13 | 0     | 0.00 | 0     | 0.00 | 0             | 0.00 |
| Steel         | 3     | 100.00 | 0     | 0.00 | 0     | 0.00 | 0     | 0.00 | 0     | 0.00 | 0             | 0.00 |
| Wood          | 276   | 88.46  | 26    | 8.33 | 6     | 1.92 | 2     | 0.64 | 1     | 0.32 | 1             | 0.32 |

## Essential Facility Damage

Before the flood analyzed in this study case, the region had 0 hospital beds available for use. On the day of the study case flood event, the model estimates that 0 hospital beds are available in the region.

**Table 5: Expected Damage to Essential Facilities**

| Classification  | # Facilities |                   |                      |             |
|-----------------|--------------|-------------------|----------------------|-------------|
|                 | Total        | At Least Moderate | At Least Substantial | Loss of Use |
| Fire Stations   | 16           | 0                 | 0                    | 0           |
| Hospitals       | 8            | 0                 | 0                    | 0           |
| Police Stations | 32           | 0                 | 0                    | 0           |
| Schools         | 126          | 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 41,056 tons of debris will be generated. Of the total amount, Finishes comprises 29% of the total, Structure comprises 41% of the total. If the debris tonnage is converted into an estimated number of truckloads, it will require 1,642 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 1,125 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 2,236 people (out of a total population of 312,090) will seek temporary shelter in public shelters.



## Economic Loss

The total economic loss estimated for the flood is 150.81 million dollars, which represents 9.52 % of the total replacement value of the study case 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 121.15 million dollars. 20% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 62.02% 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)

| <b>Category</b>                     | <b>Area</b>     | <b>Residential</b> | <b>Commercial</b> | <b>Industrial</b> | <b>Others</b> | <b>Total</b>  |
|-------------------------------------|-----------------|--------------------|-------------------|-------------------|---------------|---------------|
| <b><u>Building Loss</u></b>         |                 |                    |                   |                   |               |               |
|                                     | Building        | 59.37              | 7.72              | 0.65              | 0.21          | 67.95         |
|                                     | Content         | 33.20              | 17.11             | 1.44              | 0.66          | 52.41         |
|                                     | Inventory       | 0.00               | 0.54              | 0.25              | 0.00          | 0.79          |
|                                     | <b>Subtotal</b> | <b>92.57</b>       | <b>25.37</b>      | <b>2.34</b>       | <b>0.87</b>   | <b>121.15</b> |
| <b><u>Business Interruption</u></b> |                 |                    |                   |                   |               |               |
|                                     | Income          | 0.22               | 12.39             | 0.03              | 0.28          | 12.92         |
|                                     | Relocation      | 0.09               | 0.05              | 0.00              | 0.00          | 0.15          |
|                                     | Rental Income   | 0.11               | 0.04              | 0.00              | 0.00          | 0.15          |
|                                     | Wage            | 0.53               | 12.90             | 0.06              | 2.94          | 16.43         |
|                                     | <b>Subtotal</b> | <b>0.96</b>        | <b>25.38</b>      | <b>0.10</b>       | <b>3.22</b>   | <b>29.66</b>  |
| <b>ALL</b>                          | <b>Total</b>    | <b>93.53</b>       | <b>50.75</b>      | <b>2.44</b>       | <b>4.09</b>   | <b>150.81</b> |

## **Appendix A: County Listing for the Region**

Pennsylvania  
- Lehigh

**Appendix B: Regional Population and Building Value Data**

|                           | Building Value (thousands of dollars) |                   |                  | Total             |
|---------------------------|---------------------------------------|-------------------|------------------|-------------------|
|                           | Population                            | Residential       | Non-Residential  |                   |
| <b>Pennsylvania</b>       |                                       |                   |                  |                   |
| Lehigh                    | 312,090                               | 15,685,835        | 3,237,613        | 18,923,448        |
| <b>Total State</b>        | <b>312,090</b>                        | <b>15,685,835</b> | <b>3,237,613</b> | <b>18,923,448</b> |
| <b>Total Study Region</b> | <b>312,090</b>                        | <b>15,685,835</b> | <b>3,237,613</b> | <b>18,923,448</b> |