EARTHQUAKE LOSS ESTIMATION STUDY
FOR
BERGEN COUNTY, NEW JERSEY:

GEOLOGIC COMPONENT

Prepared for the
New Jersey State Police
Office of Emergency Management

by the
New Jersey Geological Survey

December 2000
CONTENTS

Final Report ................................................................. 1
Appendix A. Maps of Bergen County ................................. A.1
Appendix B. Magnitude 5 with default geology ............... B.1
Appendix C. Magnitude 5 with upgraded geology ............. C.1
Appendix D. Magnitude 5.5 with default geology ............. D.1
Appendix E. Magnitude 5.5 with upgraded geology .......... E.1
Appendix F. Magnitude 6 with default geology ............... F.1
Appendix G. Magnitude 6 with upgraded geology ............ G.1
Appendix H. Magnitude 6.5 with default geology ............ H.1
Appendix I. Magnitude 6.5 with upgraded geology .......... I.1
Appendix J. Magnitude 7 with default geology ............... J.1
Appendix K. Magnitude 7 with upgraded geology ............ K.1
Appendix L. Shear-wave velocity data ........................... L.1
Seismic Soil Class map .............................................. folded in pocket
Liquefaction Susceptibility Map ..................................... folded in pocket
Landslide Susceptibility Map ........................................ folded in pocket
FINAL REPORT

GEOLOGIC COMPONENT OF THE
EARTHQUAKE LOSS ESTIMATION STUDY FOR BERGEN COUNTY, NEW JERSEY

Prepared for the New Jersey State Police, Office of Emergency Management

by
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December 8, 2000

Summary: Geologic and topographic data were acquired and analyzed in order to compile maps of seismic soil class, liquefaction susceptibility, and landslide susceptibility for Bergen County (folded in pocket). The soil class, liquefaction susceptibility, and landslide susceptibility data were entered into the HAZUS model for each census tract in the county. The HAZUS model was run with the upgraded geologic data and with the default geologic data for earthquake magnitudes of 5, 5.5, 6, 6.5, and 7. Selected outputs from these runs are attached in Appendices A through K. The upgraded geology produced significant changes in both the spatial distribution of damage and the total damage estimates. The upgraded geology produced greater building damage in the Hackensack Valley and Hackensack Meadowlands areas of the county, where soils are softer and more liquefiable than the default, and less building damage on most upland areas, where soils are stronger than the default. Because uplands comprise most of the area of Bergen County, the total estimated building damage is somewhat less with the upgraded geologic data than with the default data at all magnitudes.

In addition to the HAZUS data upgrades and runs, shear-wave velocity was measured on four soil types at a total of 13 locations. The results of these measurements are provided in Appendix L. These measurements were made to check the soil-class assignments, which use test-drilling data as a proxy for shear-wave velocity. The measured velocities confirmed most of the assignments. Soil classes were adjusted for gravel-rich materials that yielded higher-than-predicted velocities.

Geologic Data Acquired: Six distinct units of surficial material were identified and mapped in Bergen County. These include glacial till, glacial-lake and glacial-river sand and gravel deposits, glacial-lake silt and clay deposits, postglacial river deposits, peat and organic silt and clay deposited in wetlands, and outcropping bedrock. The distribution and thickness of these materials were mapped at 1:24,000 scale using stereo-airphoto interpretation, field observations, archival geologic map data on file at the NJGS, and logs of about 1300 test borings. Till is a compact pebbly, cobbly, and, in places, bouldery silty sand to sandy silt sediment deposited directly beneath glacial ice. It veneers the bedrock surface and is as much as 150 feet thick in the county. On parts of the Palisades Ridge, Ramapo Mountain, Campgaw Mountain, and the
Figure 1. Bergen County, showing features named in text.
Watchung Mountains, till is thin or absent and bedrock is exposed or is within 10 feet of the surface (Figure 1). Glacial-lake deposits overlie the till in the lowlands along the Hackensack, lower Saddle, Ramapo, and Passaic Rivers, and in the Hackensack Meadowlands. These deposits include sand and gravel as much as 100 feet thick and silt and clay as much as 250 feet thick. Glacial-river sand and gravel forms terraces in the Pascack Brook and upper Saddle River valleys. Alluvial sand was deposited along all the main streams after the glacier retreated and the glacial lakes drained. It is as much as 20 feet thick and commonly overlies glacial-lake deposits. In the Hackensack Meadowlands, alluvial sand laid down before sea-level rise underlies salt-marsh and estuarine deposits. The salt-marsh and estuarine deposits are as much as 300 feet thick beneath the Hudson River but are generally less than 20 feet thick in the Hackensack Meadowlands. The extent of the these deposits is important because they are loose, saturated soils that are especially susceptible to seismic shaking. Archival maps at the NJGS dating back to 1880 were used to delineate the original limit of the marshes, which are now covered by fill over much of their former extent.

Data Analysis: Shaking behavior and liquefaction susceptibility of soils are determined by their grain size, thickness, compaction, and degree of saturation. These properties, in turn, are determined by the geologic origin of the soils and their topographic position. Soils can be classed into the HAZUS categories using Standard Penetration Test (SPT) data, which are acquired during the drilling of test borings. SPT tests report the number of blows of a 140-pound hammer falling 30 inches that are required to drive a sampling tube 12 inches into the test material. In addition to the approximately 300 borings in the Hudson County-Newark area, with a total of 4,777 SPT tests, that were used to define soil classes for the Newark and Hudson County HAZUS studies in 1998 and 1999 (Table 1), an additional 50 borings, with a total of 234 SPT tests, were acquired for Bergen County (Table 2). For each surficial unit, a mean SPT value, and standard deviation, were calculated. This mean value is then applied to the mapped extent of the surficial unit to prepare the soil class map. Fill includes a variety of materials ranging from demolition debris and excavated bedrock to trash and dredged silt and sand. Because of the variable composition of fill it is inappropriate to apply a mean SPT value, and fill was not included in the soil classification determinations. The behavior of fill under seismic shaking should be assessed on a site-specific basis. The boring logs also report the depth of the water table, which marks the upper limit of saturation. This information, along with the grain size and compaction of the soil, is used to map liquefaction susceptibility. HAZUS soil classes were assigned according to the procedures described in sections 4.1.2.1, 4.1.2.2, and 4.1.2.3 of the 1997 National Earthquake Hazards Reduction Program (NEHRP) Provisions. These procedures assign a soil class by using a weighting formula to sum the soil and rock layers to a depth of 100 feet. Liquefaction susceptibility was assigned based on Table 9.1 of the HAZUS Users Manual. The resulting maps are attached (folded in pocket).

Landslide susceptibility depends on slope angle and the geologic material underlying the slope. Slope angles for Bergen County were calculated from 1:24,000 topographic maps with 10-foot contour interval and slope materials were determined in the field. Landslide susceptibility was assigned according to the classification in Table 9.2 of the HAZUS User’s Manual (refer to map folded in pocket). Areas of potential landsliding include cliffs and steep slopes in diabase bedrock and talus on the east slope of the Palisades Ridge, small areas of steep slope on the west
slopes of the Palisades Ridge and on till-mantled sandstone and basalt ridges in the central and western parts of the county, and on steep slopes in gneiss and till on Ramapo Mountain.

Table 1.--Standard Penetration Test (SPT) data for surficial materials in the Hudson County-Newark area, from the 1998 and 1999 HAZUS studies.

<table>
<thead>
<tr>
<th>Material</th>
<th>Number of Borings</th>
<th>Number of Tests</th>
<th>Range of SPT Values</th>
<th>Mean ± Standard Deviation</th>
<th>Percentage of Zero Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>fill</td>
<td>223</td>
<td>737</td>
<td>0-191</td>
<td>17.8±19.2</td>
<td>1.2%</td>
</tr>
<tr>
<td>salt-marsh deposits</td>
<td>218</td>
<td>647</td>
<td>0-38</td>
<td>2.8±4.5</td>
<td>45.9%</td>
</tr>
<tr>
<td>alluvial sand</td>
<td>67</td>
<td>221</td>
<td>0-89</td>
<td>24.0±13.9</td>
<td>1.8%</td>
</tr>
<tr>
<td>glacial-lake sand</td>
<td>79</td>
<td>573</td>
<td>2-139</td>
<td>27.3±17.3</td>
<td>0%</td>
</tr>
<tr>
<td>glacial-lake silt and clay</td>
<td>224</td>
<td>1559</td>
<td>0-157</td>
<td>13.7±13.9</td>
<td>11.4%</td>
</tr>
<tr>
<td>till</td>
<td>247</td>
<td>723</td>
<td>3-330</td>
<td>67.4±57.8</td>
<td>0%</td>
</tr>
</tbody>
</table>

Table 2.--Additional SPT data for Bergen County.

<table>
<thead>
<tr>
<th>Material</th>
<th>Number of Borings</th>
<th>Number of Tests</th>
<th>Range of SPT Values</th>
<th>Mean± Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>alluvial silt, sand, and gravel</td>
<td>23</td>
<td>109</td>
<td>2-123</td>
<td>24.3±30.3</td>
</tr>
<tr>
<td>glacial-lake sand and gravel</td>
<td>2</td>
<td>9</td>
<td>10-53</td>
<td>24.1±15.3</td>
</tr>
<tr>
<td>glacial-lake silt and clay</td>
<td>14</td>
<td>59</td>
<td>5-45</td>
<td>17.9±8.8</td>
</tr>
<tr>
<td>till</td>
<td>13</td>
<td>57</td>
<td>4-178</td>
<td>68.2±46.7</td>
</tr>
</tbody>
</table>

**Shear-wave Velocity Measurements:** To test the accuracy of using SPT data as a proxy for shear-wave velocity, seismic data were collected at thirteen sites in Bergen County. The tested soil types include glacial-lake sand and gravel (3 sites), postglacial river deposits (3 sites), glacial-lake silt and clay (3 sites) and till (5 sites) (Table 3). The measurements were made at sites where the natural deposit was undisturbed and not covered or mixed with man-made fill. At
each site, hand-auger holes were drilled to a depth of 5 feet to test for soil disturbance and fill. The seismic data were collected using a Bison 9000 digital engineering seismograph. Both shear wave (horizontal component) and compression (P) wave data were acquired (Appendix L). P-wave data allow the interpreter to discriminate between the shear and P-waves using their large velocity difference. P-wave data generally show two velocity layers. The uppermost layer is unsaturated sediment and the lower layer is saturated sediment. The boundary between the two layers is the water table. The water table is not detectable in shear wave data because liquids do not transmit shear waves.

Table 3. Shear-wave velocity measurements. Complete data provided in Appendix L.

<table>
<thead>
<tr>
<th>Site</th>
<th>Location (latitude; longitude)</th>
<th>Material</th>
<th>Measured shear-wave velocity (feet/second)</th>
<th>Shear-wave velocity range predicted from SPT data (feet/second)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dunkerhook Park</td>
<td>40°E 58′27″; 74°W 05′50″</td>
<td>glacial-lake sand and gravel</td>
<td>1159</td>
<td>600-1200</td>
<td>at high end of predicted range</td>
</tr>
<tr>
<td>Oakland</td>
<td>41°E 01′42″; 74°W 14′42″</td>
<td>glacial-lake sand and gravel</td>
<td>1578</td>
<td>600-1200</td>
<td>greater than predicted range; gravel increases velocity</td>
</tr>
<tr>
<td>Van Saun Park --north entrance</td>
<td>40°E 57′07″; 74°W 02′52″</td>
<td>glacial-lake sand</td>
<td>846</td>
<td>600-1200</td>
<td>agrees</td>
</tr>
<tr>
<td>Mahwah</td>
<td>41°E 06′35″; 74°W 09′30″</td>
<td>alluvial silt, sand, and gravel</td>
<td>1203</td>
<td>600-1200</td>
<td>at high end of predicted range; gravel increases velocity</td>
</tr>
<tr>
<td>Old Tappan</td>
<td>41°E 00′37″; 74°W 00′37″</td>
<td>alluvial silt and sand</td>
<td>809</td>
<td>600-1200</td>
<td>agrees</td>
</tr>
<tr>
<td>Route 287</td>
<td>41°E 05′56″; 74°W 10′14″</td>
<td>alluvial silt, sand, and gravel</td>
<td>1214</td>
<td>600-1200</td>
<td>at high end of predicted range; gravel increases velocity</td>
</tr>
<tr>
<td>Closter</td>
<td>40°E 58′11″; 73°E 57′30″</td>
<td>glacial-lake silt and clay</td>
<td>925</td>
<td>600-1200</td>
<td>agrees</td>
</tr>
<tr>
<td>McClellan Road</td>
<td>41°E 00′25″; 73°E 57′47″</td>
<td>glacial-lake silt and clay</td>
<td>826</td>
<td>600-1200</td>
<td>agrees</td>
</tr>
<tr>
<td>Harrington Park layer 1</td>
<td>41°E 00′05″; 73°E 59′16″</td>
<td>glacial-lake silt and clay</td>
<td>656</td>
<td>600-1200</td>
<td>agrees</td>
</tr>
</tbody>
</table>
Twelve shear geophones were used with a 6-foot spacing. The source was located 6 feet from the first geophone. Each geophone was oriented with its axis of movement parallel to the generating source. The source is a 6-inch channel steel beam that is 5 feet long and has triangular teeth welded to the bottom. A 10-pound sledgehammer is used to impact either side of the source. Two people stand on the source while it is being hit to improve ground coupling.

Compressional (P-wave) data were collected using the standard seismic refraction line type setup. Twelve 8-hertz geophones were used in-line at 6-foot spacing. A 10 pound sledgehammer and a strike plate are used as a source.

The first seismic break on the raw records from both the shear and compressional data is picked on the records much like picking first breaks for seismic refraction data. The regression velocity is calculated using the inverse slope on the time-distance curves. The data are also presented numerically as the interval velocity between consecutive geophones along each line and as an average of the interval velocities. This is done to check for lateral velocity variation along each seismic line. A large difference between the average velocity and the regression velocity is indicative of lateral inhomogeneities within the soil; however, the regression velocity is statistically more accurate as a bulk soil property. At the Harrington Park site, glacial-lake clay is about 10 feet thick over till. This layering is indicated by refracted arrivals in both the P and S wave, with the slower velocities for layer 1 recording the lake clay and the faster velocities for layer 2 recording the till.

Table 3 shows that 9 of the 14 tests yield velocities that fall within the range predicted from the county-wide SPT data. The Mahwah, Oakland, and Route 287 sites all yielded faster-than-predicted velocities. The alluvial sediments at the Mahwah and Route 287 sites, and the glacial-lake sand and gravel at Oakland, all of which are in the Ramapo River Valley, are more gravelly than the alluvial and glacial-lake deposits from which the SPT data were obtained, which are predominantly in the Hackensack Valley. In soils, shear-wave velocity generally increases with mean grain size (Fumal and Tinsley, 1985), so gravels will be faster than sands. The gravelly deposits at the Mahwah, Oakland, and Route 287 sites show this effect, as they
yielded higher velocities than the glacial-lake and alluvial sands at the Van Saun and Old Tappan sites.

Two of the five till measurements yielded lower-than-predicted velocities. Most till is deposited beneath glacial ice, and so is overconsolidated by the weight of the ice. Once exposed, however, the compact matrix of the till is broken apart and loosened by weathering and soil processes, so that the upper several feet of outcropping till is decompacted. Also, as the glacier margin retreats, material on the surface of the ice is deposited on top of the till laid down at the base of the glacier. This surface till is noncompact because it was never compressed by the ice. The loose surface till is recorded by SPT data from borings drilled into till outcrops. Typically, the upper several feet yield low blow counts, which increase significantly below the weathered zone. The tests at the Harrington Park and Wood Dale sites may have sampled weathered or noncompressed till. The high velocity at the Campgaw site compared to the Railroad Avenue and Van Saun sites reflects the high concentration of large gneiss boulders at the Campgaw site on Campgaw Mountain. Boulders, which increase shear-wave velocity, are rare in the till at the other test locations.

Soil classes were adjusted based on the above observations. Gravelly alluvium and gravel-rich glacial-lake and glacial-stream deposits in the Ramapo, Pascack, and upper Saddle River valleys were placed into class C rather than the D class indicated by the SPT data from nongravelly deposits. Till was maintained as class C because the boring data indicate that compact till everywhere underlies the loose till, which is generally less than 5 feet thick.

HAZUS Simulations: To evaluate the effect of upgraded geology, a total of ten simulations were run. Earthquake magnitudes of 5, 5.5, 6, 6.5, and 7, with an epicenter at 74 EW; 41 EN (Appendix A) and a focal depth of 10 km, were simulated for both the default and the upgraded geology. The selected magnitudes span the range of potential damaging earthquakes in the region. The largest local earthquake in historic records was an estimated magnitude 5.2 event in 1884 with an epicenter offshore from Brooklyn, and earthquakes with magnitudes between 6 and 7 have been recorded or estimated from historical accounts in the Boston area, southern Quebec, and the St. Lawrence Valley.

To upgrade the geologic data, soil type, liquefaction susceptibility, and landslide susceptibility were modified for each census tract using the seismic soil class, liquefaction susceptibility, and landslide susceptibility maps (folded in pocket). Many census tracts, particularly in the northern and western parts of the county, spanned two or more soil types. In these cases, the dominant soil under the most densely built part of the census tract was selected. Also, areas subject to landsliding cover only a small part of the census tracts that were assigned a landslide hazard. The default geology assigned a uniform soil type (class D), and no liquefaction or landslide susceptibility, for the entire county. Maps of the upgraded and default geology, by census tract, are provided in Appendix A. It was determined that building damage was the output parameter that would most directly illustrate the effect of geology on the simulations, because it does not directly incorporate economic and demographic patterns. Appendices B through K provide tables showing the number of the buildings (classed by use) in various states of damage, and the probability of a given damage state for a given use class. The appendices also provide maps showing the percent moderate or greater building damage by census tract for the various simulations, and the total economic loss by census tract. The moderate-or-greater cutoff was
used because buildings with moderate damage must be evacuated and inspected prior to
reoccupancy. Thus, moderate damage requires significant population disruptions and emergency
response. The total economic loss includes repair and replacement costs, contents damage,
business inventory damage, relocation costs, capital-related income costs, wage loss, and rental
loss. A “Quick Assessment Report” summarizing damage, economic loss, casualties, and
population displacement for each HAZUS run is also provided.

**Evaluation of Simulations:** The upgraded geologic data produced increased damage estimates
in the Hackensack Valley and Meadowlands areas of the county and decreased damage estimates
elsewhere for all of the magnitudes, although the effect is most pronounced at magnitudes 5.5, 6,
and 6.5. This pattern reflects the softer wetland and glacial-lake soils beneath the Hackensack
Valley and Meadowlands, which are of less stable soil class and are more liquefiable than the
default conditions, and the compact glacial till soil on most of the upland areas of the county,
which is of stronger soil class than the default. The effect of the stronger upgrade soils is best
shown on the Palisades Ridge, where thin till and exposed diabase bedrock give an upgrade soil
class of A, and the number of buildings experiencing moderate or greater damage is about 30%-
less than in the default runs, which use a soil class of D.

Because the upland areas of the county are more extensive in area than the Hackensack
Valley and Meadowlands, the total number of buildings with moderate or greater damage is less
with the upgraded geologic data than with the default data. Thus, county-wide structural damage
to buildings, and the resulting economic loss, population displacement, and casualties, are
greater with the default geology than with the upgraded geology, again reflecting the stronger
upland soils in the upgraded case.

**Reference Cited (additional references are provided on the map plates)**

Fumal, T. E., and Tinsley, J. C., 1985, Mapping shear-wave velocities of near-surface geologic
materials, *in* Ziony, J. I., ed., Evaluating earthquake hazards in the Los Angeles region--an earth-
APPENDIX A

Maps of Bergen County, with census tracts, showing:

Epicenter location
Default soil type
Default liquefaction susceptibility
Default landslide susceptibility
Upgraded soil type
Upgraded liquefaction susceptibility
Upgraded landslide susceptibility
Study Region:
Bergen County

Table Description:
Study Region Epicenter

Epicenter (Arbitrary)
74 degrees longitude
41 degrees latitude

Data from the HAZUS GIS software.
November 1, 2000
Study Region: Bergen County

Table Description: Default Soil Map

Soil Type
- Class D

Data from the HAZUS GIS software.
November 1, 2000
Study Region: Bergen County

Table Description: Default Liquefaction Map

Liquefaction Susceptibility

- None

Data from the HAZUS GIS software.
November 1, 2000
Study Region: Bergen County

Table Description: Default Landslide Map

Landslide Susceptibility
- None

Data from the HAZUS GIS software. November 1, 2000
Study Region:
Bergen County

Table Description:
New Jersey Geological Survey Soils Map

Soil Type
- Class A
- Class C
- Class D
- Class E

Data generated by the New Jersey Geological Survey.
November 1, 2000
Study Region:
Bergen County

Table Description:
New Jersey Geological Survey Landslide Map

Landslide Susceptibility:
- None
- Susceptibility I
- Susceptibility II
- Susceptibility III
- Susceptibility IV
- Susceptibility V
- Susceptibility VII

Data generated by the New Jersey Geological Survey.
November 1, 2000
Study Region: Bergen County

Table Description: New Jersey Geological Survey Liquefaction Map

Liquefaction Susceptibility
- None
- Very low
- Low
- Medium
- High

Data generated by the New Jersey Geological Survey.
November 1, 2000
APPENDIX B

Magnitude 5 with default geology
Study Region
Bergen County

Scenario Description:
5.0 Default Scenario

Percentage Of Buildings With Moderate and Greater Damage

Data from the HAZUS GIS software and the New Jersey Geological Survey.
November 1, 2000
Study Region: Bergen County

Table Description: Loss - GBS - Total Loss

Scenario Description: 5.0 Default Scenario

Total Loss (Thousands of Dollars)

[Blank Box] 0 to 50000

Data from the HAZUS GIS software.
November 7, 2000
## Building Damage By General Occupancy

**November 07, 2000**

<table>
<thead>
<tr>
<th>Square Footage (Thousand. sq.ft)</th>
<th>None</th>
<th>Slight</th>
<th>Moderate</th>
<th>Extensive</th>
<th>Complete</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>New Jersey</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bergen</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agriculture</td>
<td>1,828</td>
<td>59.12</td>
<td>6.24</td>
<td>2.35</td>
<td>0.42</td>
</tr>
<tr>
<td>Commercial</td>
<td>168,771</td>
<td>67.45</td>
<td>7.07</td>
<td>3.28</td>
<td>0.58</td>
</tr>
<tr>
<td>Education</td>
<td>8,495</td>
<td>58.60</td>
<td>5.78</td>
<td>2.68</td>
<td>0.49</td>
</tr>
<tr>
<td>Government</td>
<td>1,744</td>
<td>73.30</td>
<td>7.02</td>
<td>3.33</td>
<td>0.47</td>
</tr>
<tr>
<td>Industrial</td>
<td>62,870</td>
<td>65.52</td>
<td>6.39</td>
<td>3.13</td>
<td>0.48</td>
</tr>
<tr>
<td>Religion</td>
<td>5,705</td>
<td>59.20</td>
<td>6.26</td>
<td>2.89</td>
<td>0.58</td>
</tr>
<tr>
<td>Residential</td>
<td>425,393</td>
<td>75.89</td>
<td>6.61</td>
<td>1.78</td>
<td>0.03</td>
</tr>
<tr>
<td><strong>State Average</strong></td>
<td>674,806</td>
<td>65.58</td>
<td>6.48</td>
<td>2.78</td>
<td>0.43</td>
</tr>
<tr>
<td><strong>Study Region Average</strong></td>
<td>674,806</td>
<td>65.58</td>
<td>6.48</td>
<td>2.78</td>
<td>0.43</td>
</tr>
</tbody>
</table>
# Building Damage by Count by General Occupancy

November 07, 2000

## # of Buildings

<table>
<thead>
<tr>
<th>None</th>
<th>Slight</th>
<th>Moderate</th>
<th>Extensive</th>
<th>Complete</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>115</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>118</td>
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<tr>
<td>6,803</td>
<td>517</td>
<td>141</td>
<td>3</td>
<td>0</td>
<td>7,464</td>
</tr>
<tr>
<td>379</td>
<td>17</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>399</td>
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<tr>
<td>57</td>
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<tr>
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<td>2,581</td>
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<tr>
<td>344</td>
<td>20</td>
<td>9</td>
<td>1</td>
<td>0</td>
<td>374</td>
</tr>
<tr>
<td>180,287</td>
<td>15,280</td>
<td>3,674</td>
<td>393</td>
<td>61</td>
<td>199,695</td>
</tr>
<tr>
<td>190,383</td>
<td>15,977</td>
<td>3,870</td>
<td>397</td>
<td>61</td>
<td>210,688</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Study region

<table>
<thead>
<tr>
<th>None</th>
<th>Slight</th>
<th>Moderate</th>
<th>Extensive</th>
<th>Complete</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>190,383</td>
<td>15,977</td>
<td>3,870</td>
<td>397</td>
<td>61</td>
<td>210,688</td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
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</tbody>
</table>

Study Region: ber1
Scenario: hazdef5
Quick Assessment Report

November 7, 200

Regional Statistics

<table>
<thead>
<tr>
<th>Category</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area (Square Miles)</td>
<td>247</td>
</tr>
<tr>
<td>Number of Census Tracts</td>
<td>210</td>
</tr>
<tr>
<td>Number of Buildings</td>
<td></td>
</tr>
<tr>
<td>Residential (x 1000)</td>
<td>200</td>
</tr>
<tr>
<td>Total (x 1000)</td>
<td>211</td>
</tr>
<tr>
<td>Number of People in the Region (x 1000)</td>
<td>825</td>
</tr>
<tr>
<td>Building Exposure ($ Millions)</td>
<td></td>
</tr>
<tr>
<td>Residential</td>
<td>32,800</td>
</tr>
<tr>
<td>Total</td>
<td>49,300</td>
</tr>
</tbody>
</table>

Scenario Results

<table>
<thead>
<tr>
<th>Category</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum PGA (g)</td>
<td>0.37</td>
</tr>
<tr>
<td>Number of Buildings Damaged</td>
<td></td>
</tr>
<tr>
<td>Damage Level</td>
<td>Residential</td>
</tr>
<tr>
<td>Slight</td>
<td>15,300</td>
</tr>
<tr>
<td>Moderate</td>
<td>3,700</td>
</tr>
<tr>
<td>Extensive</td>
<td>400</td>
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<tr>
<td>Complete</td>
<td>100</td>
</tr>
<tr>
<td>Total</td>
<td>19,400</td>
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</tbody>
</table>

Casualties

<table>
<thead>
<tr>
<th>Severity</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severity 1 (Medical treatment without hospitalization)</td>
<td>113</td>
</tr>
<tr>
<td>Severity 2 (Hospitalization but not life threatening)</td>
<td>15</td>
</tr>
<tr>
<td>Severity 3 (Hospitalization and life threatening)</td>
<td>1</td>
</tr>
<tr>
<td>Severity 4 (Fatalities)</td>
<td>1</td>
</tr>
</tbody>
</table>

Shelter

<table>
<thead>
<tr>
<th>Category</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Displaced Households (# households)</td>
<td>220</td>
</tr>
<tr>
<td>Short Term Shelter (# people)</td>
<td>130</td>
</tr>
</tbody>
</table>

Economic Loss

<table>
<thead>
<tr>
<th>Category</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Property Damage (Capital Stock) Losses ($ Millions)</td>
<td>1,250</td>
</tr>
<tr>
<td>Business Interruption (Income) Losses ($ Millions)</td>
<td>110</td>
</tr>
<tr>
<td>Total ($ Millions)</td>
<td>1,360</td>
</tr>
</tbody>
</table>

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.

Study Region : ber1
Scenario : hazdef5
APPENDIX C

Magnitude 5 with upgraded geology
Study Region:
Bergen County

Scenario Description:
5.0 Upgrade Scenario

Percentage Of Buildings With Moderate and Greater Damage

Data from the HAZUS GIS software and the New Jersey Geological Survey. November 1, 2000
Study Region:
Bergen County

Table Description:
Loss - GBS - Total Loss

Scenario Description:
5.0 Upgrade Scenario

Total Loss
(Thousands of Dollars)

0 to 50000

Data from the HAZUS GIS software and the New Jersey Geological Survey.
November 8, 2000
# Building Damage By General Occupancy

**November 07, 2000**

<table>
<thead>
<tr>
<th>Square Footage (Thousand sq.ft)</th>
<th>Damage State Probability (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>None</td>
</tr>
<tr>
<td>New Jersey</td>
<td></td>
</tr>
<tr>
<td>Bergen</td>
<td></td>
</tr>
<tr>
<td>Agriculture</td>
<td>1,828</td>
</tr>
<tr>
<td>Commercial</td>
<td>168,771</td>
</tr>
<tr>
<td>Education</td>
<td>8,495</td>
</tr>
<tr>
<td>Government</td>
<td>1,744</td>
</tr>
<tr>
<td>Industrial</td>
<td>62,870</td>
</tr>
<tr>
<td>Religion</td>
<td>5,705</td>
</tr>
<tr>
<td>Residential</td>
<td>425,393</td>
</tr>
<tr>
<td>State Average</td>
<td>674,806</td>
</tr>
<tr>
<td>Study Region Average</td>
<td>674,806</td>
</tr>
</tbody>
</table>

**Study Region:** ber1  
**Scenario:** haznj5
**Building Damage by Count by General Occupancy**

November 07, 2000

<table>
<thead>
<tr>
<th></th>
<th>None</th>
<th>Slight</th>
<th>Moderate</th>
<th>Extensive</th>
<th>Complete</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>118</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>119</td>
</tr>
<tr>
<td>Commercial</td>
<td>6,975</td>
<td>388</td>
<td>117</td>
<td>10</td>
<td>0</td>
<td>7,490</td>
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<tr>
<td>Education</td>
<td>387</td>
<td>10</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>398</td>
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<tr>
<td>Government</td>
<td>57</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>57</td>
</tr>
<tr>
<td>Industrial</td>
<td>2,415</td>
<td>123</td>
<td>44</td>
<td>7</td>
<td>0</td>
<td>2,569</td>
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<tr>
<td>Religion</td>
<td>352</td>
<td>21</td>
<td>6</td>
<td>1</td>
<td>0</td>
<td>380</td>
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<tr>
<td>Residential</td>
<td>187,166</td>
<td>10,044</td>
<td>2,017</td>
<td>394</td>
<td>27</td>
<td>199,648</td>
</tr>
<tr>
<td><strong>Total State</strong></td>
<td>197,470</td>
<td>10,587</td>
<td>2,185</td>
<td>412</td>
<td>27</td>
<td>210,681</td>
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</tbody>
</table>

**Study region**

<table>
<thead>
<tr>
<th></th>
<th>None</th>
<th>Slight</th>
<th>Moderate</th>
<th>Extensive</th>
<th>Complete</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>197,470</td>
<td>10,587</td>
<td>2,185</td>
<td>412</td>
<td>27</td>
<td>210,681</td>
</tr>
</tbody>
</table>

**Study Region:** ber1  
**Scenario:** haznj5
## Regional Statistics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value (x 1000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area (Square Miles)</td>
<td>247</td>
</tr>
<tr>
<td>Number of Census Tracts</td>
<td>210</td>
</tr>
<tr>
<td>Number of Buildings</td>
<td></td>
</tr>
<tr>
<td>Residential (x 1000)</td>
<td>200</td>
</tr>
<tr>
<td>Total (x 1000)</td>
<td>211</td>
</tr>
<tr>
<td>Number of People in the Region (x 1000)</td>
<td>825</td>
</tr>
</tbody>
</table>

### Building Exposure ($ Millions)

<table>
<thead>
<tr>
<th>Component</th>
<th>Value (x 1000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>32,800</td>
</tr>
<tr>
<td>Total</td>
<td>49,300</td>
</tr>
</tbody>
</table>

## Scenario Results

### Maximum PGA (g)

- 0.37

### Number of Buildings Damaged

<table>
<thead>
<tr>
<th>Damage Level</th>
<th>Residential</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slight</td>
<td>10,000</td>
<td>10,600</td>
</tr>
<tr>
<td>Moderate</td>
<td>2,000</td>
<td>2,200</td>
</tr>
<tr>
<td>Extensive</td>
<td>400</td>
<td>400</td>
</tr>
<tr>
<td>Complete</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>12,500</strong></td>
<td><strong>13,200</strong></td>
</tr>
</tbody>
</table>

### Casualties

- **Severity 1** (Medical treatment without hospitalization): 80
- **Severity 2** (Hospitalization but not life threatening): 10
- **Severity 3** (Hospitalization and life threatening): 1
- **Severity 4** (Fatalities): 1

### Shelter

- **Displaced Households (# households)**: 240
- **Short Term Shelter (# people)**: 150

### Economic Loss

<table>
<thead>
<tr>
<th>Component</th>
<th>Value ($ Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Property Damage (Capital Stock) Losses</td>
<td>1,080</td>
</tr>
<tr>
<td>Business Interruption (Income) Losses</td>
<td>80</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,160</strong></td>
</tr>
</tbody>
</table>

---

**Disclaimer:**
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Study Region: ber1
Scenario: haznj5
APPENDIX D

Magnitude 5.5 with default geology
Study Region: Bergen County

Scenario Description:
5.5 Default Scenario

Percentage Of Buildings With Moderate and Greater Damage

Data from the HAZUS GIS software and the New Jersey Geological Survey.

November 1, 2000
Study Region: Bergen County

Table Description: Loss - GBS - Total Loss
Scenario Description: 5.5 Default Scenario

Total Loss (Thousands of Dollars)
- 0 to 50000
- 50 to 100000

Data from the HAZUS GIS software.
November 7, 2000
# Building Damage By General Occupancy

<table>
<thead>
<tr>
<th>Square Footage (Thousand. sq.ft)</th>
<th>Damage State Probability (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>None</td>
</tr>
<tr>
<td>New Jersey</td>
<td></td>
</tr>
<tr>
<td>Bergen</td>
<td></td>
</tr>
<tr>
<td>Agriculture</td>
<td>1,828</td>
</tr>
<tr>
<td>Commercial</td>
<td>168,771</td>
</tr>
<tr>
<td>Education</td>
<td>8,495</td>
</tr>
<tr>
<td>Government</td>
<td>1,744</td>
</tr>
<tr>
<td>Industrial</td>
<td>62,870</td>
</tr>
<tr>
<td>Religion</td>
<td>5,705</td>
</tr>
<tr>
<td>Residential</td>
<td>425,393</td>
</tr>
<tr>
<td>State Average</td>
<td>674,806</td>
</tr>
<tr>
<td>Study Region Average</td>
<td>674,806</td>
</tr>
</tbody>
</table>

Study Region: ber1
Scenario: hazdef55
# Building Damage by Count by General Occupancy

**November 07, 2000**

<table>
<thead>
<tr>
<th></th>
<th>None</th>
<th>Slight</th>
<th>Moderate</th>
<th>Extensive</th>
<th>Complete</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>New Jersey</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bergen</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agriculture</td>
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<td>18</td>
<td>8</td>
<td>0</td>
<td>0</td>
<td>116</td>
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<td>Commercial</td>
<td>4,942</td>
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<td>963</td>
<td>141</td>
<td>1</td>
<td>7,380</td>
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<td>38</td>
<td>3</td>
<td>0</td>
<td>368</td>
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<tr>
<td>Government</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>56</td>
</tr>
<tr>
<td>Industrial</td>
<td>1,791</td>
<td>385</td>
<td>289</td>
<td>44</td>
<td>0</td>
<td>2,509</td>
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<td>232</td>
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<td>45</td>
<td>10</td>
<td>1</td>
<td>353</td>
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<tr>
<td>Residential</td>
<td>120,957</td>
<td>52,187</td>
<td>22,173</td>
<td>4,076</td>
<td>511</td>
<td>199,904</td>
</tr>
<tr>
<td><strong>Total State</strong></td>
<td>128,344</td>
<td>54,039</td>
<td>23,516</td>
<td>4,274</td>
<td>513</td>
<td>210,686</td>
</tr>
</tbody>
</table>

|                  |      |        |          |           |          |       |
| **Study region** |      |        |          |           |          |       |
| BER1             | 128,344| 54,039 | 23,516  | 4,274     | 513      | 210,686 |

Study Region: ber1
Scenario: hazdef55
Regional Statistics

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area (Square Miles)</td>
<td>247</td>
</tr>
<tr>
<td>Number of Census Tracts</td>
<td>210</td>
</tr>
<tr>
<td>Number of Buildings</td>
<td></td>
</tr>
<tr>
<td>Residential (x 1000)</td>
<td>200</td>
</tr>
<tr>
<td>Total (x 1000)</td>
<td>211</td>
</tr>
<tr>
<td>Number of People in the Region (x 1000)</td>
<td>825</td>
</tr>
<tr>
<td>Building Exposure ($ Millions)</td>
<td></td>
</tr>
<tr>
<td>Residential</td>
<td>32,800</td>
</tr>
<tr>
<td>Total</td>
<td>49,300</td>
</tr>
</tbody>
</table>

Scenario Results

<table>
<thead>
<tr>
<th>Description</th>
<th>Residential</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum PGA (g)</td>
<td></td>
<td>0.49</td>
</tr>
<tr>
<td>Number of Buildings Damaged</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slight</td>
<td>52,200</td>
<td>54,000</td>
</tr>
<tr>
<td>Moderate</td>
<td>22,200</td>
<td>23,500</td>
</tr>
<tr>
<td>Extensive</td>
<td>4,100</td>
<td>4,300</td>
</tr>
<tr>
<td>Complete</td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td>Total</td>
<td>78,900</td>
<td>82,300</td>
</tr>
</tbody>
</table>

Casualties

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severity 1 (Medical treatment without hospitalization)</td>
<td>728</td>
</tr>
<tr>
<td>Severity 2 (Hospitalization but not life threatening)</td>
<td>106</td>
</tr>
<tr>
<td>Severity 3 (Hospitalization and life threatening)</td>
<td>9</td>
</tr>
<tr>
<td>Severity 4 (Fatalities)</td>
<td>9</td>
</tr>
</tbody>
</table>

Shelter

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Displaced Households (# households)</td>
<td>3,280</td>
</tr>
<tr>
<td>Short Term Shelter (# people)</td>
<td>1,900</td>
</tr>
</tbody>
</table>

Economic Loss

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Property Damage (Capital Stock) Losses ($ Millions)</td>
<td>3,220</td>
</tr>
<tr>
<td>Business Interruption (Income) Losses ($ Millions)</td>
<td>650</td>
</tr>
<tr>
<td>Total ($ Millions)</td>
<td>3,870</td>
</tr>
</tbody>
</table>

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Study Region : ber1
Scenario : hazdef55
APPENDIX E

Magnitude 5.5 with upgraded geology
Study Region: Bergen County

Scenario Description: 5.5 Upgrade Scenario

Percentage Of Buildings With Moderate and Greater Damage

Data from the HAZUS GIS software and the New Jersey Geological Survey. November 1, 2000
Study Region: Bergen County

Table Description:
Loss - GBS - Total Loss

Scenario Description:
5.5 Upgrade Scenario

Total Loss
(Thousands of Dollars)

- 0 to 50000
- 50000 to 100000
- 100000 to 200000

Data from the HAZUS GIS software and the New Jersey Geological Survey. November 8, 2000
# Building Damage By General Occupancy

November 07, 2000

<table>
<thead>
<tr>
<th>Square Footage (Thousand. sq.ft)</th>
<th>Damage State Probability (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>None</td>
</tr>
<tr>
<td>Agricultural</td>
<td>1,828</td>
</tr>
<tr>
<td>Commercial</td>
<td>168,771</td>
</tr>
<tr>
<td>Education</td>
<td>8,495</td>
</tr>
<tr>
<td>Government</td>
<td>1,744</td>
</tr>
<tr>
<td>Industrial</td>
<td>62,870</td>
</tr>
<tr>
<td>Religion</td>
<td>5,705</td>
</tr>
<tr>
<td>Residential</td>
<td>425,393</td>
</tr>
<tr>
<td><strong>State Average</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Study Region Average</strong></td>
<td></td>
</tr>
</tbody>
</table>

---

**Study Region**: ber1  
**Scenario**: haznj55
## Building Damage by Count by General Occupancy

**November 07, 2000**

<table>
<thead>
<tr>
<th>New Jersey</th>
<th># of Buildings</th>
<th>None</th>
<th>Slight</th>
<th>Moderate</th>
<th>Extensive</th>
<th>Complete</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Agriculture</td>
<td>97</td>
<td>14</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>116</td>
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<tr>
<td></td>
<td>Commercial</td>
<td>5,367</td>
<td>1,142</td>
<td>760</td>
<td>140</td>
<td>7</td>
<td>7,416</td>
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<td>364</td>
<td>263</td>
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<td>2,558</td>
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<td></td>
<td>Religion</td>
<td>257</td>
<td>57</td>
<td>35</td>
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<td></td>
<td>Residential</td>
<td>140,845</td>
<td>40,524</td>
<td>15,238</td>
<td>2,799</td>
<td>406</td>
<td>199,812</td>
</tr>
<tr>
<td><strong>Total State</strong></td>
<td></td>
<td>148,801</td>
<td>42,141</td>
<td>16,327</td>
<td>3,001</td>
<td>417</td>
<td>210,687</td>
</tr>
<tr>
<td><strong>Study region</strong></td>
<td></td>
<td>148,801</td>
<td>42,141</td>
<td>16,327</td>
<td>3,001</td>
<td>417</td>
<td>210,687</td>
</tr>
</tbody>
</table>

---

**Study Region:** ber1  
**Scenario:** haznj55
Quick Assessment Report

November 7, 200

Regional Statistics

<table>
<thead>
<tr>
<th>Area (Square Miles)</th>
<th>247</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Census Tracts</td>
<td>210</td>
</tr>
<tr>
<td>Number of Buildings</td>
<td></td>
</tr>
<tr>
<td>Residential (x 1000)</td>
<td>200</td>
</tr>
<tr>
<td>Total (x 1000)</td>
<td>211</td>
</tr>
<tr>
<td>Number of People in the Region (x 1000)</td>
<td>825</td>
</tr>
<tr>
<td>Building Exposure ($ Millions)</td>
<td></td>
</tr>
<tr>
<td>Residential</td>
<td>32,800</td>
</tr>
<tr>
<td>Total</td>
<td>49,300</td>
</tr>
</tbody>
</table>

Scenario Results

| Maximum PGA (g)                      | 0.49 |
| Number of Buildings Damaged          |     |
| Damage Level                         |     |
| Slight                               | 40,500 |
| Moderate                             | 15,200 |
| Extensive                            | 2,800 |
| Complete                             | 400  |
| Total                                | 59,000 |

Casualties

| Severity 1 (Medical treatment without hospitalization) | 528 |
| Severity 2 (Hospitalization but not life threatening)  | 78  |
| Severity 3 (Hospitalization and life threatening)     | 8   |
| Severity 4 (Fatalities)                               | 7   |

Shelter

| Displaced Households (# households) | 2,390 |
| Short Term Shelter (# people)       | 1,440 |

Economic Loss

| Property Damage (Capital Stock) Losses ($ Millions) | 2,730 |
| Business Interruption (Income) Losses ($ Millions)  | 510  |
| Total ($ Millions)                               | 3,240 |

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.

Study Region : ber1
Scenario : haznj55
APPENDIX F

Magnitude 6 with default geology
Study Region: Bergen County

Scenario Description: 6.0 Default Scenario

Percentage Of Buildings With Moderate and Greater Damage

Data from the HAZUS GIS software and the New Jersey Geological Survey. November 1, 2000
Study Region: Bergen County

Table Description:
Loss - GBS - Total Loss

Scenario Description:
6.0 Default Scenario

Total Loss
(Thousands of Dollars)

- 0 to 50000
- 50000 to 100000
- 100000 to 200000

Data from the HAZUS GIS software. November 7, 2000
# Building Damage By General Occupancy

**November 07, 2000**

<table>
<thead>
<tr>
<th>Square Footage (Thousand sq.ft)</th>
<th>Damage State Probability (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>None</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>New Jersey</td>
<td></td>
</tr>
<tr>
<td>Bergen</td>
<td></td>
</tr>
<tr>
<td>Agriculture</td>
<td>1,828</td>
</tr>
<tr>
<td>Commercial</td>
<td>168,771</td>
</tr>
<tr>
<td>Education</td>
<td>8,495</td>
</tr>
<tr>
<td>Government</td>
<td>1,744</td>
</tr>
<tr>
<td>Industrial</td>
<td>62,870</td>
</tr>
<tr>
<td>Religion</td>
<td>5,705</td>
</tr>
<tr>
<td>Residential</td>
<td>425,393</td>
</tr>
<tr>
<td>State Average</td>
<td>674,806</td>
</tr>
<tr>
<td>Study Region Average</td>
<td>674,806</td>
</tr>
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</table>

**Study Region:** ber1  
**Scenario:** hazdef6
## Building Damage by Count by General Occupancy

November 07, 2000

<table>
<thead>
<tr>
<th># of Buildings</th>
<th>None</th>
<th>Slight</th>
<th>Moderate</th>
<th>Extensive</th>
<th>Complete</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>New Jersey</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Bergen</td>
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<td>Agriculture</td>
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<td>20</td>
<td>24</td>
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<td>2,111</td>
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<td>110</td>
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<td>0</td>
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<td>25</td>
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<td>89</td>
<td>34</td>
<td>8</td>
<td>314</td>
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<td>Residential</td>
<td>71,304</td>
<td>67,798</td>
<td>46,139</td>
<td>12,157</td>
<td>2,795</td>
<td>200,193</td>
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<tr>
<td><strong>Total State</strong></td>
<td>75,242</td>
<td>70,058</td>
<td>49,174</td>
<td>13,290</td>
<td>2,930</td>
<td>210,694</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Study region</th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>75,242</td>
<td>70,058</td>
<td>49,174</td>
<td>13,290</td>
<td>2,930</td>
<td>210,694</td>
<td></td>
</tr>
</tbody>
</table>

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**Study Region:** ber1  
**Scenario:** hazdef6
Quick Assessment Report

November 7, 200

Regional Statistics

<table>
<thead>
<tr>
<th>Area (Square Miles)</th>
<th>247</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Census Tracts</td>
<td>210</td>
</tr>
<tr>
<td>Number of Buildings</td>
<td></td>
</tr>
<tr>
<td>Residential (x 1000)</td>
<td>200</td>
</tr>
<tr>
<td>Total (x 1000)</td>
<td>211</td>
</tr>
<tr>
<td>Number of People in the Region (x 1000)</td>
<td>825</td>
</tr>
<tr>
<td>Building Exposure ($ Millions)</td>
<td></td>
</tr>
<tr>
<td>Residential</td>
<td>32,800</td>
</tr>
<tr>
<td>Total</td>
<td>49,300</td>
</tr>
</tbody>
</table>

Scenario Results

<table>
<thead>
<tr>
<th>Maximum PGA (g)</th>
<th>0.68</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Buildings Damaged</td>
<td></td>
</tr>
<tr>
<td>Damage Level</td>
<td>Residential</td>
</tr>
<tr>
<td>Slight</td>
<td>67,800</td>
</tr>
<tr>
<td>Moderate</td>
<td>46,100</td>
</tr>
<tr>
<td>Extensive</td>
<td>12,200</td>
</tr>
<tr>
<td>Complete</td>
<td>2,800</td>
</tr>
<tr>
<td>Total</td>
<td>128,900</td>
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</table>

Casualties

<table>
<thead>
<tr>
<th>Severity</th>
<th>(Medical treatment without hospitalization)</th>
<th>2,356</th>
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</thead>
<tbody>
<tr>
<td>Severity</td>
<td>(Hospitalization but not life threatening)</td>
<td>384</td>
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<tr>
<td>Severity</td>
<td>(Hospitalization and life threatening)</td>
<td>44</td>
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<tr>
<td>Severity</td>
<td>(Fatalities)</td>
<td>41</td>
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</tbody>
</table>

Shelter

<table>
<thead>
<tr>
<th>Displaced Households (# households)</th>
<th>13,570</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short Term Shelter (# people)</td>
<td>7,870</td>
</tr>
</tbody>
</table>

Economic Loss

<table>
<thead>
<tr>
<th>Property Damage (Capital Stock) Losses ($ Millions)</th>
<th>6,560</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business Interruption (Income) Losses ($ Millions)</td>
<td>1,960</td>
</tr>
<tr>
<td>Total ($ Millions)</td>
<td>8,520</td>
</tr>
</tbody>
</table>

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Study Region: ber1
Scenario: hazdef6
APPENDIX G

Magnitude 6 with upgraded geology
Study Region: Bergen County

Scenario Description: 6.0 Upgrade Scenario

Percentage Of Buildings With Moderate and Greater Damage

Data from the HAZUS GIS software and the New Jersey Geological Survey.

November 1, 2000

Data from the HAZUS GIS software and the New Jersey Geological Survey.
November 1, 2000
Study Region: Bergen County

Table Description: Loss - GBS - Total Loss

Scenario Description: 6.0 Upgrade Scenario

Total Loss (Thousands of Dollars)
- 0 to 50000
- 50000 to 100000
- 100000 to 200000
- 200000 to 300000

Data from the HAZUS GIS software and the New Jersey Geological Survey, November 8, 2000
# Building Damage By General Occupancy

**November 07, 2000**

<table>
<thead>
<tr>
<th>Square Footage (Thousand sq.ft)</th>
<th>Damage State Probability (%)</th>
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<tbody>
<tr>
<td></td>
<td>None</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>------</td>
</tr>
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<tr>
<td>Bergen</td>
<td></td>
</tr>
<tr>
<td>Agriculture</td>
<td>1,828</td>
</tr>
<tr>
<td>Commercial</td>
<td>168,771</td>
</tr>
<tr>
<td>Education</td>
<td>8,495</td>
</tr>
<tr>
<td>Government</td>
<td>1,744</td>
</tr>
<tr>
<td>Industrial</td>
<td>62,870</td>
</tr>
<tr>
<td>Religion</td>
<td>5,705</td>
</tr>
<tr>
<td>Residential</td>
<td>425,393</td>
</tr>
<tr>
<td><strong>State Average</strong></td>
<td>674,806</td>
</tr>
<tr>
<td><strong>Study Region Average</strong></td>
<td>674,806</td>
</tr>
</tbody>
</table>

**Study Region:** ber1  
**Scenario:** haznj6
Building Damage by Count by General Occupancy

November 07, 2000

<table>
<thead>
<tr>
<th># of Buildings</th>
<th>None</th>
<th>Slight</th>
<th>Moderate</th>
<th>Extensive</th>
<th>Complete</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Jersey</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bergen</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td>20</td>
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<td>1,831</td>
<td>680</td>
<td>121</td>
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<tr>
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<td>90</td>
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<td>2</td>
<td>346</td>
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<tr>
<td>Government</td>
<td>18</td>
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<td>1</td>
<td>0</td>
<td>0</td>
<td>19</td>
</tr>
<tr>
<td>Industrial</td>
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<td>469</td>
<td>634</td>
<td>243</td>
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<td>73</td>
<td>29</td>
<td>7</td>
<td>318</td>
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<td>34,879</td>
<td>8,892</td>
<td>1,897</td>
<td>200,102</td>
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<tr>
<td>Total State</td>
<td>98,796</td>
<td>62,432</td>
<td>37,528</td>
<td>9,868</td>
<td>2,065</td>
<td>210,689</td>
</tr>
<tr>
<td>Study region</td>
<td>98,796</td>
<td>62,432</td>
<td>37,528</td>
<td>9,868</td>
<td>2,065</td>
<td>210,689</td>
</tr>
</tbody>
</table>

Study Region: ber1
Scenario: haznj6
### Regional Statistics

<table>
<thead>
<tr>
<th>Area (Square Miles)</th>
<th>247</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Census Tracts</td>
<td>210</td>
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<tr>
<td>Number of Buildings</td>
<td>200</td>
</tr>
<tr>
<td>Residential (x 1000)</td>
<td>60,300</td>
</tr>
<tr>
<td>Total (x 1000)</td>
<td>211</td>
</tr>
<tr>
<td>Number of People in the Region (x 1000)</td>
<td>825</td>
</tr>
<tr>
<td>Building Exposure ($ Millions)</td>
<td>32,800</td>
</tr>
<tr>
<td>Residential</td>
<td>32,800</td>
</tr>
<tr>
<td>Total</td>
<td>49,300</td>
</tr>
</tbody>
</table>

### Scenario Results

<table>
<thead>
<tr>
<th>Maximum PGA (g)</th>
<th>0.68</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Buildings Damaged</td>
<td></td>
</tr>
<tr>
<td>Damage Level</td>
<td>Residential</td>
</tr>
<tr>
<td>Slight</td>
<td>60,300</td>
</tr>
<tr>
<td>Moderate</td>
<td>34,900</td>
</tr>
<tr>
<td>Extensive</td>
<td>8,900</td>
</tr>
<tr>
<td>Complete</td>
<td>1,900</td>
</tr>
<tr>
<td>Total</td>
<td>106,000</td>
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</tbody>
</table>

### Casualties

<table>
<thead>
<tr>
<th>Severity</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (Medical treatment without hospitalization)</td>
<td>1,902</td>
</tr>
<tr>
<td>2 (Hospitalization but not life threatening)</td>
<td>326</td>
</tr>
<tr>
<td>3 (Hospitalization and life threatening)</td>
<td>41</td>
</tr>
<tr>
<td>4 (Fatalities)</td>
<td>36</td>
</tr>
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</table>

### Shelter

<table>
<thead>
<tr>
<th>Type</th>
<th>Number</th>
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</thead>
<tbody>
<tr>
<td>Displaced Households (# households)</td>
<td>9,900</td>
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<tr>
<td>Short Term Shelter (# people)</td>
<td>5,890</td>
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### Economic Loss

<table>
<thead>
<tr>
<th>Category</th>
<th>Number ($ Millions)</th>
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</thead>
<tbody>
<tr>
<td>Property Damage (Capital Stock) Losses</td>
<td>5,670</td>
</tr>
<tr>
<td>Business Interruption (Income) Losses</td>
<td>1,610</td>
</tr>
<tr>
<td>Total</td>
<td>7,280</td>
</tr>
</tbody>
</table>

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Study Region: ber1
Scenario: haznj6
APPENDIX H

Magnitude 6.5 with default geology
Study Region:
Bergen County

Scenario Description:
6.5 Default Scenario

Percentage Of Buildings With Moderate and Greater Damage

Data from the HAZUS GIS software and the New Jersey Geological Survey.

November 1, 2000
Study Region: Bergen County

Table Description:
Loss - GBS - Total Loss

Scenario Description:
6.5 Default Scenario

Total Loss (Thousands of Dollars)
- □ 0 to 50000
- □ 50000 to 100000
- □ 100000 to 200000
- □ 200000 to 300000

Data from the HAZUS GIS software.
November 7, 2000
### Building Damage By General Occupancy

**November 07, 2000**

<table>
<thead>
<tr>
<th>Square Footage (Thousand. sq.ft)</th>
<th>Damage State Probability (%)</th>
<th>None</th>
<th>Slight</th>
<th>Moderate</th>
<th>Extensive</th>
<th>Complete</th>
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</table>

#### New Jersey

<table>
<thead>
<tr>
<th>Bergen</th>
<th>Agriculture</th>
<th>1,828</th>
<th>11.73</th>
<th>15.04</th>
<th>23.62</th>
<th>12.30</th>
<th>5.38</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Commercial</td>
<td>168,771</td>
<td>13.29</td>
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<td>8.02</td>
</tr>
<tr>
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<td>Education</td>
<td>8,495</td>
<td>12.13</td>
<td>12.03</td>
<td>22.26</td>
<td>14.47</td>
<td>6.72</td>
</tr>
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<td>14.54</td>
<td>13.83</td>
<td>27.83</td>
<td>19.43</td>
<td>8.71</td>
</tr>
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<td>Industrial</td>
<td>62,870</td>
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<td>12.45</td>
<td>24.87</td>
<td>17.53</td>
<td>7.81</td>
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<td>21.21</td>
<td>13.16</td>
<td>6.37</td>
</tr>
<tr>
<td></td>
<td>Residential</td>
<td>425,393</td>
<td>18.13</td>
<td>26.45</td>
<td>26.38</td>
<td>9.80</td>
<td>3.32</td>
</tr>
</tbody>
</table>

#### State Average

| State Average | 674,806 | 13.63 | 15.67 | 24.60 | 14.82 | 6.62 |

#### Study Region Average

| Study Region Average | 674,806 | 13.63 | 15.67 | 24.60 | 14.82 | 6.62 |

---

**Study Region:** ber1  
**Scenario:** hazdef65
# Building Damage by Count by General Occupancy

November 07, 2000

<table>
<thead>
<tr>
<th>New Jersey</th>
<th># of Buildings</th>
<th>None</th>
<th>Slight</th>
<th>Moderate</th>
<th>Extensive</th>
<th>Complete</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bergen</td>
<td>Agriculture</td>
<td>10</td>
<td>13</td>
<td>30</td>
<td>13</td>
<td>3</td>
<td>69</td>
</tr>
<tr>
<td></td>
<td>Commercial</td>
<td>1,397</td>
<td>1,278</td>
<td>2,481</td>
<td>1,561</td>
<td>583</td>
<td>7,300</td>
</tr>
<tr>
<td></td>
<td>Education</td>
<td>67</td>
<td>47</td>
<td>122</td>
<td>77</td>
<td>22</td>
<td>335</td>
</tr>
<tr>
<td></td>
<td>Government</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Industrial</td>
<td>488</td>
<td>390</td>
<td>829</td>
<td>533</td>
<td>163</td>
<td>2,403</td>
</tr>
<tr>
<td></td>
<td>Religion</td>
<td>49</td>
<td>62</td>
<td>110</td>
<td>56</td>
<td>23</td>
<td>300</td>
</tr>
<tr>
<td></td>
<td>Residential</td>
<td>42,752</td>
<td>65,798</td>
<td>63,437</td>
<td>21,720</td>
<td>6,579</td>
<td>200,286</td>
</tr>
<tr>
<td>Total State</td>
<td></td>
<td>44,763</td>
<td>67,588</td>
<td>67,010</td>
<td>23,960</td>
<td>7,373</td>
<td>210,694</td>
</tr>
</tbody>
</table>

Study region

<table>
<thead>
<tr>
<th>Study region</th>
<th>None</th>
<th>Slight</th>
<th>Moderate</th>
<th>Extensive</th>
<th>Complete</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>44,763</td>
<td>67,588</td>
<td>67,010</td>
<td>23,960</td>
<td>7,373</td>
<td>210,694</td>
</tr>
</tbody>
</table>

Study Region: ber1
Scenario: hazdef65
Regional Statistics

<table>
<thead>
<tr>
<th>Area (Square Miles)</th>
<th>247</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Census Tracts</td>
<td>210</td>
</tr>
<tr>
<td>Number of Buildings</td>
<td></td>
</tr>
<tr>
<td>Residential (x 1000)</td>
<td>200</td>
</tr>
<tr>
<td>Total (x 1000)</td>
<td>211</td>
</tr>
<tr>
<td>Number of People in the Region (x 1000)</td>
<td>825</td>
</tr>
<tr>
<td>Building Exposure ($ Millions)</td>
<td></td>
</tr>
<tr>
<td>Residential</td>
<td>32,800</td>
</tr>
<tr>
<td>Total</td>
<td>49,300</td>
</tr>
</tbody>
</table>

Scenario Results

<table>
<thead>
<tr>
<th>Maximum PGA (g)</th>
<th>0.95</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Buildings Damaged</td>
<td></td>
</tr>
<tr>
<td>Damage Level</td>
<td>Residential</td>
</tr>
<tr>
<td>Slight</td>
<td>65,800</td>
</tr>
<tr>
<td>Moderate</td>
<td>63,400</td>
</tr>
<tr>
<td>Extensive</td>
<td>21,700</td>
</tr>
<tr>
<td>Complete</td>
<td>6,600</td>
</tr>
<tr>
<td>Total</td>
<td>157,500</td>
</tr>
</tbody>
</table>

Casualties

<table>
<thead>
<tr>
<th>Severity 1 (Medical treatment without hospitalization)</th>
<th>4,916</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severity 2 (Hospitalization but not life threatening)</td>
<td>904</td>
</tr>
<tr>
<td>Severity 3 (Hospitalization and life threatening)</td>
<td>182</td>
</tr>
<tr>
<td>Severity 4 (Fatalities)</td>
<td>109</td>
</tr>
</tbody>
</table>

Shelter

<table>
<thead>
<tr>
<th>Displaced Households (# households)</th>
<th>26,600</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short Term Shelter (# people)</td>
<td>15,450</td>
</tr>
</tbody>
</table>

Economic Loss

<table>
<thead>
<tr>
<th>Property Damage (Capital Stock) Losses ($ Millions)</th>
<th>10,720</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business Interruption (Income) Losses ($ Millions)</td>
<td>3,630</td>
</tr>
<tr>
<td>Total ($ Millions)</td>
<td>14,350</td>
</tr>
</tbody>
</table>

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.

Study Region : ber1
Scenario : hazdef65
APPENDIX I

Magnitude 6.5 with upgraded geology
Study Region: Bergen County

Scenario Description: 6.5 Upgrade Scenario

Percentage Of Buildings With Moderate and Greater Damage

Data from the HAZUS GIS software and the New Jersey Geological Survey.
November 1, 2000
Study Region: Bergen County

Table Description:
Loss - GBS - Total Loss

Scenario Description:
6.5 Upgrade Scenario

Total Loss (Thousands of Dollars)

- 0 to 50000
- 50000 to 100000
- 100000 to 200000
- 200000 to 300000
- 300000 to 400000
- 400000 to 500000
- 500000 to 600000

Data from the HAZUS GIS software and the New Jersey Geological Survey
November 8, 2000
# Building Damage By General Occupancy

**November 07, 2000**

<table>
<thead>
<tr>
<th>Square Footage (Thousand. sq.ft)</th>
<th>Damage State Probability (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>None</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>------</td>
</tr>
<tr>
<td><strong>State Average</strong></td>
<td>674,806</td>
</tr>
<tr>
<td><strong>Study Region Average</strong></td>
<td>674,806</td>
</tr>
</tbody>
</table>

## New Jersey

### Bergen

<table>
<thead>
<tr>
<th>Category</th>
<th>Square Footage</th>
<th>None</th>
<th>Slight</th>
<th>Moderate</th>
<th>Extensive</th>
<th>Complete</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>1,828</td>
<td>15.73</td>
<td>15.56</td>
<td>21.48</td>
<td>10.67</td>
<td>4.64</td>
</tr>
<tr>
<td>Commercial</td>
<td>168,771</td>
<td>17.96</td>
<td>14.97</td>
<td>24.11</td>
<td>14.76</td>
<td>6.78</td>
</tr>
<tr>
<td>Education</td>
<td>8,495</td>
<td>15.86</td>
<td>12.61</td>
<td>20.71</td>
<td>12.60</td>
<td>5.85</td>
</tr>
<tr>
<td>Government</td>
<td>1,744</td>
<td>20.07</td>
<td>14.80</td>
<td>25.80</td>
<td>16.40</td>
<td>7.35</td>
</tr>
<tr>
<td>Industrial</td>
<td>62,870</td>
<td>17.71</td>
<td>13.20</td>
<td>23.07</td>
<td>15.02</td>
<td>6.69</td>
</tr>
<tr>
<td>Religion</td>
<td>5,705</td>
<td>16.32</td>
<td>16.06</td>
<td>19.66</td>
<td>11.49</td>
<td>5.47</td>
</tr>
<tr>
<td>Residential</td>
<td>425,393</td>
<td>22.86</td>
<td>26.53</td>
<td>23.62</td>
<td>8.29</td>
<td>2.86</td>
</tr>
</tbody>
</table>

## Study Region

- **Study Region**: ber1
- **Scenario**: haznj65

Page: 1 of 1
### Building Damage by Count by General Occupancy

**November 07, 2000**

<table>
<thead>
<tr>
<th></th>
<th>None</th>
<th>Slight</th>
<th>Moderate</th>
<th>Extensive</th>
<th>Complete</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>New Jersey</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Bergen</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agriculture</td>
<td>16</td>
<td>17</td>
<td>28</td>
<td>9</td>
<td>2</td>
<td>72</td>
</tr>
<tr>
<td>Commercial</td>
<td>1,709</td>
<td>1,295</td>
<td>2,329</td>
<td>1,410</td>
<td>573</td>
<td>7,316</td>
</tr>
<tr>
<td>Education</td>
<td>86</td>
<td>47</td>
<td>124</td>
<td>60</td>
<td>18</td>
<td>335</td>
</tr>
<tr>
<td>Government</td>
<td>7</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>Industrial</td>
<td>552</td>
<td>377</td>
<td>783</td>
<td>518</td>
<td>207</td>
<td>2,437</td>
</tr>
<tr>
<td>Religion</td>
<td>67</td>
<td>66</td>
<td>100</td>
<td>53</td>
<td>27</td>
<td>313</td>
</tr>
<tr>
<td>Residential</td>
<td>51,912</td>
<td>66,360</td>
<td>57,422</td>
<td>18,695</td>
<td>5,821</td>
<td>200,210</td>
</tr>
<tr>
<td><strong>Total State</strong></td>
<td>54,349</td>
<td>68,162</td>
<td>60,788</td>
<td>20,746</td>
<td>6,648</td>
<td>210,693</td>
</tr>
<tr>
<td><strong>Study region</strong></td>
<td>54,349</td>
<td>68,162</td>
<td>60,788</td>
<td>20,746</td>
<td>6,648</td>
<td>210,693</td>
</tr>
</tbody>
</table>

**Study Region:** ber1  
**Scenario:** haznj65
Quick Assessment Report

November 7, 200

Regional Statistics

<table>
<thead>
<tr>
<th>Area (Square Miles)</th>
<th>247</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Census Tracts</td>
<td>210</td>
</tr>
<tr>
<td>Number of Buildings</td>
<td></td>
</tr>
<tr>
<td>Residential (x 1000)</td>
<td>200</td>
</tr>
<tr>
<td>Total (x 1000)</td>
<td>211</td>
</tr>
<tr>
<td>Number of People in the Region (x 1000)</td>
<td>825</td>
</tr>
<tr>
<td>Building Exposure ($ Millions)</td>
<td></td>
</tr>
<tr>
<td>Residential</td>
<td>32,800</td>
</tr>
<tr>
<td>Total</td>
<td>49,300</td>
</tr>
</tbody>
</table>

Scenario Results

<table>
<thead>
<tr>
<th>Maximum PGA (g)</th>
<th>0.95</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Buildings Damaged</td>
<td></td>
</tr>
<tr>
<td>Damage Level</td>
<td>Residential</td>
</tr>
<tr>
<td>Slight</td>
<td>66,400</td>
</tr>
<tr>
<td>Moderate</td>
<td>57,400</td>
</tr>
<tr>
<td>Extensive</td>
<td>18,700</td>
</tr>
<tr>
<td>Complete</td>
<td>5,800</td>
</tr>
<tr>
<td>Total</td>
<td>148,300</td>
</tr>
</tbody>
</table>

Casualties

<table>
<thead>
<tr>
<th>Severity</th>
<th>Residential</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (Medical treatment without hospitalization)</td>
<td>4,725</td>
</tr>
<tr>
<td>2 (Hospitalization but not life threatening)</td>
<td>872</td>
</tr>
<tr>
<td>3 (Hospitalization and life threatening)</td>
<td>163</td>
</tr>
<tr>
<td>4 (Fatalities)</td>
<td>106</td>
</tr>
</tbody>
</table>

Shelter

<table>
<thead>
<tr>
<th>Shelter Type</th>
<th>Residential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Displaced Households (# households)</td>
<td>22,280</td>
</tr>
<tr>
<td>Short Term Shelter (# people)</td>
<td>13,140</td>
</tr>
</tbody>
</table>

Economic Loss

<table>
<thead>
<tr>
<th>Economic Loss Type</th>
<th>Residential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Property Damage (Capital Stock) Losses ($ Millions)</td>
<td>9,990</td>
</tr>
<tr>
<td>Business Interruption (Income) Losses ($ Millions)</td>
<td>3,340</td>
</tr>
<tr>
<td>Total ($ Millions)</td>
<td>13,330</td>
</tr>
</tbody>
</table>

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Study Region : ber1
Scenario : haznj65
APPENDIX J

Magnitude 7 with default geology
Study Region:
Bergen County

Scenario Description:
7.0 Default Scenario

Percentage Of Buildings With Moderate and Greater Damage

Data from the HAZUS GIS software and the New Jersey Geological Survey.
November 1, 2000
Study Region: Bergen County

Table Description: Loss - GBS - Total Loss
Scenario Description: 7.0 Default Scenario

Total Loss (Thousands of Dollars)
- 0 to 50000
- 50000 to 100000
- 100000 to 200000
- 200000 to 300000
- 300000 to 400000
- 400000 to 500000
- 500000 to 600000
- 600000 to 700000

Data from the HAZUS GIS Software.
November 7, 2000
## Building Damage By General Occupancy

### November 07, 2000

<table>
<thead>
<tr>
<th>Square Footage (Thousand. sq.ft)</th>
<th>Damage State Probability (%)</th>
<th>None</th>
<th>Slight</th>
<th>Moderate</th>
<th>Extensive</th>
<th>Complete</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>New Jersey</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Bergen</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agriculture</td>
<td>1,828</td>
<td>5.61</td>
<td>10.33</td>
<td>23.15</td>
<td>16.96</td>
<td>12.06</td>
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<tr>
<td>Commercial</td>
<td>168,771</td>
<td>6.07</td>
<td>9.24</td>
<td>23.46</td>
<td>22.50</td>
<td>17.31</td>
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<td>Education</td>
<td>8,495</td>
<td>5.67</td>
<td>7.87</td>
<td>20.18</td>
<td>19.59</td>
<td>14.39</td>
</tr>
<tr>
<td>Government</td>
<td>1,744</td>
<td>6.32</td>
<td>8.54</td>
<td>23.87</td>
<td>25.78</td>
<td>19.80</td>
</tr>
<tr>
<td>Industrial</td>
<td>62,870</td>
<td>5.76</td>
<td>7.84</td>
<td>21.61</td>
<td>23.00</td>
<td>17.55</td>
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<td>5,705</td>
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<td>12.05</td>
<td>21.37</td>
<td>17.00</td>
<td>12.19</td>
</tr>
<tr>
<td>Residential</td>
<td>425,393</td>
<td>9.74</td>
<td>22.00</td>
<td>30.80</td>
<td>15.22</td>
<td>6.59</td>
</tr>
<tr>
<td><strong>State Average</strong></td>
<td>674,806</td>
<td>6.52</td>
<td>11.12</td>
<td>23.49</td>
<td>20.01</td>
<td>14.27</td>
</tr>
<tr>
<td><strong>Study Region Average</strong></td>
<td>674,806</td>
<td>6.52</td>
<td>11.12</td>
<td>23.49</td>
<td>20.01</td>
<td>14.27</td>
</tr>
</tbody>
</table>

**Study Region**: ber1  
**Scenario**: hazdef7
## Building Damage by Count by General Occupancy

**November 07, 2000**

<table>
<thead>
<tr>
<th>Occupancy</th>
<th>None</th>
<th>Slight</th>
<th>Moderate</th>
<th>Extensive</th>
<th>Complete</th>
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<tr>
<td><strong>New Jersey</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bergen</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agriculture</td>
<td>3</td>
<td>6</td>
<td>28</td>
<td>21</td>
<td>17</td>
<td>75</td>
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<tr>
<td>Commercial</td>
<td>631</td>
<td>793</td>
<td>2,257</td>
<td>2,133</td>
<td>1,525</td>
<td>7,339</td>
</tr>
<tr>
<td>Education</td>
<td>21</td>
<td>16</td>
<td>106</td>
<td>117</td>
<td>69</td>
<td>329</td>
</tr>
<tr>
<td>Government</td>
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<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>2</td>
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<td>233</td>
<td>751</td>
<td>755</td>
<td>478</td>
<td>2,428</td>
</tr>
<tr>
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<td>15</td>
<td>35</td>
<td>108</td>
<td>76</td>
<td>57</td>
<td>291</td>
</tr>
<tr>
<td>Residential</td>
<td>22,643</td>
<td>54,679</td>
<td>75,300</td>
<td>34,296</td>
<td>13,311</td>
<td>200,229</td>
</tr>
<tr>
<td><strong>Total State</strong></td>
<td>23,524</td>
<td>55,762</td>
<td>78,551</td>
<td>37,399</td>
<td>15,457</td>
<td>210,693</td>
</tr>
</tbody>
</table>

### Study region

|                | 23,524 | 55,762 | 78,551 | 37,399 | 15,457 | 210,693 |

Study Region: ber1  
Scenario: hazdef7
Quick Assessment Report

Regional Statistics

<table>
<thead>
<tr>
<th>Area (Square Miles)</th>
<th>247</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Census Tracts</td>
<td>210</td>
</tr>
<tr>
<td>Number of Buildings</td>
<td></td>
</tr>
<tr>
<td>Residential (x 1000)</td>
<td>200</td>
</tr>
<tr>
<td>Total (x 1000)</td>
<td>211</td>
</tr>
<tr>
<td>Number of People in the Region (x 1000)</td>
<td>825</td>
</tr>
<tr>
<td>Building Exposure ($ Millions)</td>
<td></td>
</tr>
<tr>
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Scenario Results

Maximum PGA (g) | 1.19 |

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Casualties

| Severity 1 (Medical treatment without hospitalization) | 9,207 |
| Severity 2 (Hospitalization but not life threatening) | 1,778 |
| Severity 3 (Hospitalization and life threatening) | 476 |
| Severity 4 (Fatalities) | 229 |

Shelter

| Displaced Households (# households) | 44,860 |
| Short Term Shelter (# people) | 26,040 |

Economic Loss

| Property Damage (Capital Stock) Losses ($ Millions) | 15,950 |
| Business Interruption (Income) Losses ($ Millions) | 5,880 |
| Total ($ Millions) | 21,820 |

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.

Study Region: ber1
Scenario: hazdef7
APPENDIX K

Magnitude 7 with upgraded geology
Study Region:
Bergen County

Scenario Description:
7.0 Upgrade Scenario

Percentage Of Buildings With Moderate and Greater Damage

Data from the HAZUS GIS software and the New Jersey Geological Survey.
November 1, 2000
Study Region: Bergen County

Table Description: Loss - GBS - Total Loss

Scenario Description: 7.0 Upgrade Scenario

Total Loss (Thousands of Dollars)

- 0 to 50000
- 50000 to 100000
- 100000 to 200000
- 200000 to 300000
- 300000 to 400000
- 400000 to 500000
- 500000 to 600000
- 600000 to 700000

Data from the HAZUS GIS software and the New Jersey Geological Survey. November 8, 2000
## Building Damage By General Occupancy

**November 07, 2000**

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Study Region: ber1
Scenario: haznj7
### Building Damage by Count by General Occupancy

**November 07, 2000**

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**Study region**

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**Study Region:** ber1  
**Scenario:** haznj7
Regional Statistics

Area (Square Miles) 247
Number of Census Tracts 210
Number of Buildings
  Residential (x 1000) 200
  Total (x 1000) 211
Number of People in the Region (x 1000) 825
Building Exposure ($ Millions)
  Residential 32,800
  Total 49,300

Scenario Results

Maximum PGA (g) 1.19

Number of Buildings Damaged

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Casualties

Severity 1 (Medical treatment without hospitalization) 8,980
Severity 2 (Hospitalization but not life threatening) 1,734
Severity 3 (Hospitalization and life threatening) 422
Severity 4 (Fatalities) 223

Shelter

Displaced Households (# households) 38,690
Short Term Shelter (# people) 22,710

Economic Loss

Property Damage (Capital Stock) Losses ($ Millions) 15,160
Business Interruption (Income) Losses ($ Millions) 5,530
Total ($ Millions) 20,700

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Study Region: ber1
Scenario: haznj7
APPENDIX L

Shear-wave velocity data

Abbreviations are:

\textit{gp spc} = distance of geophone from source (feet)
\textit{pick} = arrival time of wave at geophone (milliseconds)
\textit{int time} = interval travel time between geophone (milliseconds)
\textit{int vel} = interval velocity--wave velocity between geophones (feet/second)
\textit{avg vel} = wave velocity calculated by averaging the interval velocities
\textit{regression velocity} = wave velocity calculated from best-fit line to first arrivals
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