EARTHQUAKE LOSS ESTIMATION STUDY
FOR
SOMERSET COUNTY, NEW JERSEY:

GEOLOGIC COMPONENT

Prepared for the
New Jersey State Police
Office of Emergency Management

by
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New Jersey Geological Survey

March 2008

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Summary

Geologic, topographic, and test-boring data were acquired and analyzed in order to map seismic soil class, liquefaction susceptibility, and landslide susceptibility for Somerset County (see map plates at end of document). The soil class, liquefaction susceptibility, and landslide susceptibility data were entered into the HAZUS earthquake-simulation model for each census tract in the county (Appendix A). The HAZUS model was run with these upgraded geologic data for earthquakes with magnitudes of 5, 5.5, 6, 6.5, and 7, with epicenters at the county centroid. As a comparison, the HAZUS model was run with its prepackaged geologic data (referred to henceforth as *default* data) at magnitudes of 5.5 and 6. The HAZUS model was also run for expected ground motion with return periods of 500, 1000, and 2500 years, based on probabilistic analysis of regional earthquake history. Each of these runs was made with both upgraded and default geologic data. Selected outputs from these runs are attached in Appendices B through T.

Soils over most of Somerset County are stronger than the default values, so damage estimates from runs using upgraded geology are less than from runs using default geology. In a few census tracts damage is greater with the upgraded geology because soils are more prone to liquefaction than indicated by default data. Total economic loss ranges from a low of $0.6B at M5 to a high of $35B at M7. Damage and economic loss for an M5 earthquake at the county centroid are similar to those from the 2500-year return period probabilistic run, indicating that there is a 2% chance of an M5 earthquake occurring in the county in any 50 year period, based on the history of known earthquakes in the region.

In addition to the HAZUS data upgrades and runs, shear-wave velocity was measured on four soil types (weathered diabase, weathered shale, stream-terrace deposits, and alluvium) at a total of 12 locations (Appendix U). 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 the assignments.

Geologic Data Acquired

Surficial materials in Somerset County include glacial and nonglacial deposits, and weathered bedrock material (fig. 1). Nonglacial deposits include floodplain alluvium, stream-terrace deposits, weathered sand and gravel of the Pensauken Formation, windblown sand and silt, and colluvium (mixed rock fragments and soil deposited at the foot of hillslopes). Nonglacial deposits are generally less than 20 feet thick. Glacial deposits include till, sand and gravel deposited in glacial lakes and river plains, and silt and clay deposited in glacial lakes. The glacial deposits are as much as 80 feet thick. Weathered bedrock is material formed by mechanical and chemical decomposition of bedrock. It ranges from blocky rubble to clayey sand to silty clay. It may be up to 50 feet thick on gneiss bedrock but is generally less than 10 feet thick elsewhere. The distribution and thickness of these surficial materials were mapped between 1983 and 2007 at 1:24,000 scale using stereo-airphoto interpretation, field observations, archival geologic map data on file at the NJGS, and logs of wells and test borings. Geologic-map references are listed on the map sheets (plates at end of document).

Bedrock (fig. 2) includes basalt, diabase, shale, conglomerate, and argillite (a hard mudstone). Gneiss and a small area of quartzite and carbonate rock crop out in the Highlands in the northern part of the county. A couple of small deposits of Coastal Plain clay occur in the southern part of the county. Diabase, basalt, argillite, and gneiss are hard rocks that are resistant to erosion and so form ridges and uplands such as the Watchung Mountains and Sourland Mountain. Shale and conglomerate are more easily eroded and so underlie valleys and lowlands.

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.

Data on 1041 SPT tests from 213 borings in Somerset County were obtained from test-boring logs on file at the N. J. Geological Survey and N. J. Department of Environmental Protection, Bureau of Water Allocation (table 1). These data complement data from other areas for similar soils that were collected for previous earthquake-loss studies (Stanford and others, 2002, 2003, 2005). The other data include 496 borings in Morris County, with a total of 3521 tests; 193 borings, with a total of 944 tests, from Union County; and 448 borings, with a total of 3528 tests, from Middlesex County.

SPT data from the Somerset County borings yield means, ranges, and standard deviations that are similar to those from other counties for the same soil types, with the following exceptions. Mean SPT values for weathered shale in Middlesex and Union counties are 70 and 110, respectively, compared to a mean of 59 for weathered shale in Somerset County. The greater values in Middlesex and Union are due to a higher cutoff for refusal in those counties, as indicated by the 35% of tests reporting refusal in Somerset compared to 3% in Middlesex, for weathered

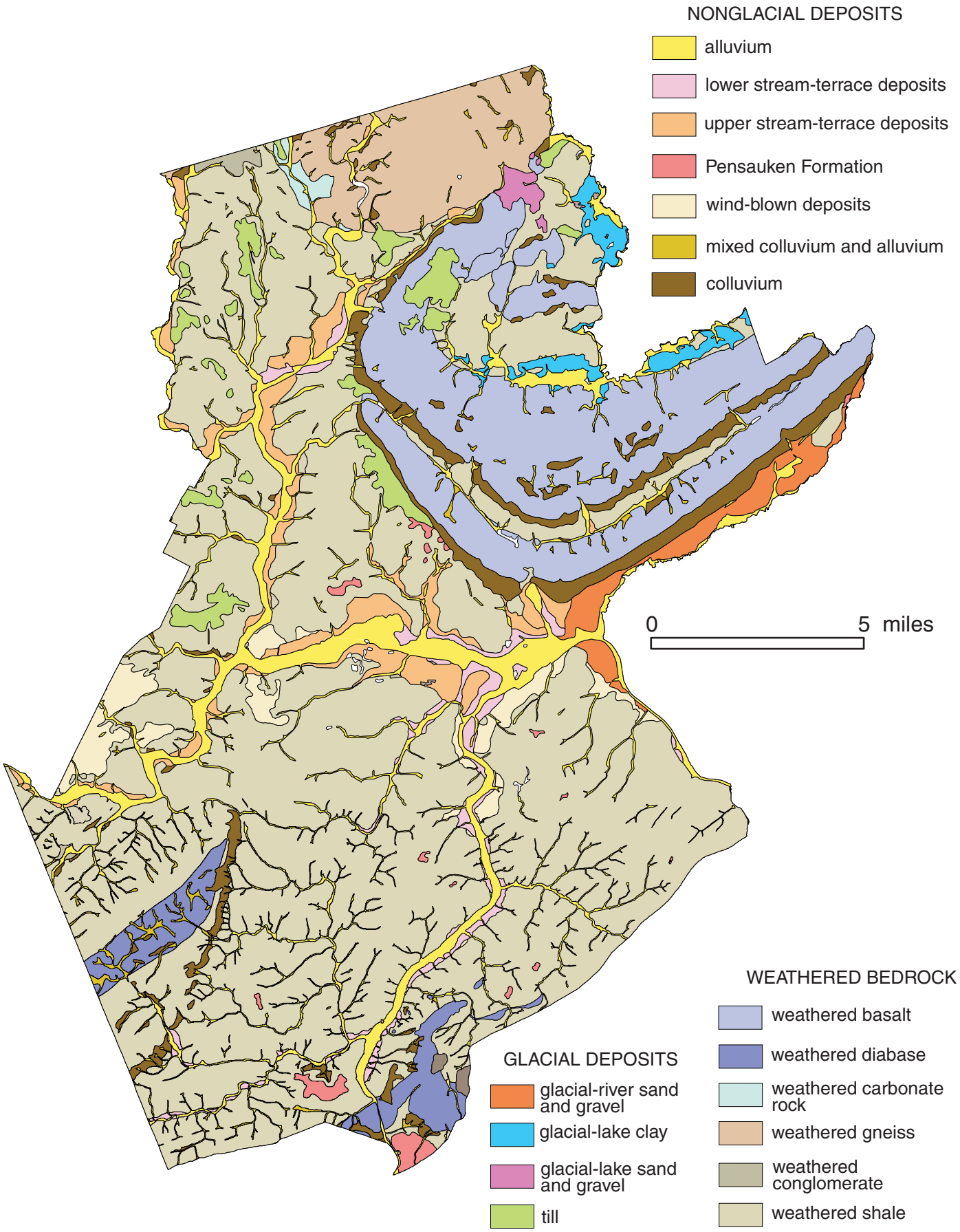

Figure 1. Surficial materials of Somerset County. From N. J. Geological Survey digital data.

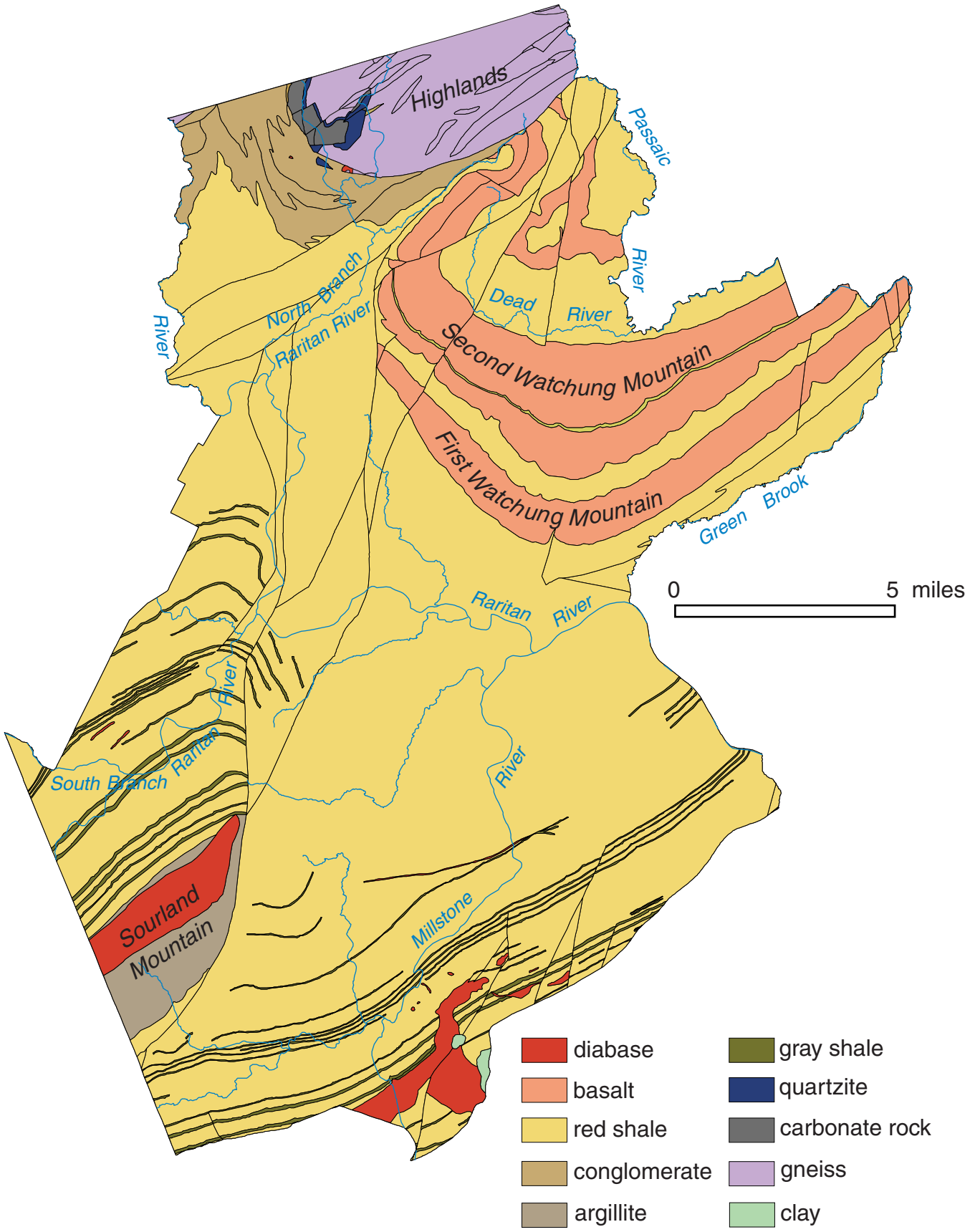

Figure 2. Bedrock and drainage of Somerset County. From N. J. Geological Survey digital data.

shale (table 1). Glacial-lake silt and clay in Morris County has a greater mean and standard deviation (17±18) than in Somerset County (11±6), perhaps because these deposits were consolidated by overriding ice or overlying sand deposits in Morris County, circumstances that did not occur in Somerset County. Weathered shale (39±14) and colluvium (33±23) in Morris County have lower and higher means, respectively, than their counterparts in Somerset County (59±36 and 19±7, respectively), but the small number of tests on weathered shale in Morris and on colluvium in Somerset (11 in each case) are probably not representative samples.

Penetration tests for Somerset County can be divided into three groups. Weathered-rock materials (weathered shale, diabase, basalt, and gneiss) have mean SPT values between 30 and 60 because they contain gravel-sized and larger rock fragments which resist penetration, and have been exposed to oxidation and weathering, which harden subsoil horizons. Coarse alluvium, stream-terrace deposits, and glacial-river sand and gravel have mean SPT values between 20 and 40 because these deposits contain beds of pebble and cobble gravel that resist penetration. Fine alluvium and glacial-lake silt and clay have mean SPT values between 10 and 20. These deposits consist of silt, fine sand, and clay that are seasonally or perennially saturated and so have not been weathered or oxidized. They are less resistant to penetration than the other surficial materials because they lack gravel or hard subsoil. Glacial-lake sand and gravel and colluvium do contain gravel or rock fragments and have been exposed to weathering and oxidation. Their mean SPT values (14 and 19, respectively) are based on few tests and probably are artificially low.

Table 1.--Standard Penetration Test (SPT) data for surficial materials in Somerset County.

Material	Number of Borings	Number of Tests	Range of SPT Values	Mean ± Standard Deviation	Percentage of tests refused[1]
fill	76	151	1-152	32±33	3
fine-grained alluvium	65	223	0-61	16±11	0.4
coarse-grained alluvium	40	92	10-180	39±24	15
glacial-lake sand and gravel	3	19	8-21	14±4	0
glacial-lake silt and clay	9	50	3-29	11±6	0
glacial-river sand and gravel	11	41	3-56	22±14	0
stream-terrace deposits	50	217	2-109	31±21	3
colluvium	3	11	5-32	19±7	0
weathered gneiss	4	15	8-124	44±29	13

weathered diabase	8	16	11-141	31±30	0
weathered shale	118	200	5-194	59±36	35
weathered basalt	7	22	6-88	36±24	23

[1]For these tests, the sampling tube failed to advance 6 inches after 100 blows of the hammer. In some tests, hammering continued past 100 blows until the tube was advanced 6 inches. In these cases, the full blow count was included in the data set even if it exceeded 100 blows per 6 inches.

For each surficial unit, the 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. Where more than one surficial material is present overlying bedrock, as determined by geologic mapping and records of test borings and water wells, the appropriate mean SPT value is applied to the thickness of each layer. Fill includes a variety of materials ranging from demolition debris and excavated bedrock to trash and 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. 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 SPT and shear-wave properties of the soil and rock layers to a depth of 100 feet.

The upper 100 feet includes some thickness of unweathered bedrock. To calculate soil class in these cases, an average shear-wave velocity of 5500 feet per second for basalt, diabase, gneiss, quartzite, argillite, and carbonate rock, and of 2300 feet per second for shale and conglomerate, was applied to the thickness of the bedrock column. These velocities are low-end estimates for shallow bedrock based on P-wave velocities measured by seismic refraction surveys in Morris County conducted in the course of groundwater-resource studies in the 1980s (Canace and others, 1983, 1993), and on direct measurements of shear-wave velocity on shale and diabase in Somerset County (reported in table 2) and on similar rock types in the Los Angeles area (Fumal and Tinsley, 1985). Note that soil classes A and B are used only where bedrock is overlain by less than 10 feet of surficial material. In Somerset County this occurs only in quarries and on a few steep ravine slopes, where surficial material has been excavated or eroded.

Weathered-rock soils, colluvium, and windblown deposits (which are everywhere less than 10 feet thick) are soil class C. So are till, stream-terrace deposits, coarse alluvium, and Pensauken Formation where they are less than 20 feet thick. Fine-grained alluvium, glacial-river sand and gravel, and glacial-lake sand and gravel are class C where they are less than 10 feet thick but are class D where thicker than 10 feet. Where stream-terrace deposits and Pensauken Formation are greater than 20 feet thick, they are also class D. Class D soils thus occur primarily in floodplains and thicker parts of stream terraces in the Raritan, Millstone, and Green Brook valleys. The only class E soils are glacial-lake silt and clay greater than 20 feet thick, which occur only in the Great Swamp area in the northeastern corner of the county. Where the clays are less than 20 feet thick, for example, in the Dead River valley, they are class D. Outcrops of

basalt, diabase, and gneiss in quarries and ravines have little or no soil cover and are class A. Shale has a much slower shear-wave velocity and is included in class C even where it is covered by less than 10 feet of soil.

Liquefaction susceptibility was assigned based on Table 9.1 of the HAZUS Users Manual, with some modifications to the classification scheme based on local penetration-test data and field observations. For example, saturated fine sand and silt with low compaction and penetration resistance within some saturated glacial-lake, glacial-river, and stream-terrace deposits of Pleistocene age indicate a moderate-to-high liquefaction susceptibility, rather than the low susceptibility for Pleistocene lake and river deposits provided in Table 9.1. Also, gravel-rich floodplain and river-channel deposits of Holocene and modern age along the North Branch of the Raritan River upstream of Far Hills have moderate to low susceptibility rather than high susceptibility as indicated in Table 9.1 because there are few beds of fine sand and silt in these gravel-rich deposits.

Landslide susceptibility depends on slope angle and the geologic material underlying the slope. Slope angles for Somerset County were calculated from 1:24,000 topographic maps with 20- or 10-foot contour interval and slope materials were determined in the field (data sources are listed on the landslide map, folded in pocket). Landslide susceptibility was assigned according to the classification in Table 9.2 of the HAZUS User's Manual (refer to landslide map plate at end of document). Areas of potential landsliding include some natural slopes on weathered gneiss in the Highlands, on weathered basalt in the Watchung Mountains, on weathered diabase and argillite on Sourland Mountain, and on smaller areas of steep riverbanks and ravines in shale in the Raritan and Millstone valleys. Man-made slopes in roadcuts and quarries, primarily in basalt and diabase bedrock, may also generate slides or rockfalls.

Shear-wave Velocity Measurements

To test the accuracy of using SPT tests as a proxy for shear-wave velocity, and to obtain data for deposits lacking SPT tests, seismic velocities were collected at twelve sites in Somerset County. The tested soil types include weathered diabase (3 sites), weathered shale (3 sites), stream-terrace deposits (3 sites), and alluvium (3 sites) (table 2). The measurements were made at sites where the natural deposit was undisturbed and not covered or mixed with man-made fill. At each site, holes were hand-augered or dug to test for soil disturbance and fill.

The seismic data were collected using a Bison 9000 digital engineering seismograph. Both shear (S) wave (horizontal component) and compression (P) wave data were acquired (Appendix U). P waves are much faster than shear waves and help in isolating the shear-wave signal in the seismic record. To measure P and S velocities, twelve P-wave geophones and twelve S-wave geophones were planted along the survey line at intervals of 6 feet. The source was located 6 feet from the first geophone. For the S-wave measurement, each geophone was oriented with its axis of movement parallel to the generating source. The S-wave 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 to improve ground coupling while it is hammered. For the P-wave measurement, 8-hertz geophones are used. A 10-pound sledgehammer impacting a strike plate is the source.

The first seismic break on the arrival records from both the S and P data is picked for

each geophone and marks the arrival of the seismic wave at the geophone. 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 (Appendix U). 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 heterogeneity within the soil. The regression velocity is statistically more accurate as a bulk soil property.

At all sites, both the P and S data record at least two layers: an upper soil of slower velocity over bedrock of higher velocity. At one site (North Branch) both the P and S data record three layers: stream-terrace deposits over weathered shale over unweathered shale. P-wave data at seven of the twelve sites show three velocity layers: unsaturated soil over saturated soil over bedrock. The boundary between saturated and unsaturated soil is the water table, which is not detectable in shear-wave data because liquids do not transmit shear waves.

Table 2 shows that nine of the twelve velocity measurements fall within, or negligibly outside, the range predicted from the county-wide SPT data for the layer in question. Two of the three discrepancies (Zion 1 and Zion 2) are in weathered diabase, for which there are only 16 penetration tests, too few to be representative of the material. The other discrepancy (North Branch) is in stream-terrace deposits. The other two measurements on these deposits (York and River Road) are at the fast end of the range predicted from SPT data. All three of these sites are in the Raritan valley upstream of the Somerville area, while most of the SPT data are from test borings drilled downstream from Somerville, where the deposit contains more silt and less gravel. Gravel increases shear-wave velocity and may account for the faster-than-predicted velocities at these three sites.

Table 2. Shear-wave velocity measurements. Complete data provided in Appendix U.

Site	Location (latitude; longitude)	Material	Measured shear-wave velocity (feet/second)	Shear-wave velocity range predicted from SPT data (feet/second)	Comments
Rock	40º23’43”; 74º37’50”	weathered diabase	1198 (layer 1) 3614 (layer 2)	600-1200	agrees (layer 1), layer 2 is partially weathered diabase
Zion 1	40º27’45”; 74º43’45”	weathered diabase	1446 (layer 1) 7611 (layer 2)	600-1200	faster than predicted (layer 1), layer 2 is diabase bedrock
Zion 2	40º28’14”; 74º43’40”	weathered diabase	1603 (layer 1) 3318 (layer 2)	600-1200	faster than predicted (layer 1), layer 2 is partially weathered diabase
Jacques	40º28’02”; 74º33’39”	weathered shale	1154 (layer 1) 2520 (layer 2)	1200-2500	slightly slower than predicted (layer 1), layer 2 is shale bedrock
Dutchtown	40º26’49”; 74º41’25”	weathered shale	1395 (layer 1) 3822 (layer 2)	1200-2500	agrees (layer 1), layer 2 is shale bedrock
Van Holten	40º36’17”; 74º39’5”	weathered shale	2013 (layer 1) 4412 (layer 2)	1200-2500	agrees (layer 1), layer 2 is shale bedrock

York	40º33'17"; 74º40'11"	stream-terrace deposits	1207 (layer 1) 4286 (layer 2)	600-1200	at fast end of predicted range (layer 1), layer 2 is shale bedrock
River Road	40º39'47"; 74º38'53"	stream-terrace deposits	1200 (layer 1) 2295 (layer 2)	600-1200	at fast end of predicted range (layer 1), layer 2 is shale bedrock
North Branch	40º35'31"; 74º40'32"	stream-terrace deposits	1622 (layer 1) 3593 (layer 2) 5085 (layer 3)	600-1200	faster than predicted (layer 1), layer 2 is shale bedrock, layer 3 is harder shale bedrock
Griggstown	40º26'17"; 74º37'00"	fine-grained alluvium	605 (layer 1) 2465 (layer 2)	E/D boundary, about 500-800	agrees (layer 1), layer 2 is shale bedrock
Blackwells	40º28'28"; 74º34'31"	fine-grained alluvium	709 (layer 1) 2108 (layer 2)	500-800	agrees (layer 1), layer 2 is shale bedrock
Opie	40º31'31"; 74º42'24"	fine-grained alluvium	526 (layer 1) 2074 (layer 2)	500-800	agrees (layer 1), layer 2 is shale bedrock

HAZUS Simulations

A total of nineteen simulations were run in order to estimate losses and damage from both specified earthquakes (known as *deterministic* runs) and from approximations of expected ground motion for given time intervals (known as *probabilistic* runs). Deterministic runs were made for earthquake magnitudes of 5, 5.5, 6, 6.5, and 7, with an epicenter at the centroid of the county. 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 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 South Carolina, the Boston area, southern Quebec, and the St. Lawrence Valley. Upgraded soil, liquefaction, and landslide data were used for all runs; runs at magnitude 5.5 and 6 were also made with default geologic data as a comparison.

Probabilistic runs model the expected ground motion (peak ground acceleration and accelerations at specific vibration frequencies) that has a 2%, 5%, and 10% probability of being exceeded in 50 years (Frankel and others, 1997). These probabilities correspond to return periods of 2500, 1000, and 500 years, respectively. The runs are identified by these return periods (table 3 and Appendices I-T). The model is based on statistical smoothing of the location and intensity of historic earthquakes, so there are no specified epicenters or magnitudes for these runs. The magnitudes included with each probabilistic run (table 3) are used only as driving magnitudes for the calculation of liquefaction response and do not represent scenario earthquakes. The probabilistic runs assume that future earthquakes will have locations and magnitudes similar to historic earthquakes. In regions of infrequent earthquakes like the eastern United States this is a less reliable assumption than in areas of frequent earthquakes. Probabilistic runs were made with upgraded geology for return periods of 500, 1000, and 2500 years, with liquefaction-driving magnitudes of 5.5, 6, and 6.5 for each return period. Runs at each return period, at liquefaction-driving magnitude 6, were also made with default geologic data for comparison.

The geologic data were upgraded by modifying data fields for soil type, liquefaction susceptibility, and landslide susceptibility in the HAZUS model for each census tract using the seismic soil class, liquefaction susceptibility, and landslide susceptibility maps (plates at end of document). Many census tracts 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. In these census tracts, however, highways and local roads, and some buildings, adjoin slopes that are landslide-prone, so the landslide hazard was included in the upgrade runs. 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.

Building damage best illustrates the effect of geology on the simulations, because it does not directly incorporate economic and demographic patterns. Appendices B through T provide tables showing the number of the buildings (classed by use) in various states of damage. The appendices also provide maps showing the percent moderate or greater building damage by census tract for the various simulations. 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 disruption and emergency response. A loss estimation sheet summarizing damage, economic loss, casualties, and population displacement for each HAZUS run is also provided. 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. The economic loss, building damage, and displaced households estimates for each run are summarized in table 3.

Table 3. Comparison of total economic loss (TEL, in billions of dollars), major building damage (MBD, in thousands of buildings), and displaced households (DH, actual number of households requiring shelter) for the HAZUS runs (D=deterministic run, number is earthquake magnitude; P=probabilistic run, number is return period in years, M=driving magnitude for liquefaction). Total economic loss includes building damage plus loss of building contents plus loss due to business interruption. Major building damage includes buildings of any type damaged to the “extensive” and “complete” state.

Magnitude	default			full upgrade		
	TEL	MBD	DH	TEL	MBD	DH
D 5.0	-	-	-	0.6-2.4	0-2	700-3000
D 5.5	1.3-5.1	1-5	800-3000	1.3-5.3	1-5	1300-5000
D 6.0	3.5-14	5-20	4000-14,000	3-12.1	4-17	3000-12,000
D 6.5	-	-	-	5.7-22.6	9-40	6000-25,000
D 7.0	-	-	-	8.8-35.1	16-70	11,000-43,000

P500 M5.5	-	-	-	0-0.1	<1	30-100
P500 M6	0.1-0.3	<1	40-170	0-0.1	<1	30-100
P500 M6.5	-	-	-	0-0.1	<1	30-100
P1000 M5.5	-	-	-	0.2-0.6	<1	90-400
P1000 M6	0.3-1.1	0-1	150-600	0.2-0.6	<1	90-400
P1000 M6.5	-	-	-	0.2-0.6	<1	90-400
P2500 M5.5	-	-	-	0.7-2.7	0-3	700-3000
P2500 M6	0.9-3.8	1-4	800-3000	0.7-2.8	0-3	800-3000
P2500 M6.5	-	-	-	0.7-2.9	0-3	800-3000

Evaluation of Simulations

The deterministic runs produce significantly more damage that the probabilistic runs because the earthquakes in these runs are deliberately placed at the center of the county in order to simulate the range of maximum credible events. This approach is appropriate for emergency response planning, where extreme events should be considered. The probabilistic runs place Somerset County within the regional picture of historically based ground motions, an approach appropriate for assessing and managing seismic risk and comparing it to other risks. The 2500-year probabilistic runs generate the same range of damage as the M5 deterministic run. This similarity indicates that an M5 earthquake centered in Somerset County has about a 2% chance of occurring within any 50-year period, based on the historic earthquake record. However, because earthquakes of M5 or greater are extremely rare in the eastern United States, it is unlikely that the historic catalog of earthquakes has captured the full range of potential epicenter locations, so a greater than 2% probability of an earthquake of M5 or larger in or near Somerset County in any 50-year period cannot be ruled out.

Except for the M5.5 deterministic run, the upgraded geology produced less total damage that the default geology. This is because only 9 out of a total of 62 census tracts in the county are assigned soil class D in the upgrade runs, and the rest are in the stronger soil class C, while all 62 are class D in the default case. A few census tracts with moderate liquefaction susceptibility show an increase of about 10% in damage in the upgrade runs, because the default case is no liquefaction susceptibility. In the probabilistic runs, no census tracts show more than 10% of buildings damaged to a moderate or greater state for 500 or 1000 year return periods. For the 2500-year return period, most census tracts show about 10% less damage using upgraded geology. Varying the driving magnitude for liquefaction from 5.5 to 6 to 6.5 has no effect on damage for 500 and 1000 year return periods, and only a negligible increase with increased magnitude for the 2500 year period.

Landslide hazard has no discernable impact on building damage or economic loss. None of the census tracts in Somerset County were judged to have a landslide susceptibility of

HAZUS class 4 or greater, although there are slopes in the county of susceptibility classes 4, 5, 6, 7, 8, and 9 (see map at end of document). In Passaic County, tracts of landslide susceptibility class 4 showed, at magnitude 7.0, a 20% increase in buildings damaged to a moderate-or-greater extent compared to upgraded geology with no landslide hazard (Stanford and others, 2004). These results suggest that landsliding is a potential but not a significant hazard for the maximum earthquakes possible in this area. However, isolated landsliding has occurred in the northeastern United States at earthquake magnitudes less than 5.5 (for example, the magnitude 5.3 Ausable Forks, New York earthquake of April 20, 2002), and it is likely that a census-tract analysis of damage is inadequate for assessing the specific hazards associated with particular highway and railroad cuts and utility lines traversing steep slopes. Deep cuts in rock may be susceptible to rockfall, and deep cuts in soil or steep embankments of fill may be susceptible to landsliding at earthquake magnitudes possible here.

References Cited (additional references listed on map plates)

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Stanford, S. D., Pristas, R. S., Hall, D. W., and Waldner, J. S., 2004, Earthquake loss estimation study for Passaic County, New Jersey: geologic component: report prepared by the N. J.

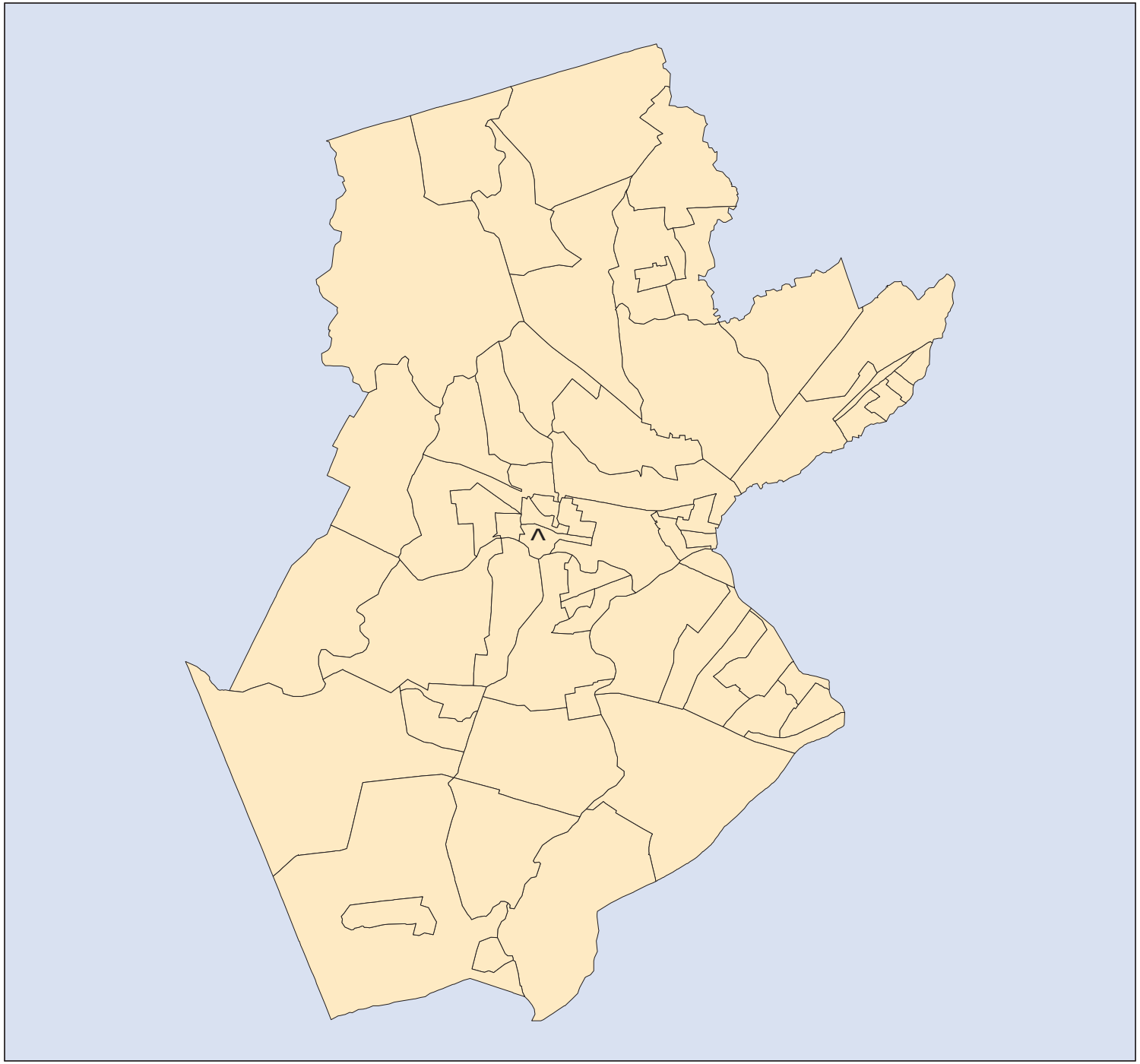
Geological Survey for the N. J. State Police Office of Emergency Management, 8 p. plus appendices, http://www.njgeology.org/enviroed/freedwn/passaic_hazus.pdf .

Stanford, S. D., Pristas, R. S., Hall, D. W., and Waldner, J. S., 2005, Earthquake loss estimation study for Morris County, New Jersey: geologic component: report prepared by the N. J. Geological Survey for the N. J. State Police Office of Emergency Management, 12 p. plus appendices, http://www.njgeology.org/enviroed/freedwn/morris_hazus.pdf.

APPENDIX A

Maps of Somerset 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



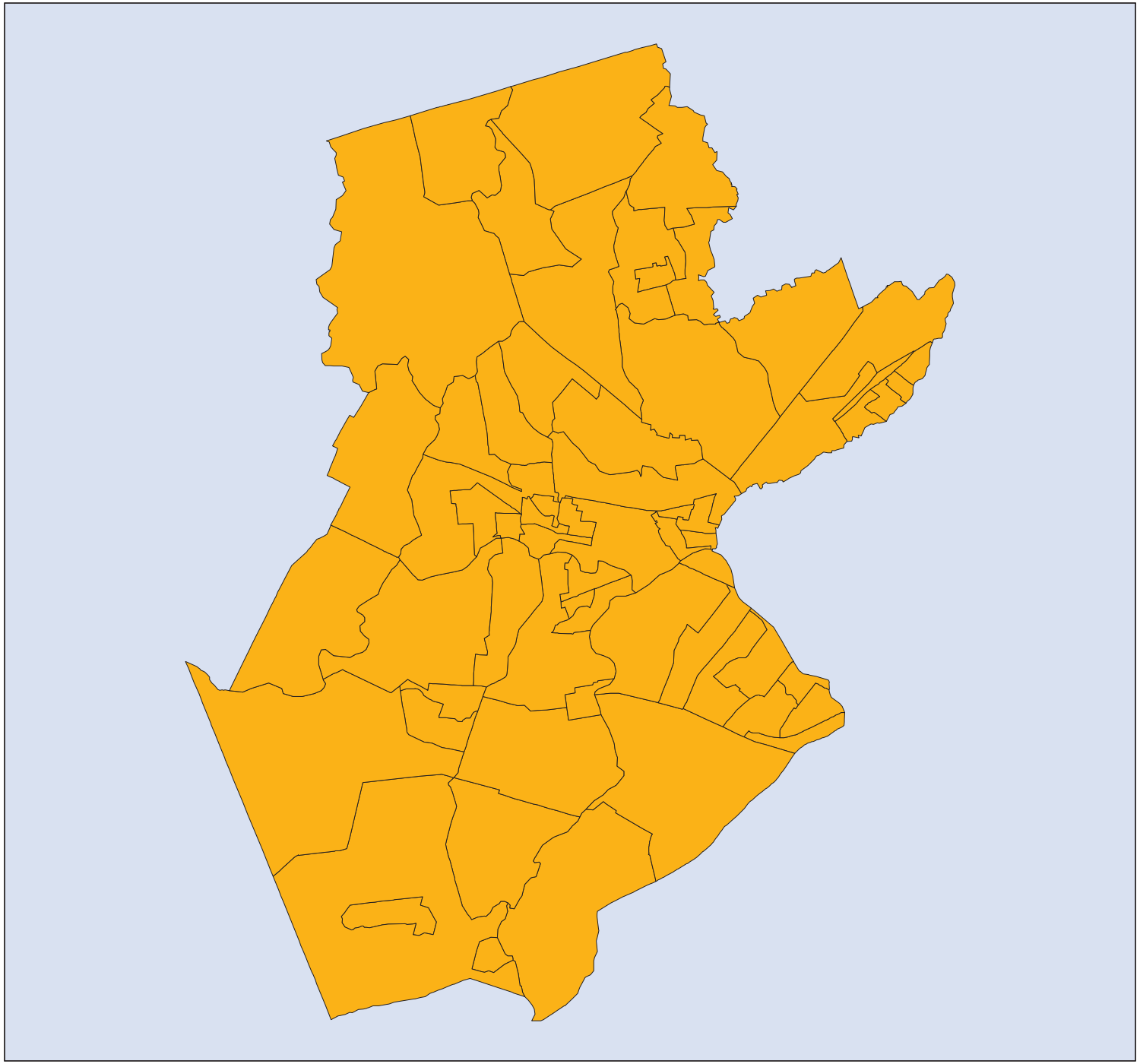
5 2.5 0 5 Miles

Study Region:
Somerset County

Table Description:
Study Region Epicenter

^ Epicenter (Arbitrary)
74.616 degrees longitude
40.564 degrees latitude

Data from the HAZUS-MH GIS software and the New Jersey Geological Survey.
February 13, 2008



5 2.5 0 5 Miles

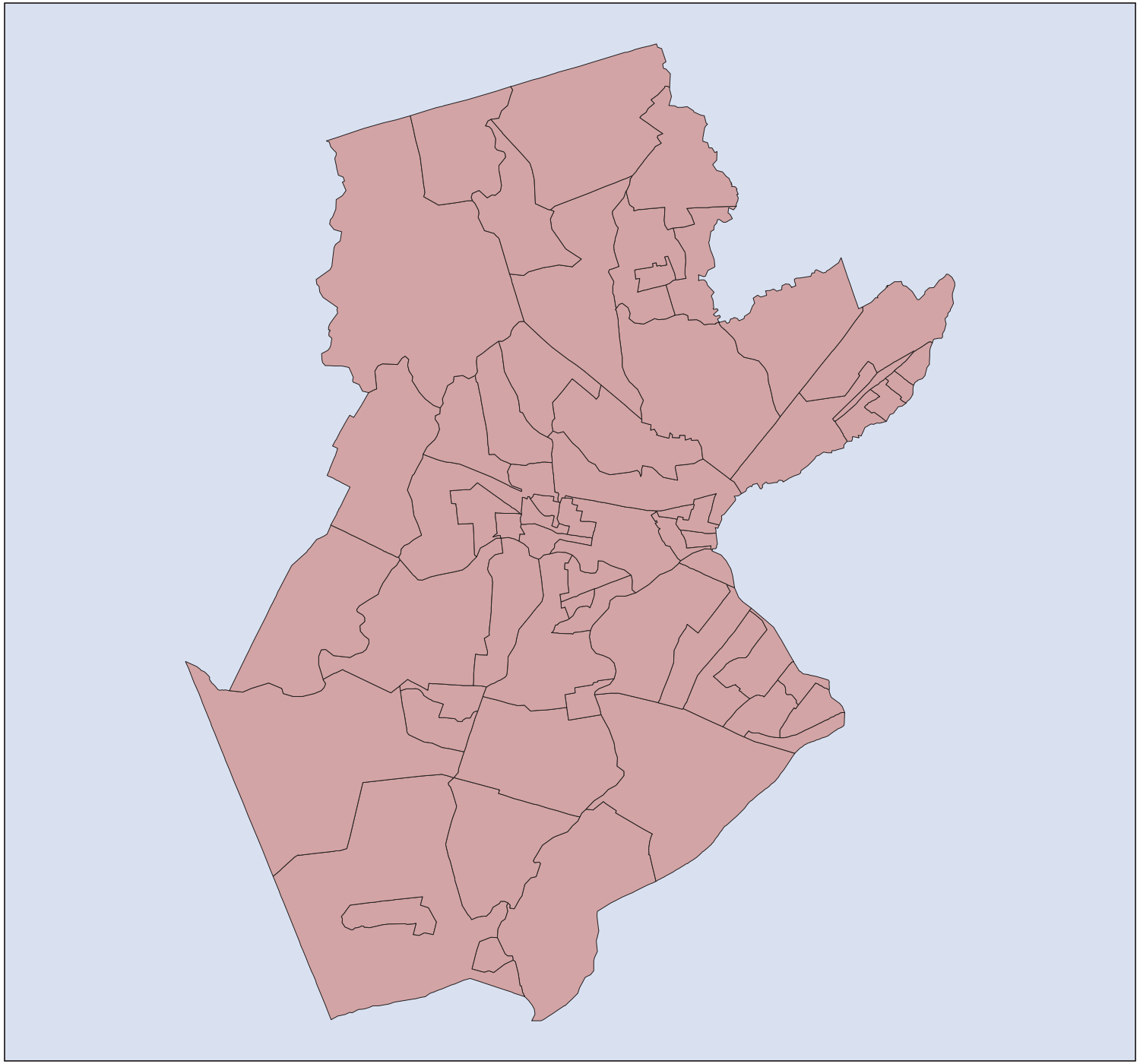
Study Region:
Somerset County

Table Description:
Default Soil Map

Soil Type

Class D

Data from the HAZUS-MH GIS software and the New Jersey Geological Survey. February 13, 2008



Study Region:
Somerset County

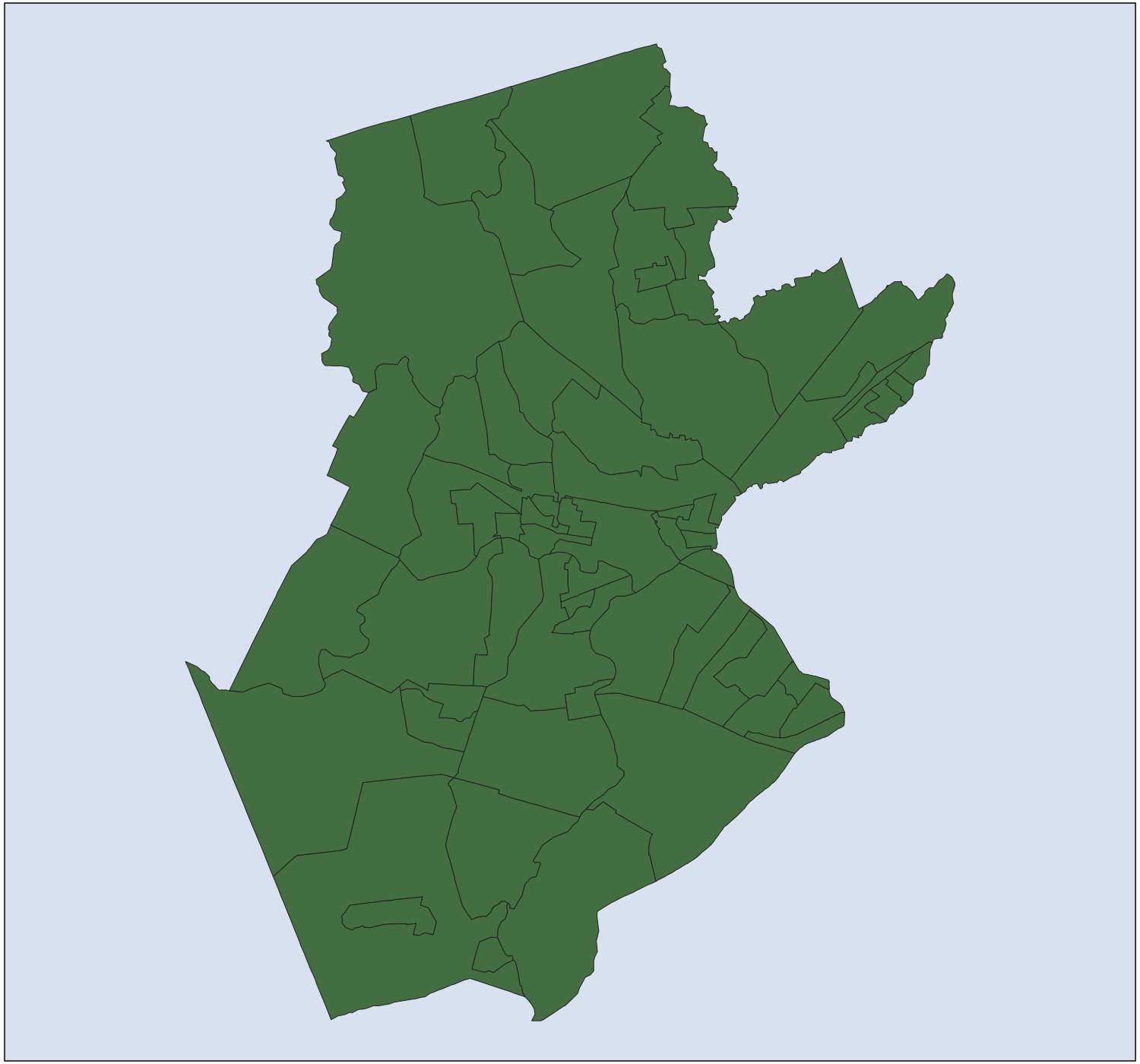
Table Description:
Default Liquefaction Map

Liquefaction Susceptibility

None (Class 0)

5 2.5 0 5 Miles

Data from the HAZUS-MH GIS software and the New Jersey Geological Survey.
February 13, 2008



5 2.5 0 5 Miles

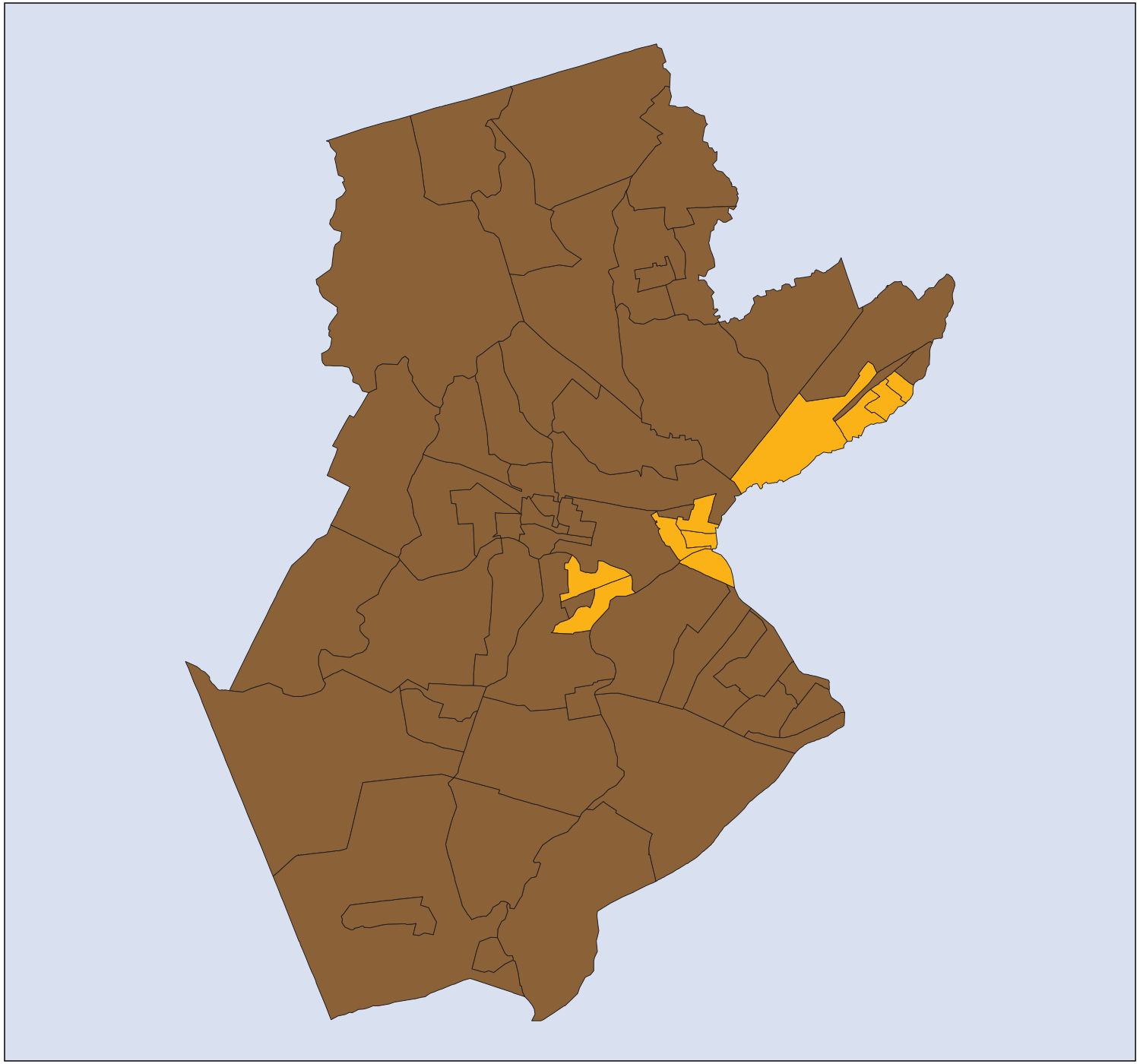
Study Region:
Somerset County

Table Description:
Default Landslide Map

Landslide Susceptibility

None (Class 0)

Data from the HAZUS-MH GIS software and the New Jersey Geological Survey. February 13, 2008



Study Region:
Somerset County

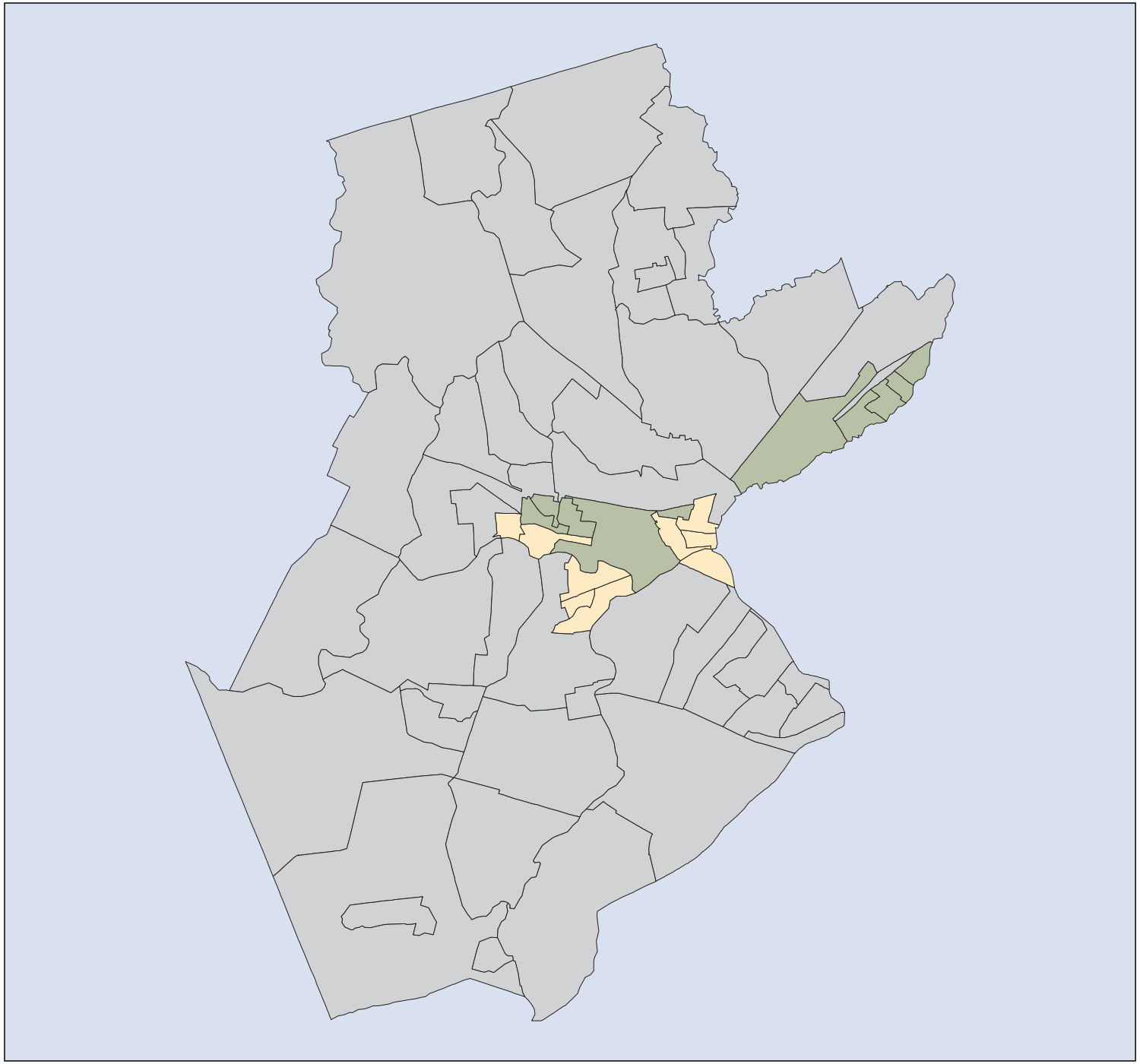
Table Description:
Upgraded Soil Map

Soil Type

- Class C
- Class D

5 2.5 0 5 Miles

Data from the HAZUS-MH GIS software and the New Jersey Geological Survey. February 13, 2008



Study Region:
Somerset County

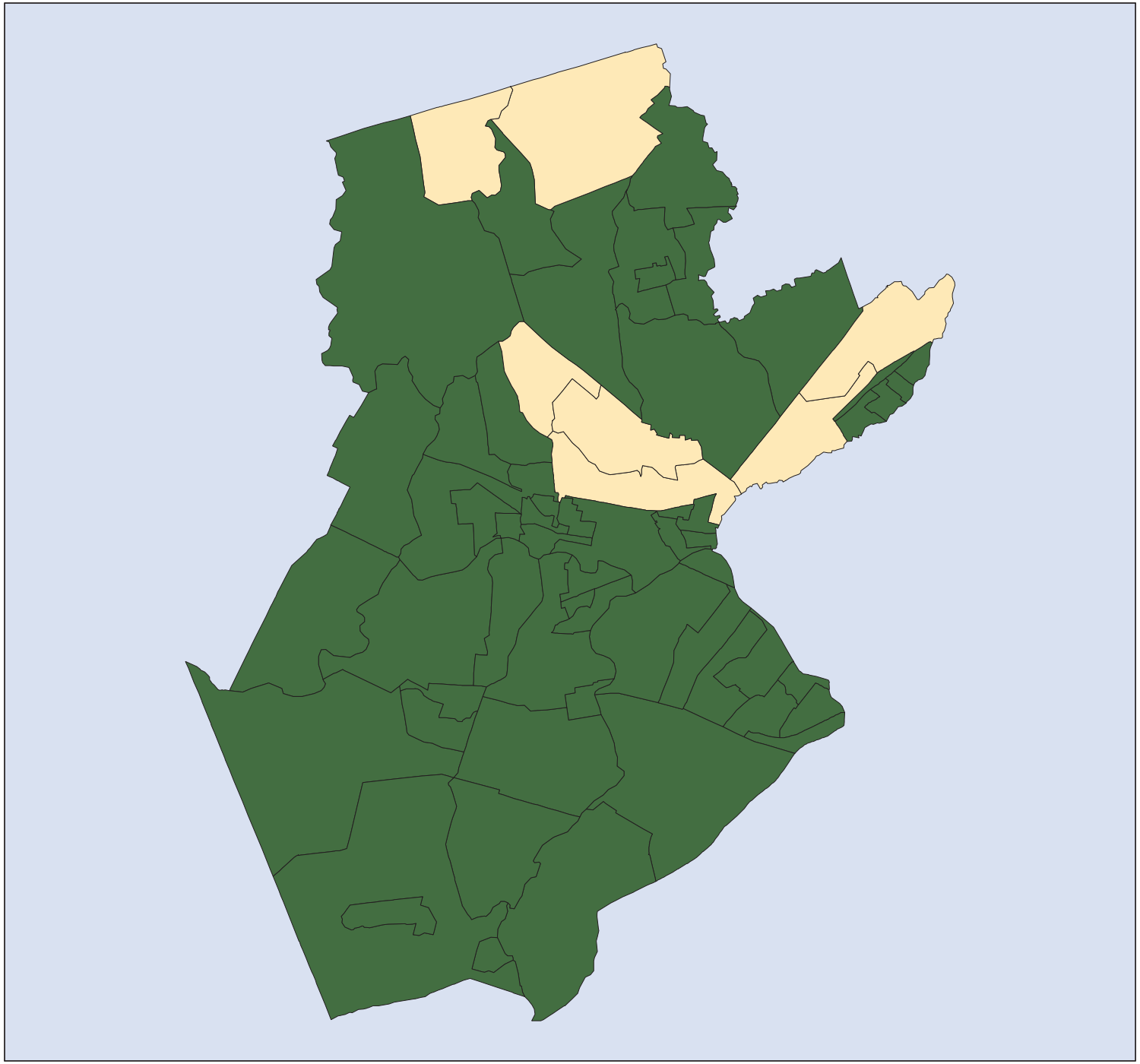
Table Description:
Upgraded Liquefaction Map

Liquefaction Susceptibility

- Very Low (Class 1)
- Low (Class 2)
- Moderate (Class 3)

5 2.5 0 5 Miles

Data from the HAZUS-MH GIS software and the New Jersey Geological Survey. February 13, 2008



Study Region:
Somerset County

Table Description:
Upgraded Landslide Map

Landslide Susceptibility

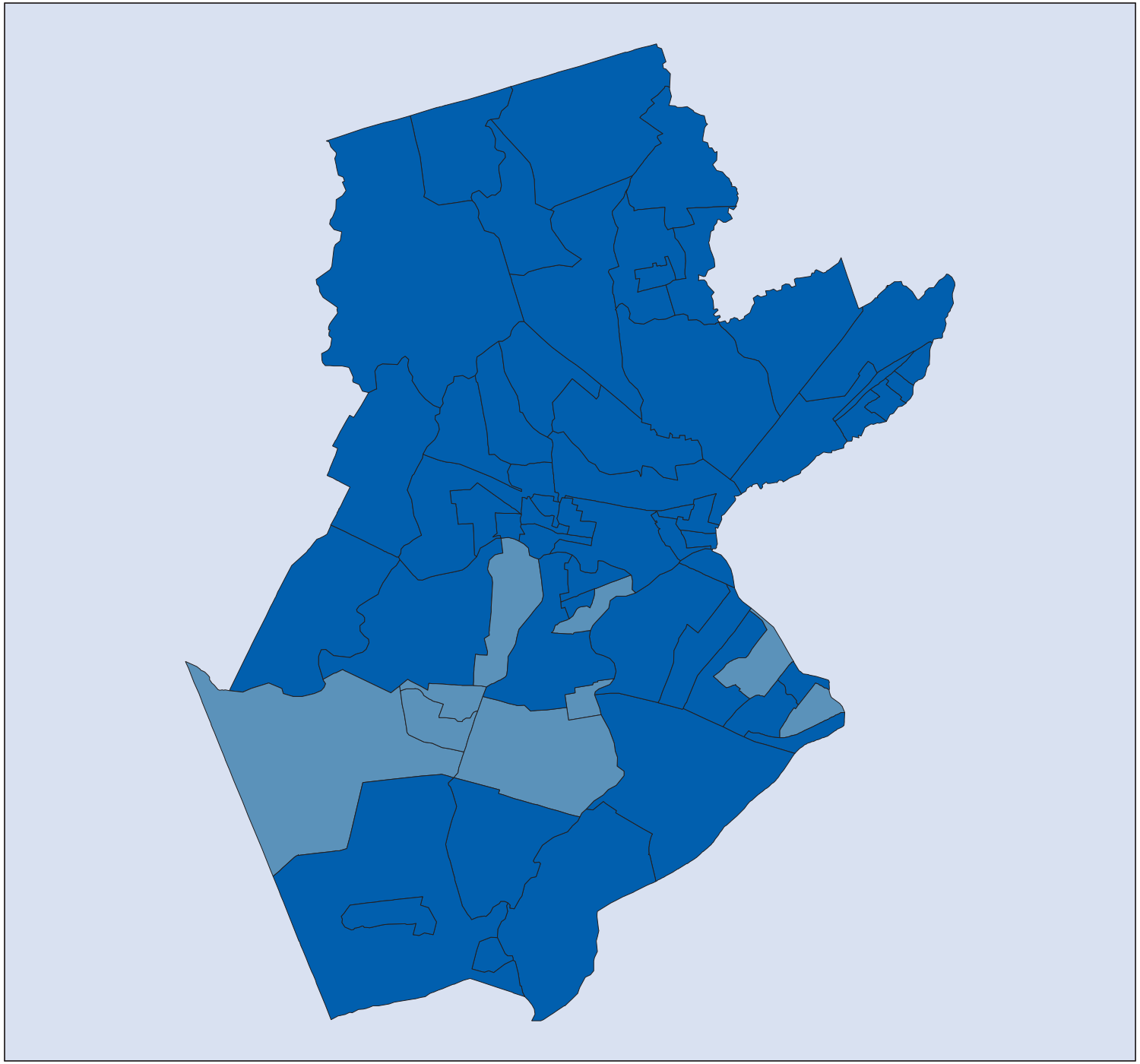
- None (Class 0)
- Moderate (Class 3)

5 2.5 0 5 Miles

Data from the HAZUS-MH GIS software and the New Jersey Geological Survey. February 13, 2008

APPENDIX B

Magnitude 5 with upgraded geology



5 2.5 0 5 Miles

Study Region:
Somerset County

Scenario Description:
5.0 Upgrade Scenario

Percentage Of Buildings With Moderate and Greater Damage

- 90 to 100
- 80 to 90
- 70 to 80
- 60 to 70
- 50 to 60
- 40 to 50
- 30 to 40
- 20 to 30
- 10 to 20
- 0 to 10

NEW JERSEY GEOLOGICAL SURVEY 1835

Data from the HAZUS-MH GIS software and the New Jersey Geological Survey. February 13, 2008

Building Damage by Count by General Occupancy

February 06, 2008

	# of Buildings					
	None	Slight	Moderate	Extensive	Complete	Total
New Jersey						
Somerset						
Commercial	*2,190*	*166*	*73*	*15*	*31*	*2,475*
Industrial	*465*	*35*	*16*	*3*	*6*	*525*
Government	*96*	*7*	*3*	*1*	*2*	*108*
Agriculture	*67*	*4*	*2*	*0*	*1*	*74*
Single Family	*78,714*	*3,687*	*843*	*182*	*753*	*84,180*
Religion	*127*	*9*	*4*	*1*	*2*	*142*
Other Residential	*5,138*	*391*	*149*	*36*	*182*	*5,897*
Education	*72*	*5*	*2*	*0*	*1*	*81*
Total	**86,869**	**4,304**	**1,092**	**238**	**979**	**93,482**
Region Total	**86,869**	**4,304**	**1,092**	**238**	**979**	**93,482**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/states were selected at the time of study region creation.

HAZUS-MH Loss Estimation

Estimated Economic Loss ($ Billions)

Category	Description	Range
General Building Stock	Building Damage	0.40 - 1.50
	Building Contents	0.00 - 0.20
	Business Interruption	0.00 - 0.10
Infrastructure	Lifelines Damage	
	Total	0.60 - 2.40

Estimated Building Damage(Thousands of Buildings)

Description	Residential	Commercial	Other	Total
Minor	2 - 10	< 1.0	< 1.0	2 - 10
Major	0 - 2	< 1.0	< 1.0	0 - 2
Total	3 - 12	< 1.0	< 1.0	3 - 13

Estimated Casualties : Night Time

Severity Level	Description	# Persons
Level 1	Medical Aid	140 - 600
Level 2	Hospital Care	40 - 150
Level 3	Life-threatening	< 20
Level 4	Fatalities	10 - 30

Estimated Shelter Needs

Type	Households	People
Displaced Households	700 - 3,000	
Public Shelter		

Comments :

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, goetechnical, and observed ground motion data.

Earthquake Information

Location :

Origin Time:

Magnitude : 5.00

Epicenter Latitude/Longitude :
40.56 / -74.62

Depth & Type :10.00/A

Fault Name :
NA

Maximum PGA : 0.00

Ground Motion /Attenuation : CEUS Event

Information Sources:

Comments :

Population and Building Exposure (2002 D&B) (2000 Census)

Population: 297,490

Building Exposure : ($ Millions)

Residential	22,917
Commerical	5,887
Other	2,681
Total	31,485

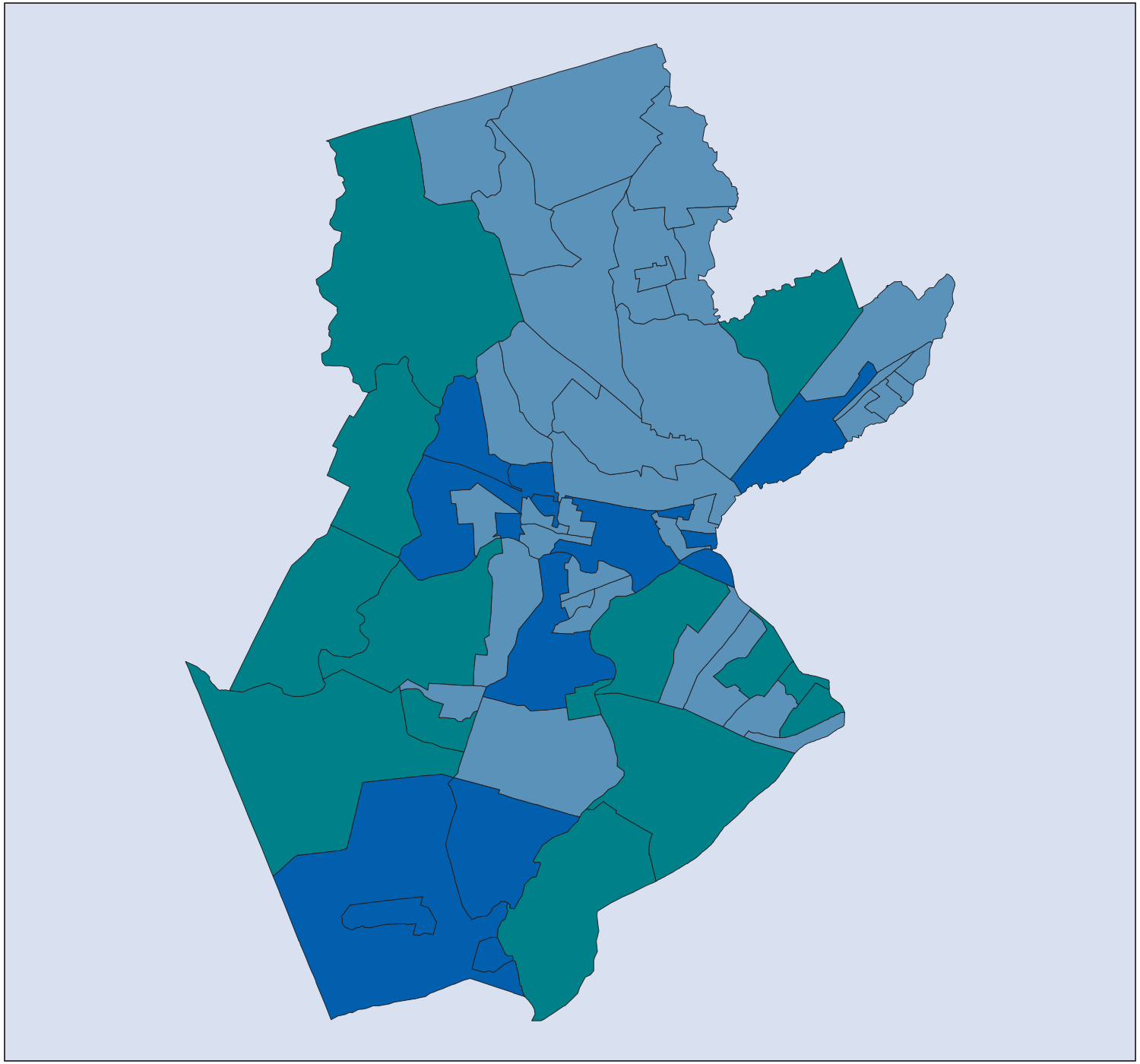
State: 160 - 700

Counties :
- Somerset,NJ

Major Metro Area :

APPENDIX C

Magnitude 5.5 with default geology



5 2.5 0 5 Miles

Study Region:
Somerset County

Scenario Description:
5.5 Default Scenario

Percentage Of Buildings With Moderate and Greater Damage

- 90 to 100
- 80 to 90
- 70 to 80
- 60 to 70
- 50 to 60
- 40 to 50
- 30 to 40
- 20 to 30
- 10 to 20
- 0 to 10

NEW JERSEY GEOLOGICAL SURVEY 1835

Data from the HAZUS-MH GIS software and the New Jersey Geological Survey. February 13, 2008

Building Damage by Count by General Occupancy

February 07, 2008

	# of Buildings					
	None	Slight	Moderate	Extensive	Complete	Total
New Jersey						
Somerset						
Commercial	*1,399*	*501*	*419*	*132*	*24*	*2,475*
Industrial	*290*	*103*	*97*	*30*	*5*	*525*
Government	*63*	*20*	*18*	*6*	*1*	*108*
Agriculture	*44*	*16*	*10*	*3*	*0*	*74*
Single Family	*49,589*	*22,587*	*9,795*	*1,867*	*342*	*84,180*
Religion	*79*	*31*	*23*	*7*	*2*	*142*
Other Residential	*3,342*	*1,421*	*856*	*232*	*47*	*5,897*
Education	*46*	*16*	*14*	*4*	*1*	*81*
Total	**54,852**	**24,696**	**11,231**	**2,282**	**421**	**93,482**
Region Total	**54,852**	**24,696**	**11,231**	**2,282**	**421**	**93,482**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/states were selected at the time of study region creation.

HAZUS-MH Loss Estimation

Estimated Economic Loss ($ Billions)

Category	Description	Range
General Building Stock	Building Damage	0.80 - 3.20
	Building Contents	0.10 - 0.30
	Business Interruption	0.10 - 0.40
Infrastructure	Lifelines Damage	
	Total	1.30 - 5.10

Estimated Building Damage(Thousands of Buildings)

Description	Residential	Commercial	Other	Total
Minor	17 - 70	0 - 1	< 1.0	18 - 70
Major	1 - 5	< 1.0	< 1.0	1 - 5
Total	18 - 70	0 - 2	< 1.0	19 - 80

Estimated Casualties : Night Time

Severity Level	Description	# Persons
Level 1	Medical Aid	200 - 800
Level 2	Hospital Care	40 - 160
Level 3	Life-threatening	< 20
Level 4	Fatalities	10 - 40

Estimated Shelter Needs

Type	Households	People
Displaced Households	800 - 3,000	
Public Shelter		

Comments :

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, goetechnical, and observed ground motion data.

Earthquake Information

Location :

Origin Time:

Magnitude : 5.50

Epicenter Latitude/Longitude :
40.56 / -74.62

Depth & Type :10.00/A

Fault Name :
NA

Maximum PGA : 1.00

Ground Motion /Attenuation : CEUS Event

Information Sources:

Comments :

Population and Building Exposure (2002 D&B) (2000 Census)

Population: 297,490

Building Exposure : ($ Millions)

Residential	22,917
Commerical	5,887
Other	2,681
Total	31,485

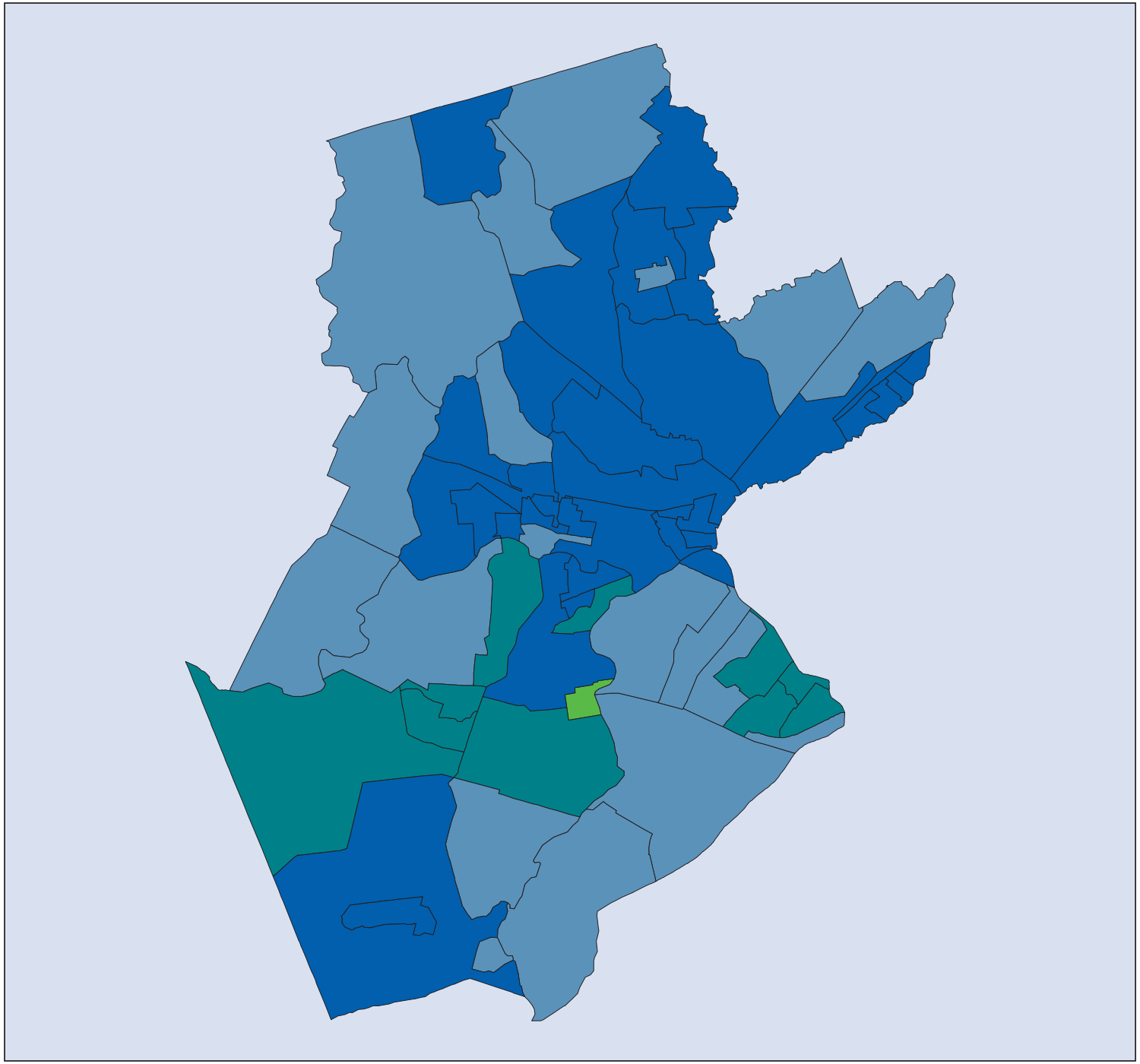
State: 160 - 600

Counties :
- Somerset,NJ

Major Metro Area :

APPENDIX D

Magnitude 5.5 with upgraded geology



5 2.5 0 5 Miles

Study Region:
Somerset County

Scenario Description:
5.5 Upgrade Scenario

Percentage Of Buildings With Moderate and Greater Damage

- 90 to 100
- 80 to 90
- 70 to 80
- 60 to 70
- 50 to 60
- 40 to 50
- 30 to 40
- 20 to 30
- 10 to 20
- 0 to 10

NEW JERSEY GEOLOGICAL SURVEY 1835

Data from the HAZUS-MH GIS software and the New Jersey Geological Survey. February 13, 2008

Building Damage by Count by General Occupancy

February 07, 2008

	# of Buildings					
	None	Slight	Moderate	Extensive	Complete	Total
New Jersey						
Somerset						
Commercial	*1,634*	*417*	*292*	*80*	*52*	*2,475*
Industrial	*347*	*86*	*65*	*17*	*10*	*525*
Government	*74*	*17*	*12*	*3*	*2*	*108*
Agriculture	*51*	*13*	*7*	*2*	*1*	*74*
Single Family	*58,982*	*16,990*	*6,021*	*1,053*	*1,134*	*84,180*
Religion	*93*	*26*	*16*	*5*	*3*	*142*
Other Residential	*3,673*	*1,182*	*640*	*157*	*245*	*5,897*
Education	*54*	*13*	*10*	*2*	*2*	*81*
Total	**64,908**	**18,744**	**7,063**	**1,319**	**1,449**	**93,482**
Region Total	**64,908**	**18,744**	**7,063**	**1,319**	**1,449**	**93,482**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/states were selected at the time of study region creation.

HAZUS-MH Loss Estimation

Estimated Economic Loss ($ Billions)

Category	Description	Range
General Building Stock	Building Damage	0.80 - 3.30
	Building Contents	0.10 - 0.40
	Business Interruption	0.10 - 0.40
Infrastructure	Lifelines Damage	
	Total	1.30 - 5.30

Estimated Building Damage(Thousands of Buildings)

Description	Residential	Commercial	Other	Total
Minor	12 - 50	0 - 1	< 1.0	12 - 50
Major	1 - 5	< 1.0	< 1.0	1 - 5
Total	13 - 50	0 - 1	< 1.0	14 - 60

Estimated Casualties : Night Time

Severity Level	Description	# Persons
Level 1	Medical Aid	300 - 1,100
Level 2	Hospital Care	70 - 300
Level 3	Life-threatening	10 - 30
Level 4	Fatalities	10 - 60

Estimated Shelter Needs

Type	Households	People
Displaced Households	1,300 - 5,000	
Public Shelter		

Comments :

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, goetechnical, and observed ground motion data.

Earthquake Information

Location :

Origin Time:

Magnitude : 5.50

Epicenter Latitude/Longitude :
40.56 / -74.62

Depth & Type :10.00/A

Fault Name :
NA

Maximum PGA : 1.00

Ground Motion /Attenuation : CEUS Event

Information Sources:

Comments :

Population and Building Exposure (2002 D&B) (2000 Census)

Population: 297,490

Building Exposure : ($ Millions)

Residential	22,917
Commerical	5,887
Other	2,681
Total	31,485

State: 300 - 1,100

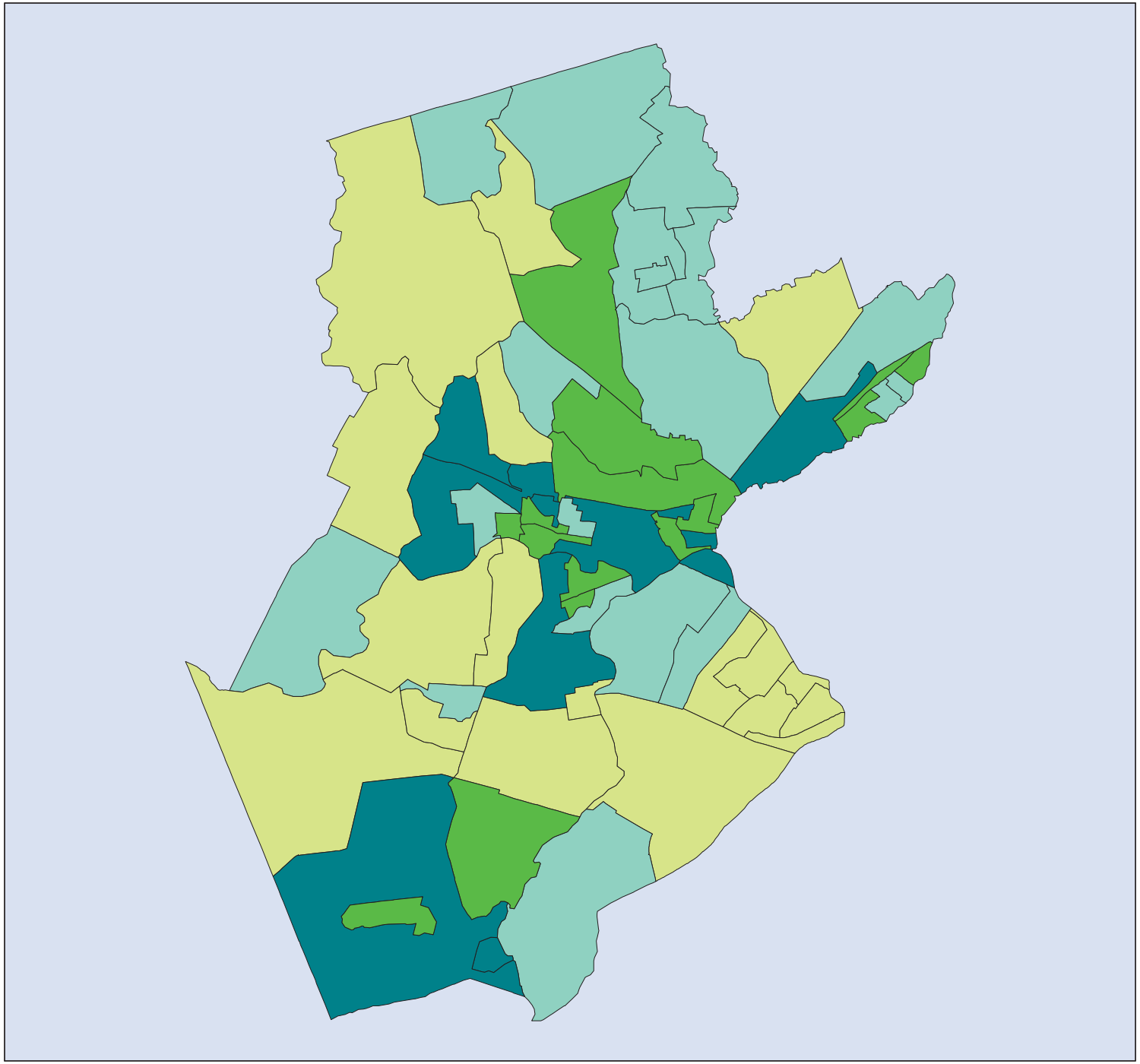
Counties :
- Somerset,NJ

Major Metro Area :

Time of report: February 07, 2008 11:48 am

APPENDIX E

Magnitude 6 with default geology



5 2.5 0 5 Miles

Study Region:
Somerset County

Scenario Description:
6.0 Default Scenario

Percentage Of Buildings With Moderate and Greater Damage

- 90 to 100
- 80 to 90
- 70 to 80
- 60 to 70
- 50 to 60
- 40 to 50
- 30 to 40
- 20 to 30
- 10 to 20
- 0 to 10

NEW JERSEY GEOLOGICAL SURVEY 1835

Data from the HAZUS-MH GIS software and the New Jersey Geological Survey. February 13, 2008

Building Damage by Count by General Occupancy

February 07, 2008

	# of Buildings					
	None	Slight	Moderate	Extensive	Complete	Total
New Jersey						
Somerset						
Commercial	*460*	*459*	*797*	*521*	*238*	*2,475*
Industrial	*86*	*83*	*170*	*127*	*59*	*525*
Government	*21*	*18*	*34*	*24*	*11*	*108*
Agriculture	*16*	*17*	*24*	*12*	*5*	*74*
Single Family	*21,715*	*28,686*	*24,177*	*7,448*	*2,154*	*84,180*
Religion	*31*	*33*	*42*	*25*	*11*	*142*
Other Residential	*1,318*	*1,615*	*1,767*	*863*	*334*	*5,897*
Education	*15*	*14*	*26*	*18*	*8*	*81*
Total	**23,661**	**30,926**	**27,038**	**9,037**	**2,820**	**93,482**
Region Total	**23,661**	**30,926**	**27,038**	**9,037**	**2,820**	**93,482**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/states were selected at the time of study region creation.

HAZUS-MH Loss Estimation

Estimated Economic Loss ($ Billions)

Category	Description	Range
General Building Stock	Building Damage	2.40 - 9.40
	Building Contents	0.20 - 0.70
	Business Interruption	0.40 - 1.50
Infrastructure	Lifelines Damage	
	Total	3.50 - 14.00

Estimated Building Damage(Thousands of Buildings)

Description	Residential	Commercial	Other	Total
Minor	30 - 110	0 - 2	< 1.0	30 - 120
Major	5 - 20	0 - 1	< 1.0	5 - 20
Total	30 - 130	1 - 4	0 - 1	30 - 140

Estimated Casualties : Night Time

Severity Level	Description	# Persons
Level 1	Medical Aid	900 - 3,000
Level 2	Hospital Care	200 - 800
Level 3	Life-threatening	30 - 110
Level 4	Fatalities	50 - 200

Estimated Shelter Needs

Type	Households	People
Displaced Households	4,000 - 14,000	
Public Shelter		

Comments :

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, goetechnical, and observed ground motion data.

Earthquake Information

Location :

Origin Time:

Magnitude : 6.00

Epicenter Latitude/Longitude :
40.56 / -74.62

Depth & Type :10.00/A

Fault Name :
NA

Maximum PGA : 1.00

Ground Motion /Attenuation : CEUS Event

Information Sources:

Comments :

Population and Building Exposure (2002 D&B) (2000 Census)

Population: 297,490

Building Exposure : ($ Millions)

Residential	22,917
Commerical	5,887
Other	2,681
Total	31,485

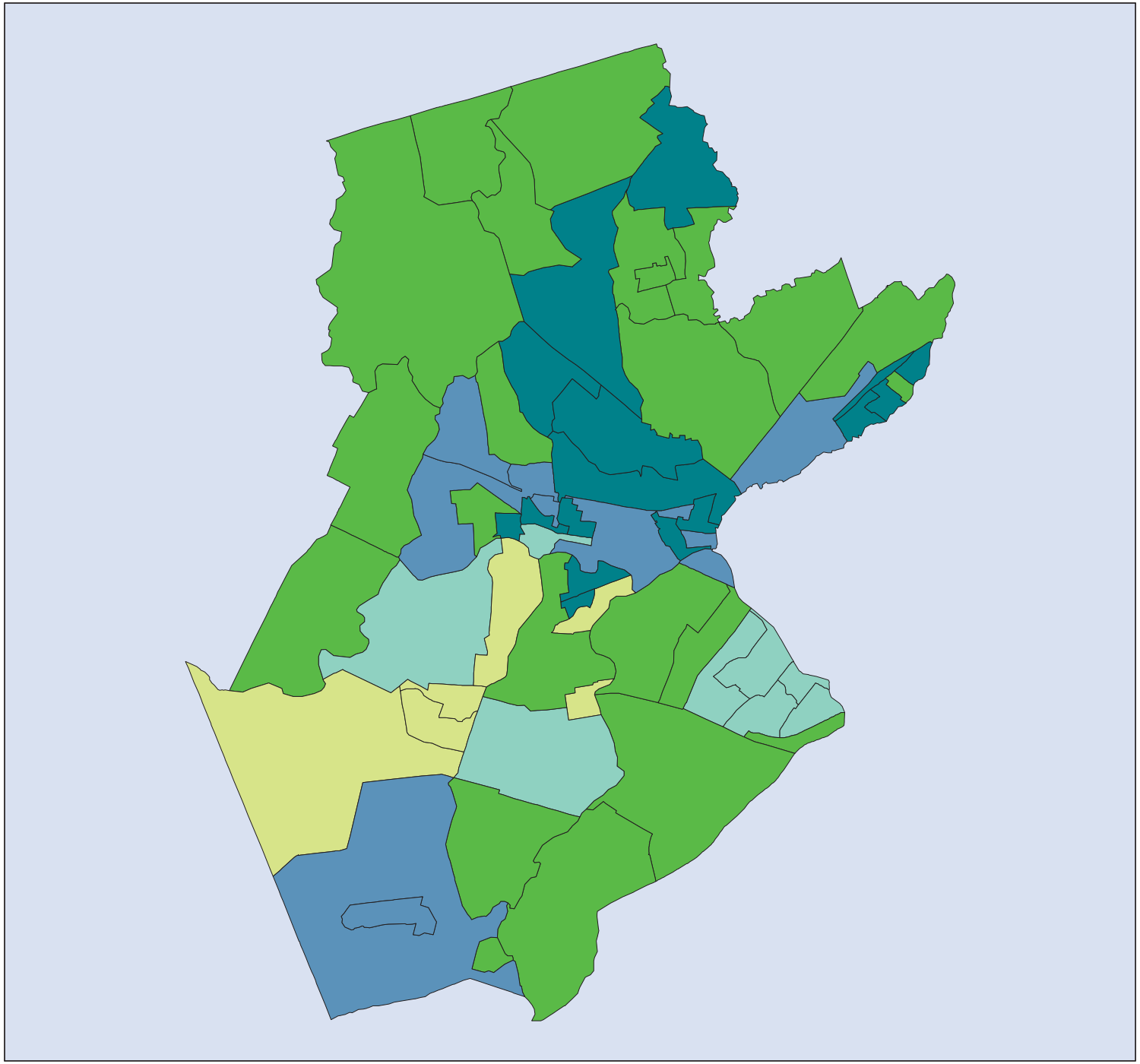
State: 700 - 3,000

Counties :
- Somerset,NJ

Major Metro Area :

APPENDIX F

Magnitude 6 with upgraded geology



Study Region:
Somerset County

Scenario Description:
6.0 Upgrade Scenario

Percentage Of Buildings With Moderate and Greater Damage

- 90 to 100
- 80 to 90
- 70 to 80
- 60 to 70
- 50 to 60
- 40 to 50
- 30 to 40
- 20 to 30
- 10 to 20
- 0 to 10

5 2.5 0 5 Miles

Data from the HAZUS-MH GIS software and the New Jersey Geological Survey.
February 13, 2008

Building Damage by Count by General Occupancy

February 07, 2008

	# of Buildings					
	None	Slight	Moderate	Extensive	Complete	Total
New Jersey						
Somerset						
Commercial	*725*	*522*	*706*	*358*	*164*	*2,475*
Industrial	*146*	*102*	*158*	*85*	*35*	*525*
Government	*34*	*21*	*30*	*16*	*7*	*108*
Agriculture	*25*	*18*	*20*	*8*	*4*	*74*
Single Family	*32,026*	*27,514*	*17,803*	*4,590*	*2,248*	*84,180*
Religion	*46*	*35*	*36*	*17*	*8*	*142*
Other Residential	*1,802*	*1,587*	*1,466*	*610*	*431*	*5,897*
Education	*24*	*17*	*24*	*12*	*5*	*81*
Total	**34,827**	**29,815**	**20,242**	**5,696**	**2,902**	**93,482**
Region Total	**34,827**	**29,815**	**20,242**	**5,696**	**2,902**	**93,482**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/states were selected at the time of study region creation.

HAZUS-MH Loss Estimation

Estimated Economic Loss ($ Billions)

Category	Description	Range
General Building Stock	Building Damage	1.90 - 7.80
	Building Contents	0.20 - 0.70
	Business Interruption	0.30 - 1.10
Infrastructure	Lifelines Damage	
	Total	3.00 - 12.10

Estimated Building Damage(Thousands of Buildings)

Description	Residential	Commercial	Other	Total
Minor	20 - 100	0 - 2	< 1.0	30 - 100
Major	3 - 15	0 - 1	< 1.0	4 - 17
Total	30 - 110	0 - 3	0 - 1	30 - 120

Estimated Casualties : Night Time

Severity Level	Description	# Persons
Level 1	Medical Aid	700 - 3,000
Level 2	Hospital Care	170 - 700
Level 3	Life-threatening	20 - 80
Level 4	Fatalities	40 - 160

Estimated Shelter Needs

Type	Households	People
Displaced Households	3,000 - 12,000	
Public Shelter		

Comments :

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, goetechnical, and observed ground motion data.

Earthquake Information

Location :

Origin Time:

Magnitude : 6.00

Epicenter Latitude/Longitude :
40.56 / -74.62

Depth & Type :10.00/A

Fault Name :
NA

Maximum PGA : 1.00

Ground Motion /Attenuation : CEUS Event

Information Sources:

Comments :

Population and Building Exposure (2002 D&B) (2000 Census)

Population: 297,490

Building Exposure : ($ Millions)

Residential	22,917
Commerical	5,887
Other	2,681
Total	31,485

State: 700 - 3,000

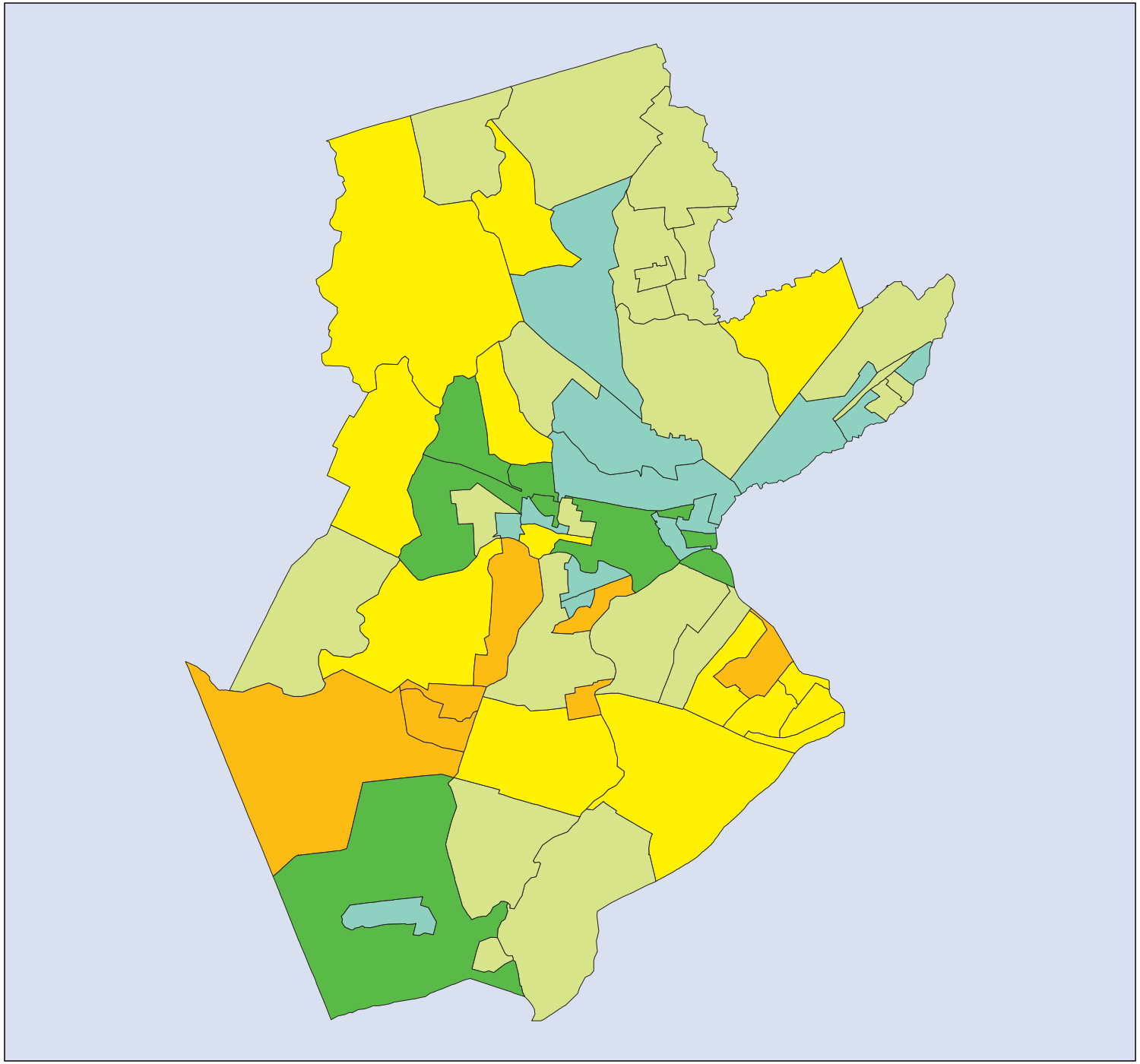
Counties :
- Somerset,NJ

Major Metro Area :

Time of report: February 07, 2008 1:49 pm

APPENDIX G

Magnitude 6.5 with upgraded geology



Study Region:
Somerset County

Scenario Description:
6.5 Upgrade Scenario

Percentage Of Buildings With Moderate and Greater Damage

- 90 to 100
- 80 to 90
- 70 to 80
- 60 to 70
- 50 to 60
- 40 to 50
- 30 to 40
- 20 to 30
- 10 to 20
- 0 to 10

5 2.5 0 5 Miles

Data from the HAZUS-MH GIS software and the New Jersey Geological Survey.
February 13, 2008

Building Damage by Count by General Occupancy

February 07, 2008

	# of Buildings					
	None	Slight	Moderate	Extensive	Complete	Total
New Jersey						
Somerset						
Commercial	*251*	*334*	*748*	*651*	*491*	*2,475*
Industrial	*46*	*58*	*152*	*154*	*116*	*525*
Government	*12*	*13*	*32*	*30*	*22*	*108*
Agriculture	*9*	*13*	*25*	*16*	*11*	*74*
Single Family	*13,798*	*26,066*	*28,678*	*10,796*	*4,842*	*84,180*
Religion	*18*	*28*	*43*	*31*	*21*	*142*
Other Residential	*734*	*1,326*	*1,858*	*1,123*	*855*	*5,897*
Education	*8*	*10*	*24*	*22*	*16*	*81*
Total	**14,876**	**27,849**	**31,560**	**12,823**	**6,374**	**93,482**
Region Total	**14,876**	**27,849**	**31,560**	**12,823**	**6,374**	**93,482**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/states were selected at the time of study region creation.

HAZUS-MH Loss Estimation

Estimated Economic Loss ($ Billions)

Category	Description	Range
General Building Stock	Building Damage	3.80 - 15.10
	Building Contents	0.30 - 1.20
	Business Interruption	0.60 - 2.30
Infrastructure	Lifelines Damage	
	Total	5.70 - 22.60

Estimated Building Damage(Thousands of Buildings)

Description	Residential	Commercial	Other	Total
Minor	30 - 120	0 - 2	< 1.0	30 - 120
Major	8 - 40	0 - 2	< 1.0	9 - 40
Total	40 - 150	1 - 4	0 - 1	40 - 160

Estimated Casualties : Night Time

Severity Level	Description	# Persons
Level 1	Medical Aid	1,500 - 6,000
Level 2	Hospital Care	400 - 1,500
Level 3	Life-threatening	50 - 200
Level 4	Fatalities	100 - 400

Estimated Shelter Needs

Type	Households	People
Displaced Households	6,000 - 25,000	
Public Shelter		

Comments :

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, goetechnical, and observed ground motion data.

Earthquake Information

Location :

Origin Time:

Magnitude : 6.50

Epicenter Latitude/Longitude :
40.56 / -74.62

Depth & Type :10.00/A

Fault Name :
NA

Maximum PGA : 1.00

Ground Motion /Attenuation : CEUS Event

Information Sources:

Comments :

Population and Building Exposure (2002 D&B) (2000 Census)

Population: 297,490

Building Exposure : ($ Millions)

Residential	22,917
Commerical	5,887
Other	2,681
Total	31,485

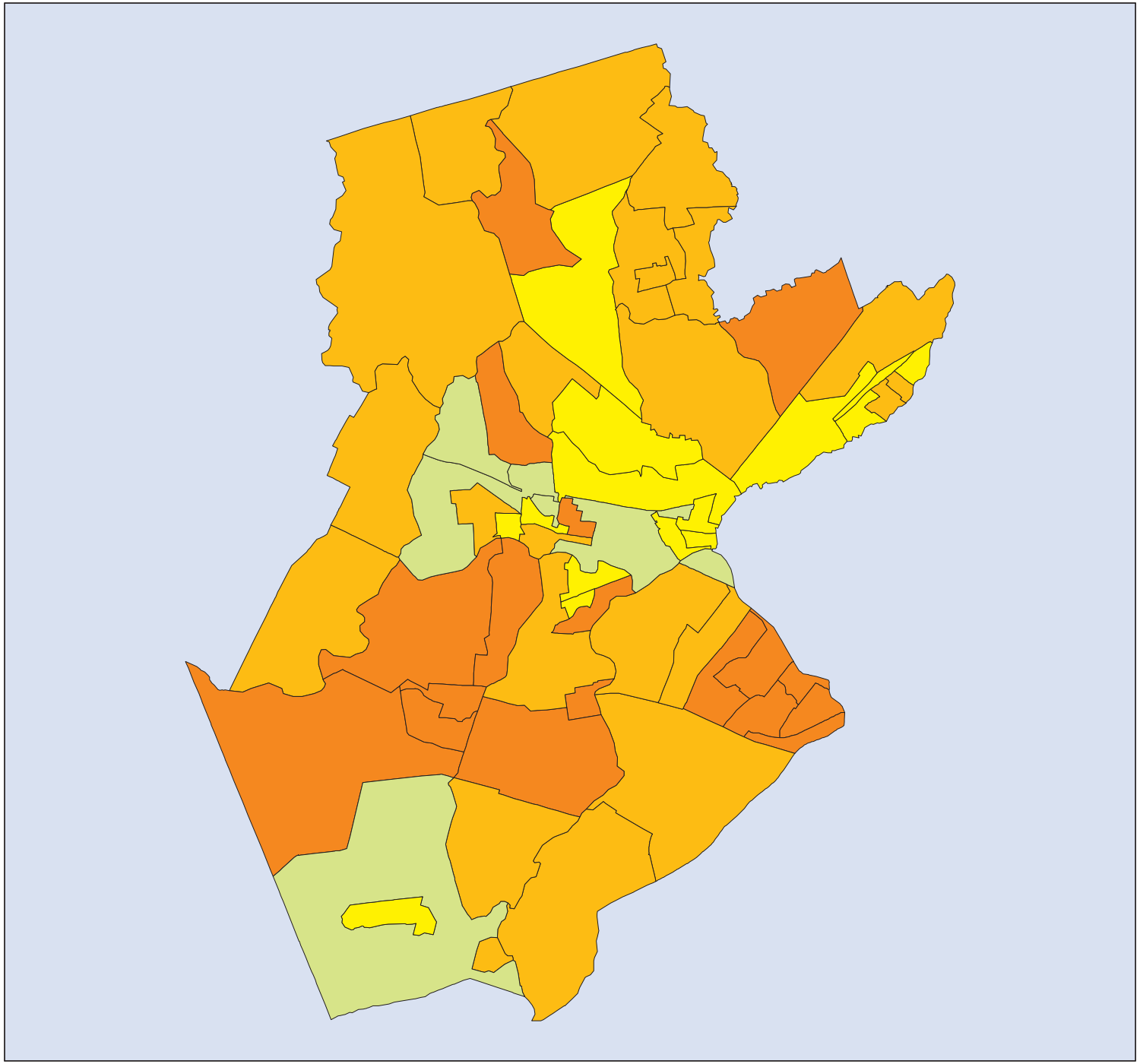
State: 1,300 - 5,000

Counties :
- Somerset,NJ

Major Metro Area :

APPENDIX H

Magnitude 7 with upgraded geology



Study Region:
Somerset County

Scenario Description:
7.0 Upgrade Scenario

Percentage Of Buildings With Moderate and Greater Damage

- 90 to 100
- 80 to 90
- 70 to 80
- 60 to 70
- 50 to 60
- 40 to 50
- 30 to 40
- 20 to 30
- 10 to 20
- 0 to 10

5 2.5 0 5 Miles

Data from the HAZUS-MH GIS software and the New Jersey Geological Survey.
February 13, 2008

Building Damage by Count by General Occupancy

February 07, 2008

	# of Buildings					
	None	Slight	Moderate	Extensive	Complete	Total
New Jersey						
Somerset						
Commercial	*68*	*146*	*517*	*724*	*1,019*	*2,475*
Industrial	*11*	*22*	*90*	*157*	*245*	*525*
Government	*3*	*6*	*20*	*32*	*47*	*108*
Agriculture	*3*	*7*	*20*	*20*	*24*	*74*
Single Family	*5,535*	*18,642*	*32,819*	*17,596*	*9,588*	*84,180*
Religion	*6*	*18*	*38*	*37*	*43*	*142*
Other Residential	*274*	*876*	*1,806*	*1,421*	*1,521*	*5,897*
Education	*2*	*4*	*16*	*25*	*34*	*81*
Total	**5,902**	**19,720**	**35,327**	**20,013**	**12,520**	**93,482**
Region Total	**5,902**	**19,720**	**35,327**	**20,013**	**12,520**	**93,482**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/states were selected at the time of study region creation.

HAZUS-MH Loss Estimation

Estimated Economic Loss ($ Billions)

Category	Description	Range
General Building Stock	Building Damage	6.00 - 24.00
	Building Contents	0.50 - 1.80
	Business Interruption	0.90 - 3.50
Infrastructure	Lifelines Damage	
	Total	8.80 - 35.10

Estimated Building Damage(Thousands of Buildings)

Description	Residential	Commercial	Other	Total
Minor	30 - 110	0 - 1	< 1.0	30 - 110
Major	15 - 60	0 - 3	0 - 1	16 - 70
Total	40 - 170	1 - 4	0 - 1	40 - 180

Estimated Casualties : Night Time

Severity Level	Description	# Persons
Level 1	Medical Aid	3,000 - 10,000
Level 2	Hospital Care	700 - 3,000
Level 3	Life-threatening	90 - 400
Level 4	Fatalities	180 - 700

Estimated Shelter Needs

Type	Households	People
Displaced Households	11,000 - 43,000	
Public Shelter		

Comments :

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, goetechnical, and observed ground motion data.

Earthquake Information

Location :

Origin Time:

Magnitude : 7.00

Epicenter Latitude/Longitude :
40.56 / -74.62

Depth & Type :10.00/A

Fault Name :
NA

Maximum PGA : 2.00

Ground Motion /Attenuation : CEUS Event

Information Sources:

Comments :

Population and Building Exposure (2002 D&B) (2000 Census)

Population: 297,490

Building Exposure : ($ Millions)

Residential	22,917
Commerical	5,887
Other	2,681
Total	31,485

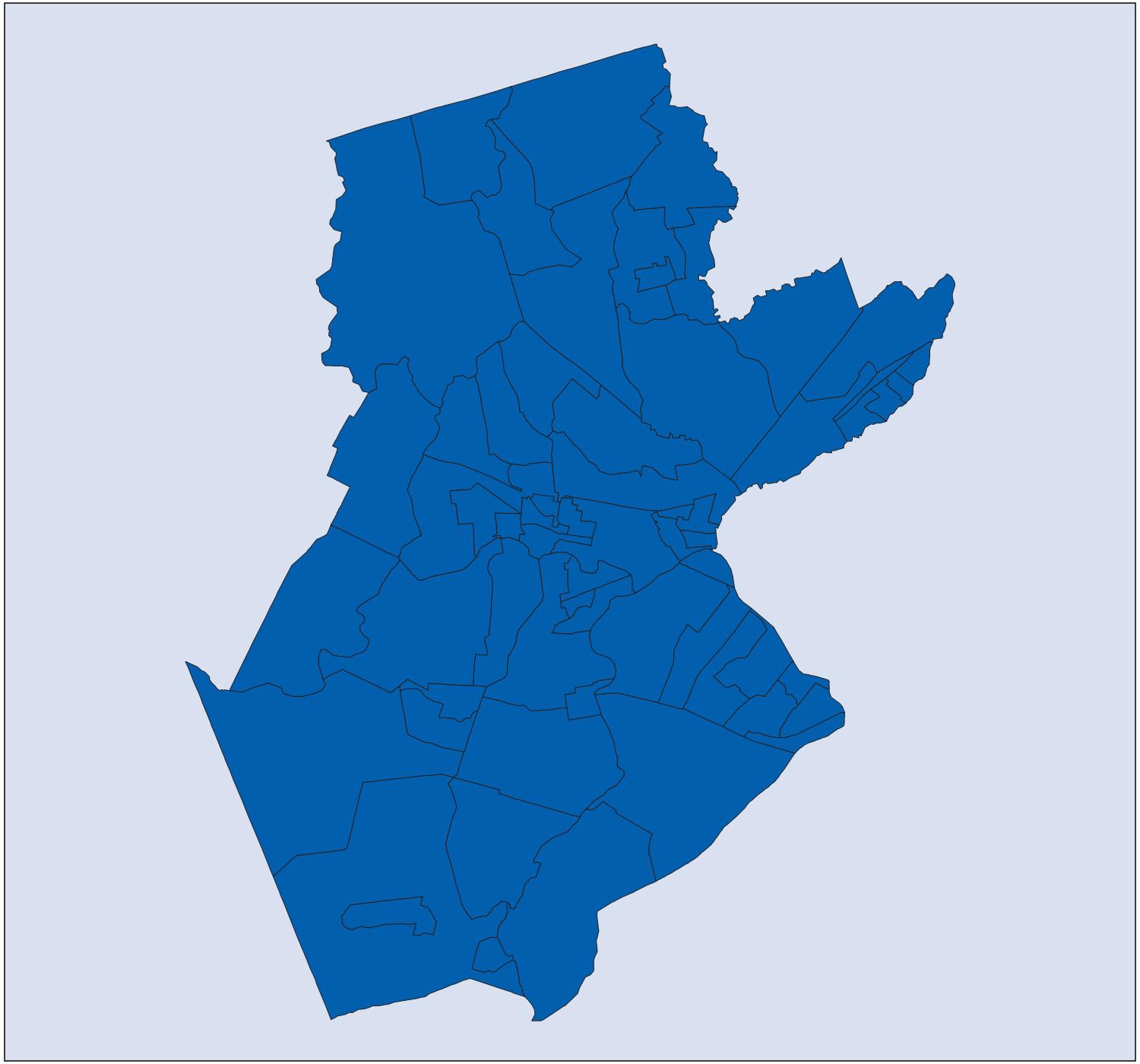
State: 2,000 - 9,000

Counties :
- Somerset,NJ

Major Metro Area :

APPENDIX I

500-year return period with upgraded geology (M5.5)



Study Region:
Somerset County

Scenario Description:
5.5 Probabilistic 500 Year Upgrade Scenario

Percentage Of Buildings With Moderate and Greater Damage

- 90 to 100
- 80 to 90
- 70 to 80
- 60 to 70
- 50 to 60
- 40 to 50
- 30 to 40
- 20 to 30
- 10 to 20
- 0 to 10

5 2.5 0 5 Miles

Data from the HAZUS-MH GIS software and the New Jersey Geological Survey. February 13, 2008

Building Damage by Count by General Occupancy

February 05, 2008

	# of Buildings					
	None	Slight	Moderate	Extensive	Complete	Total
New Jersey						
Somerset						
Commercial	*2,322*	*109*	*39*	*5*	*0*	*2,475*
Industrial	*496*	*21*	*7*	*1*	*0*	*525*
Government	*102*	*4*	*2*	*0*	*0*	*108*
Agriculture	*70*	*3*	*1*	*0*	*0*	*74*
Single Family	*81,814*	*1,878*	*420*	*61*	*6*	*84,180*
Religion	*133*	*6*	*2*	*0*	*0*	*142*
Other Residential	*5,596*	*215*	*74*	*10*	*1*	*5,897*
Education	*76*	*3*	*1*	*0*	*0*	*81*
Total	**90,610**	**2,240**	**546**	**79**	**8**	**93,482**
Region Total	**90,610**	**2,240**	**546**	**79**	**8**	**93,482**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/states were selected at the time of study region creation.

HAZUS-MH Loss Estimation

Estimated Economic Loss ($ Billions)

Category	Description	Range
General Building Stock	Building Damage	0.00 - 0.10
	Building Contents	< 0.1
	Business Interruption	< 0.1
Infrastructure	Lifelines Damage	
	Total	0.00 - 0.10

Estimated Building Damage(Thousands of Buildings)

Description	Residential	Commercial	Other	Total
Minor	1 - 5	< 1.0	< 1.0	1 - 5
Major	< 1.0	< 1.0	< 1.0	< 1.0
Total	1 - 5	< 1.0	< 1.0	1 - 5

Estimated Casualties : Night Time

Severity Level	Description	# Persons
Level 1	Medical Aid	10 - 40
Level 2	Hospital Care	< 20
Level 3	Life-threatening	< 20
Level 4	Fatalities	< 20

Estimated Shelter Needs

Type	Households	People
Displaced Households	30 - 100	
Public Shelter		

Comments :

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, goetechnical, and observed ground motion data.

Earthquake Information

Location :

Origin Time:

Magnitude : 5.50

Epicenter Latitude/Longitude :
/

Depth & Type :/P

Fault Name :
NA

Maximum PGA : 0.00

Ground Motion /Attenuation :

Information Sources:

Comments :

Population and Building Exposure (2002 D&B) (2000 Census)

Population: 297,490

Building Exposure : ($ Millions)

Residential	22,917
Commerical	5,887
Other	2,681
Total	31,485

State: 10 - 20

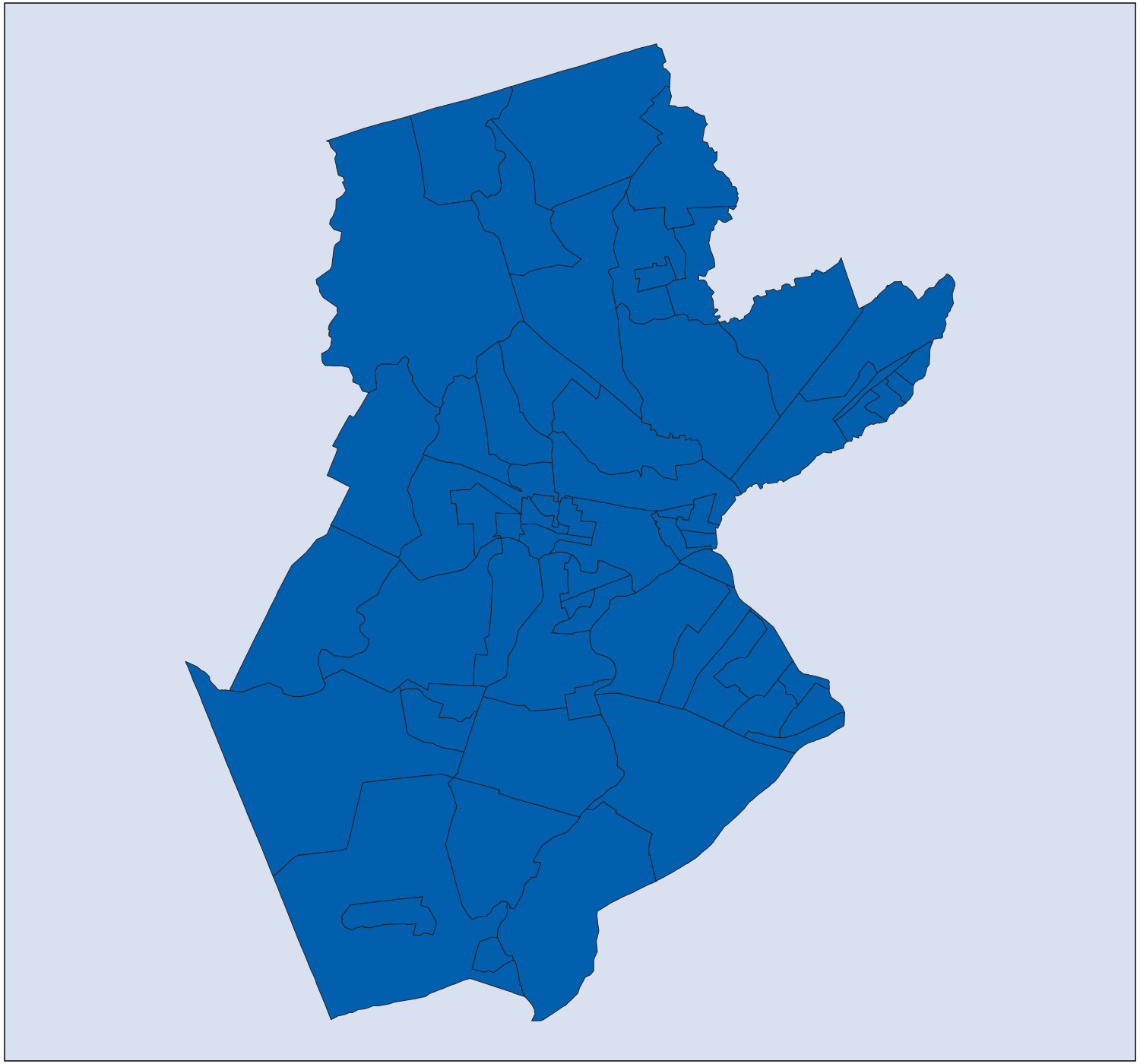
Counties :
- Somerset,NJ

Major Metro Area :

Time of report: February 05, 2008 3:01 pm

APPENDIX J

500-year return period with default geology (M6)



5 2.5 0 5 Miles

Study Region:
Somerset County

Scenario Description:
6.0 Probabilistic 500 Year Default Scenario

Percentage Of Buildings With Moderate and Greater Damage

- 90 to 100
- 80 to 90
- 70 to 80
- 60 to 70
- 50 to 60
- 40 to 50
- 30 to 40
- 20 to 30
- 10 to 20
- 0 to 10

NEW JERSEY GEOLOGICAL SURVEY 1835

Data from the HAZUS-MH GIS software and the New Jersey Geological Survey. February 13, 2008

Building Damage by Count by General Occupancy

February 11, 2008

	# of Buildings					
	None	Slight	Moderate	Extensive	Complete	Total
New Jersey						
Somerset						
Commercial	*2,232*	*163*	*68*	*10*	*1*	*2,475*
Industrial	*475*	*33*	*14*	*2*	*0*	*525*
Government	*98*	*7*	*3*	*0*	*0*	*108*
Agriculture	*68*	*4*	*2*	*0*	*0*	*74*
Single Family	*79,935*	*3,394*	*733*	*106*	*12*	*84,180*
Religion	*129*	*9*	*4*	*1*	*0*	*142*
Other Residential	*5,453*	*315*	*111*	*16*	*2*	*5,897*
Education	*74*	*5*	*2*	*0*	*0*	*81*
Total	**88,464**	**3,931**	**937**	**136**	**14**	**93,482**
Region Total	**88,464**	**3,931**	**937**	**136**	**14**	**93,482**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/states were selected at the time of study region creation.

HAZUS-MH Loss Estimation

Estimated Economic Loss ($ Billions)

Category	Description	Range
General Building Stock	Building Damage	0.00 - 0.20
	Building Contents	< 0.1
	Business Interruption	< 0.1
Infrastructure	Lifelines Damage	
	Total	0.10 - 0.30

Estimated Building Damage(Thousands of Buildings)

Description	Residential	Commercial	Other	Total
Minor	2 - 9	< 1.0	< 1.0	2 - 9
Major	< 1.0	< 1.0	< 1.0	< 1.0
Total	2 - 9	< 1.0	< 1.0	2 - 10

Estimated Casualties : Night Time

Severity Level	Description	# Persons
Level 1	Medical Aid	20 - 60
Level 2	Hospital Care	< 20
Level 3	Life-threatening	< 20
Level 4	Fatalities	< 20

Estimated Shelter Needs

Type	Households	People
Displaced Households	40 - 170	
Public Shelter		

Comments :

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, goetechnical, and observed ground motion data.

Earthquake Information

Location :

Origin Time:

Magnitude : 6.00

Epicenter Latitude/Longitude :

/

Depth & Type :/P

Fault Name :
NA

Maximum PGA : 0.00

Ground Motion /Attenuation :

Information Sources:

Comments :

Population and Building Exposure (2002 D&B) (2000 Census)

Population: 297,490

Building Exposure : ($ Millions)

Residential	22,917
Commerical	5,887
Other	2,681
Total	31,485

State: 10 - 40

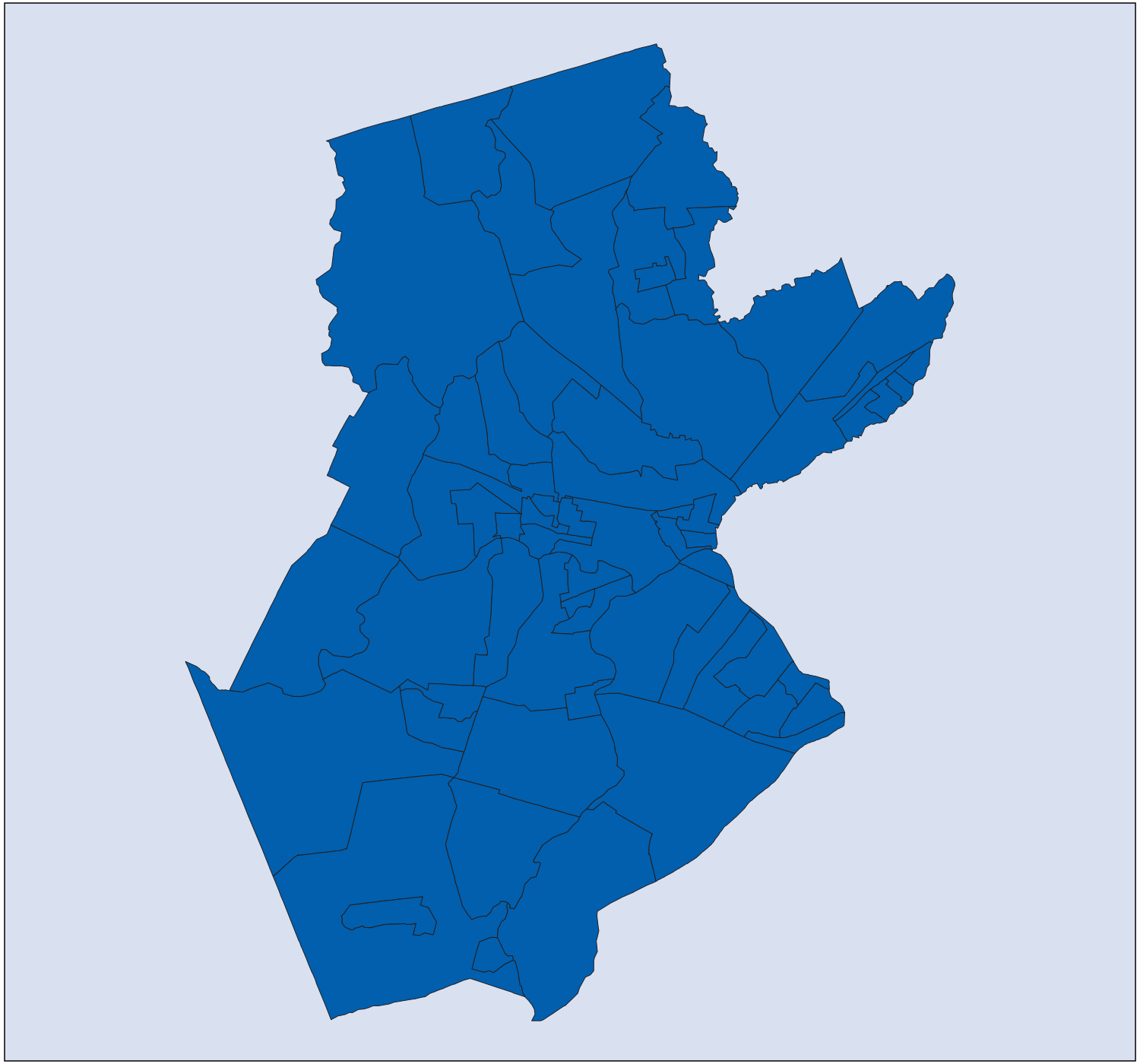
Counties :
- Somerset,NJ

Major Metro Area :

Time of report: February 11, 2008 10:57 am

APPENDIX K

500-year return period with upgraded geology (M6)



Study Region:
Somerset County

Scenario Description:
6.0 Probabilistic 500 Year Upgrade Scenario

Percentage Of Buildings With Moderate and Greater Damage

- 90 to 100
- 80 to 90
- 70 to 80
- 60 to 70
- 50 to 60
- 40 to 50
- 30 to 40
- 20 to 30
- 10 to 20
- 0 to 10

5 2.5 0 5 Miles

Data from the HAZUS-MH GIS software and the New Jersey Geological Survey. February 13, 2008

Building Damage by Count by General Occupancy

February 05, 2008

	# of Buildings					
	None	Slight	Moderate	Extensive	Complete	Total
New Jersey						
Somerset						
Commercial	*2,322*	*109*	*39*	*5*	*0*	*2,475*
Industrial	*496*	*21*	*7*	*1*	*0*	*525*
Government	*102*	*4*	*2*	*0*	*0*	*108*
Agriculture	*70*	*3*	*1*	*0*	*0*	*74*
Single Family	*81,814*	*1,878*	*420*	*61*	*6*	*84,180*
Religion	*133*	*6*	*2*	*0*	*0*	*142*
Other Residential	*5,596*	*215*	*74*	*10*	*1*	*5,897*
Education	*76*	*3*	*1*	*0*	*0*	*81*
Total	**90,610**	**2,240**	**546**	**79**	**8**	**93,482**
Region Total	**90,610**	**2,240**	**546**	**79**	**8**	**93,482**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/states were selected at the time of study region creation.

HAZUS-MH Loss Estimation

Estimated Economic Loss ($ Billions)

Category	Description	Range
General Building Stock	Building Damage	0.00 - 0.10
	Building Contents	< 0.1
	Business Interruption	< 0.1
Infrastructure	Lifelines Damage	
	Total	0.00 - 0.10

Estimated Building Damage(Thousands of Buildings)

Description	Residential	Commercial	Other	Total
Minor	1 - 5	< 1.0	< 1.0	1 - 5
Major	< 1.0	< 1.0	< 1.0	< 1.0
Total	1 - 5	< 1.0	< 1.0	1 - 5

Estimated Casualties : Night Time

Severity Level	Description	# Persons
Level 1	Medical Aid	10 - 40
Level 2	Hospital Care	< 20
Level 3	Life-threatening	< 20
Level 4	Fatalities	< 20

Estimated Shelter Needs

Type	Households	People
Displaced Households	30 - 100	
Public Shelter		

Comments :

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, goetechnical, and observed ground motion data.

Earthquake Information

Location :

Origin Time:

Magnitude : 6.00

Epicenter Latitude/Longitude :

/

Depth & Type :/P

Fault Name :
NA

Maximum PGA : 0.00

Ground Motion /Attenuation :

Information Sources:

Comments :

Population and Building Exposure (2002 D&B) (2000 Census)

Population: 297,490

Building Exposure : ($ Millions)

Residential	22,917
Commerical	5,887
Other	2,681
Total	31,485

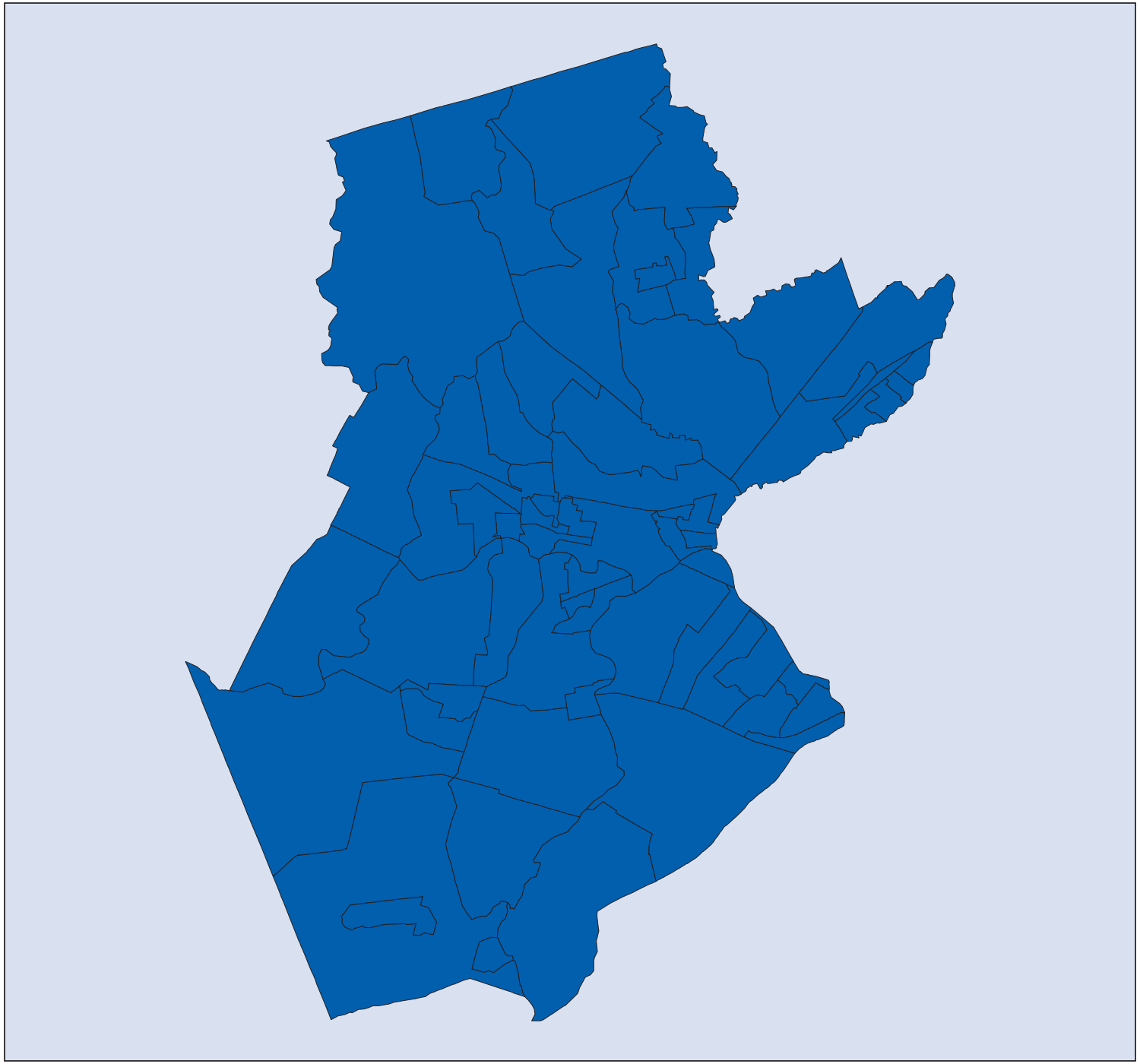
State: 10 - 20

Counties :
- Somerset,NJ

Major Metro Area :

APPENDIX L

500-year return period with upgraded geology (M6.5)



5 2.5 0 5 Miles

Study Region:
Somerset County

Scenario Description:
6.5 Probabilistic 500 Year Upgrade Scenario

Percentage Of Buildings With Moderate and Greater Damage

- 90 to 100
- 80 to 90
- 70 to 80
- 60 to 70
- 50 to 60
- 40 to 50
- 30 to 40
- 20 to 30
- 10 to 20
- 0 to 10

NEW JERSEY GEOLOGICAL SURVEY 1835

Data from the HAZUS-MH GIS software and the New Jersey Geological Survey. February 13, 2008

Building Damage by Count by General Occupancy

February 06, 2008

	# of Buildings					
	None	Slight	Moderate	Extensive	Complete	Total
New Jersey						
Somerset						
Commercial	*2,322*	*109*	*39*	*5*	*0*	*2,475*
Industrial	*496*	*21*	*7*	*1*	*0*	*525*
Government	*102*	*4*	*2*	*0*	*0*	*108*
Agriculture	*70*	*3*	*1*	*0*	*0*	*74*
Single Family	*81,814*	*1,878*	*420*	*61*	*6*	*84,180*
Religion	*133*	*6*	*2*	*0*	*0*	*142*
Other Residential	*5,596*	*215*	*74*	*10*	*1*	*5,897*
Education	*76*	*3*	*1*	*0*	*0*	*81*
Total	**90,610**	**2,240**	**546**	**79**	**8**	**93,482**
Region Total	**90,610**	**2,240**	**546**	**79**	**8**	**93,482**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/states were selected at the time of study region creation.

HAZUS-MH Loss Estimation

Estimated Economic Loss ($ Billions)

Category	Description	Range
General Building Stock	Building Damage	0.00 - 0.10
	Building Contents	< 0.1
	Business Interruption	< 0.1
Infrastructure	Lifelines Damage	
	Total	0.00 - 0.10

Estimated Building Damage(Thousands of Buildings)

Description	Residential	Commercial	Other	Total
Minor	1 - 5	< 1.0	< 1.0	1 - 5
Major	< 1.0	< 1.0	< 1.0	< 1.0
Total	1 - 5	< 1.0	< 1.0	1 - 5

Estimated Casualties : Night Time

Severity Level	Description	# Persons
Level 1	Medical Aid	10 - 40
Level 2	Hospital Care	< 20
Level 3	Life-threatening	< 20
Level 4	Fatalities	< 20

Estimated Shelter Needs

Type	Households	People
Displaced Households	30 - 100	
Public Shelter		

Comments :

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, goetechnical, and observed ground motion data.

Earthquake Information

Location :

Origin Time:

Magnitude : 6.50

Epicenter Latitude/Longitude :

/

Depth & Type :/P

Fault Name :
NA

Maximum PGA : 0.00

Ground Motion /Attenuation :

Information Sources:

Comments :

Population and Building Exposure (2002 D&B) (2000 Census)

Population: 297,490

Building Exposure : ($ Millions)

Residential	22,917
Commerical	5,887
Other	2,681
Total	31,485

State: 10 - 20

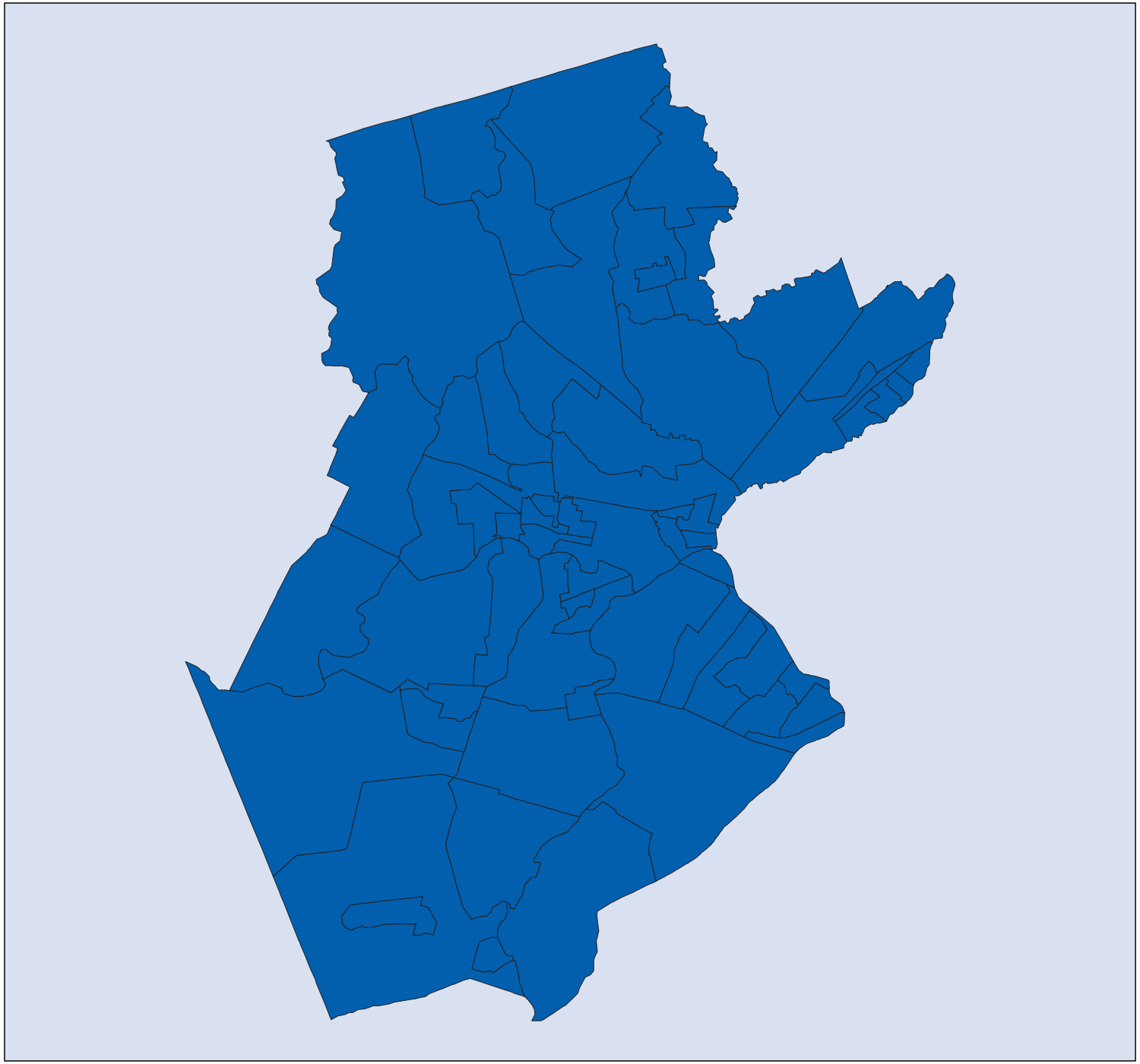
Counties :
- Somerset,NJ

Major Metro Area :

Time of report: February 06, 2008 9:04 am

APPENDIX M

1000-year return period with upgraded geology (M5.5)



5 2.5 0 5 Miles

Study Region:
Somerset County

Scenario Description:
5.5 Probabilistic 1000 Year Upgrade Scenario

Percentage Of Buildings With Moderate and Greater Damage

- 90 to 100
- 80 to 90
- 70 to 80
- 60 to 70
- 50 to 60
- 40 to 50
- 30 to 40
- 20 to 30
- 10 to 20
- 0 to 10

NEW JERSEY GEOLOGICAL SURVEY 1835

Data from the HAZUS-MH GIS software and the New Jersey Geological Survey. February 13, 2008

Building Damage by Count by General Occupancy

February 06, 2008

	# of Buildings					
	None	Slight	Moderate	Extensive	Complete	Total
New Jersey						
Somerset						
Commercial	*2,083*	*247*	*121*	*22*	*2*	*2,475*
Industrial	*449*	*47*	*24*	*4*	*0*	*525*
Government	*93*	*10*	*5*	*1*	*0*	*108*
Agriculture	*63*	*8*	*3*	*1*	*0*	*74*
Single Family	*77,032*	*5,632*	*1,294*	*194*	*28*	*84,180*
Religion	*122*	*13*	*6*	*1*	*0*	*142*
Other Residential	*5,129*	*521*	*207*	*35*	*5*	*5,897*
Education	*69*	*7*	*3*	*1*	*0*	*81*
Total	**85,041**	**6,485**	**1,663**	**258**	**35**	**93,482**
Region Total	**85,041**	**6,485**	**1,663**	**258**	**35**	**93,482**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/states were selected at the time of study region creation.

HAZUS-MH Loss Estimation

Estimated Economic Loss ($ Billions)

Category	Description	Range
General Building Stock	Building Damage	0.10 - 0.40
	Building Contents	< 0.1
	Business Interruption	0.00 - 0.10
Infrastructure	Lifelines Damage	
	Total	0.20 - 0.60

Estimated Building Damage(Thousands of Buildings)

Description	Residential	Commercial	Other	Total
Minor	3 - 15	< 1.0	< 1.0	4 - 16
Major	< 1.0	< 1.0	< 1.0	< 1.0
Total	4 - 15	< 1.0	< 1.0	4 - 16

Estimated Casualties : Night Time

Severity Level	Description	# Persons
Level 1	Medical Aid	30 - 120
Level 2	Hospital Care	< 20
Level 3	Life-threatening	< 20
Level 4	Fatalities	< 20

Estimated Shelter Needs

Type	Households	People
Displaced Households	90 - 400	
Public Shelter		

Comments :

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, goetechnical, and observed ground motion data.

Earthquake Information

Location :

Origin Time:

Magnitude : 5.50

Epicenter Latitude/Longitude :
/

Depth & Type :/P

Fault Name :
NA

Maximum PGA : 0.00

Ground Motion /Attenuation :

Information Sources:

Comments :

Population and Building Exposure (2002 D&B) (2000 Census)

Population: 297,490

Building Exposure : ($ Millions)

Residential	22,917
Commerical	5,887
Other	2,681
Total	31,485

State: 20 - 80

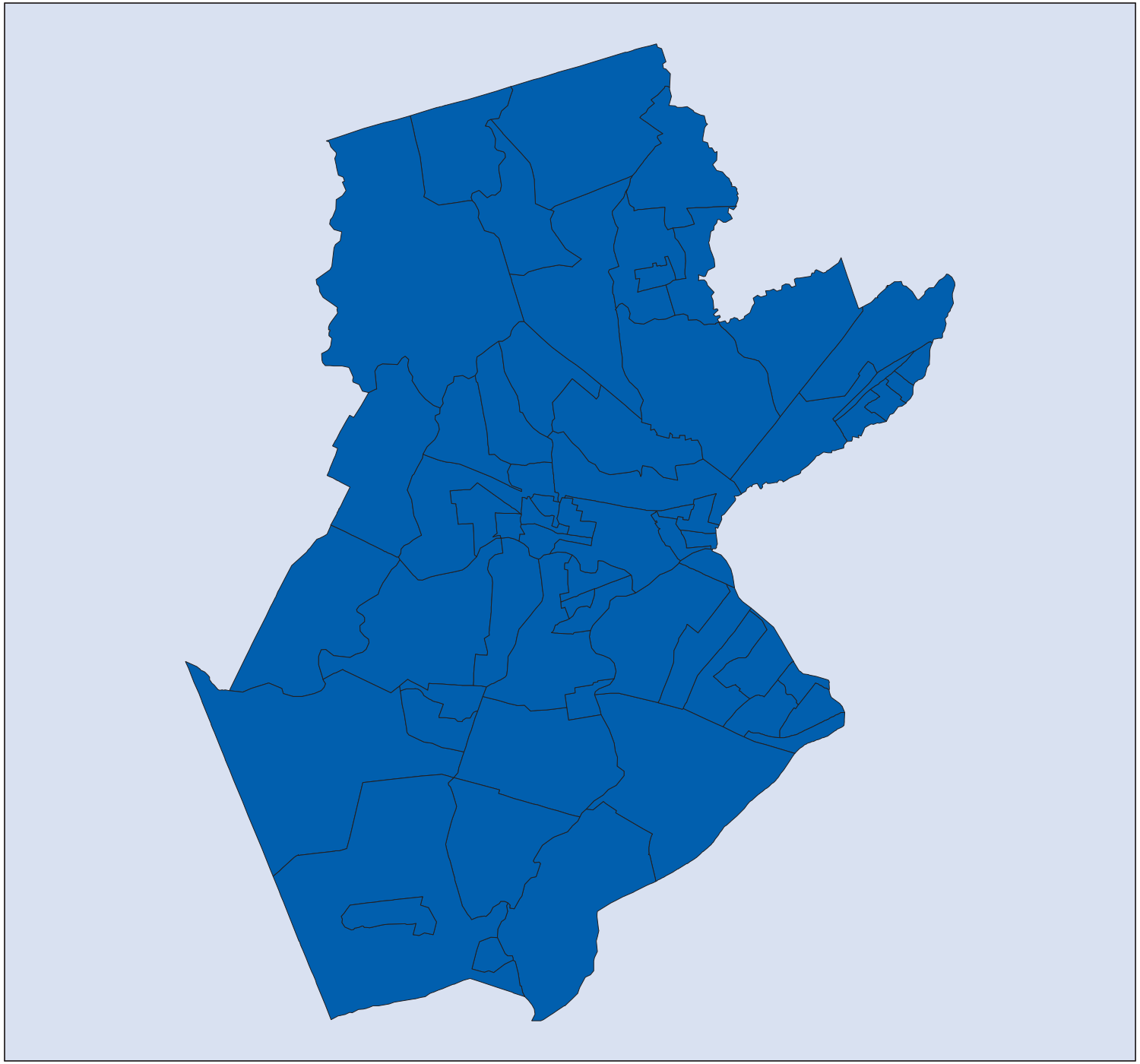
Counties :
- Somerset,NJ

Major Metro Area :

Time of report: February 06, 2008 10:57 am

APPENDIX N

1000-year return period with default geology (M6)



5 2.5 0 5 Miles

Study Region:
Somerset County

Scenario Description:
6.0 Probabilistic 1000 Year Default Scenario

Percentage Of Buildings With Moderate and Greater Damage

- 90 to 100
- 80 to 90
- 70 to 80
- 60 to 70
- 50 to 60
- 40 to 50
- 30 to 40
- 20 to 30
- 10 to 20
- 0 to 10

NEW JERSEY GEOLOGICAL SURVEY 1835

Data from the HAZUS-MH GIS software and the New Jersey Geological Survey. February 13, 2008

Building Damage by Count by General Occupancy

February 11, 2008

	# of Buildings					
	None	Slight	Moderate	Extensive	Complete	Total
New Jersey						
Somerset						
Commercial	*1,864*	*361*	*205*	*42*	*4*	*2,475*
Industrial	*399*	*72*	*44*	*9*	*1*	*525*
Government	*83*	*15*	*9*	*2*	*0*	*108*
Agriculture	*56*	*12*	*5*	*1*	*0*	*74*
Single Family	*73,207*	*8,497*	*2,107*	*324*	*45*	*84,180*
Religion	*113*	*18*	*9*	*2*	*0*	*142*
Other Residential	*4,854*	*684*	*298*	*54*	*6*	*5,897*
Education	*62*	*11*	*6*	*1*	*0*	*81*
Total	**80,638**	**9,670**	**2,684**	**435**	**56**	**93,482**
Region Total	**80,638**	**9,670**	**2,684**	**435**	**56**	**93,482**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/states were selected at the time of study region creation.

HAZUS-MH Loss Estimation

Estimated Economic Loss ($ Billions)

Category	Description	Range
General Building Stock	Building Damage	0.20 - 0.70
	Building Contents	0.00 - 0.10
	Business Interruption	0.00 - 0.10
Infrastructure	Lifelines Damage	
	Total	0.30 - 1.10

Estimated Building Damage(Thousands of Buildings)

Description	Residential	Commercial	Other	Total
Minor	5 - 20	0 - 1	< 1.0	6 - 20
Major	< 1.0	< 1.0	< 1.0	0 - 1
Total	6 - 20	0 - 1	< 1.0	6 - 30

Estimated Casualties : Night Time

Severity Level	Description	# Persons
Level 1	Medical Aid	50 - 190
Level 2	Hospital Care	10 - 30
Level 3	Life-threatening	< 20
Level 4	Fatalities	< 20

Estimated Shelter Needs

Type	Households	People
Displaced Households	150 - 600	
Public Shelter		

Comments :

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, goetechnical, and observed ground motion data.

Earthquake Information

Location :

Origin Time:

Magnitude : 6.00

Epicenter Latitude/Longitude :

/

Depth & Type :/P

Fault Name :
NA

Maximum PGA : 0.00

Ground Motion /Attenuation :

Information Sources:

Comments :

Population and Building Exposure (2002 D&B) (2000 Census)

Population: 297,490

Building Exposure : ($ Millions)

Residential	22,917
Commerical	5,887
Other	2,681
Total	31,485

State: 30 - 130

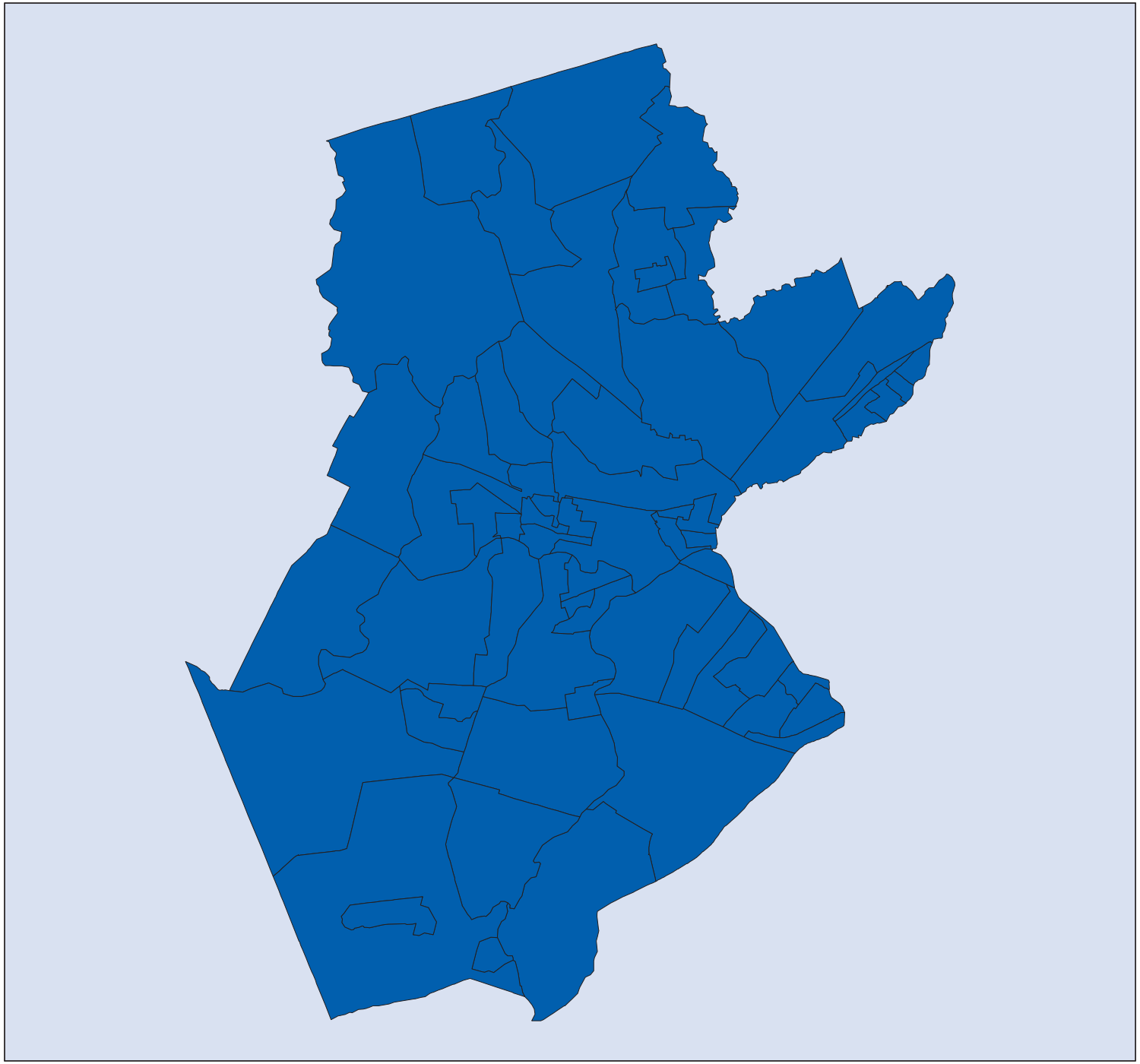
Counties :
- Somerset,NJ

Major Metro Area :

Time of report: February 11, 2008 11:22 am

APPENDIX O

1000-year return period with upgraded geology (M6)



Study Region:
Somerset County

Scenario Description:
6.0 Probabilistic 1000 Year Upgrade Scenario

Percentage Of Buildings With Moderate and Greater Damage

- 90 to 100
- 80 to 90
- 70 to 80
- 60 to 70
- 50 to 60
- 40 to 50
- 30 to 40
- 20 to 30
- 10 to 20
- 0 to 10

NEW JERSEY GEOLOGICAL SURVEY 1835

5 2.5 0 5 Miles

Data from the HAZUS-MH GIS software and the New Jersey Geological Survey. February 13, 2008

Building Damage by Count by General Occupancy

February 06, 2008

	# of Buildings					
	None	Slight	Moderate	Extensive	Complete	Total
New Jersey						
Somerset						
Commercial	*2,083*	*247*	*121*	*22*	*2*	*2,475*
Industrial	*449*	*47*	*24*	*4*	*0*	*525*
Government	*93*	*10*	*5*	*1*	*0*	*108*
Agriculture	*63*	*8*	*3*	*1*	*0*	*74*
Single Family	*77,032*	*5,632*	*1,294*	*194*	*28*	*84,180*
Religion	*122*	*13*	*6*	*1*	*0*	*142*
Other Residential	*5,129*	*521*	*207*	*35*	*5*	*5,897*
Education	*69*	*7*	*3*	*1*	*0*	*81*
Total	**85,040**	**6,485**	**1,663**	**258**	**36**	**93,482**
Region Total	**85,040**	**6,485**	**1,663**	**258**	**36**	**93,482**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/states were selected at the time of study region creation.

HAZUS-MH Loss Estimation

Estimated Economic Loss ($ Billions)

Category	Description	Range
General Building Stock	Building Damage	0.10 - 0.40
	Building Contents	< 0.1
	Business Interruption	0.00 - 0.10
Infrastructure	Lifelines Damage	
	Total	0.20 - 0.60

Estimated Building Damage(Thousands of Buildings)

Description	Residential	Commercial	Other	Total
Minor	3 - 15	< 1.0	< 1.0	4 - 16
Major	< 1.0	< 1.0	< 1.0	< 1.0
Total	4 - 15	< 1.0	< 1.0	4 - 16

Estimated Casualties : Night Time

Severity Level	Description	# Persons
Level 1	Medical Aid	30 - 120
Level 2	Hospital Care	< 20
Level 3	Life-threatening	< 20
Level 4	Fatalities	< 20

Estimated Shelter Needs

Type	Households	People
Displaced Households	90 - 400	
Public Shelter		

Comments :

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, goetechnical, and observed ground motion data.

Earthquake Information

Location :

Origin Time:

Magnitude : 6.00

Epicenter Latitude/Longitude :

/

Depth & Type :/P

Fault Name :
NA

Maximum PGA : 0.00

Ground Motion /Attenuation :

Information Sources:

Comments :

Population and Building Exposure (2002 D&B) (2000 Census)

Population: 297,490

Building Exposure : ($ Millions)

Residential	22,917
Commerical	5,887
Other	2,681
Total	31,485

State: 20 - 80

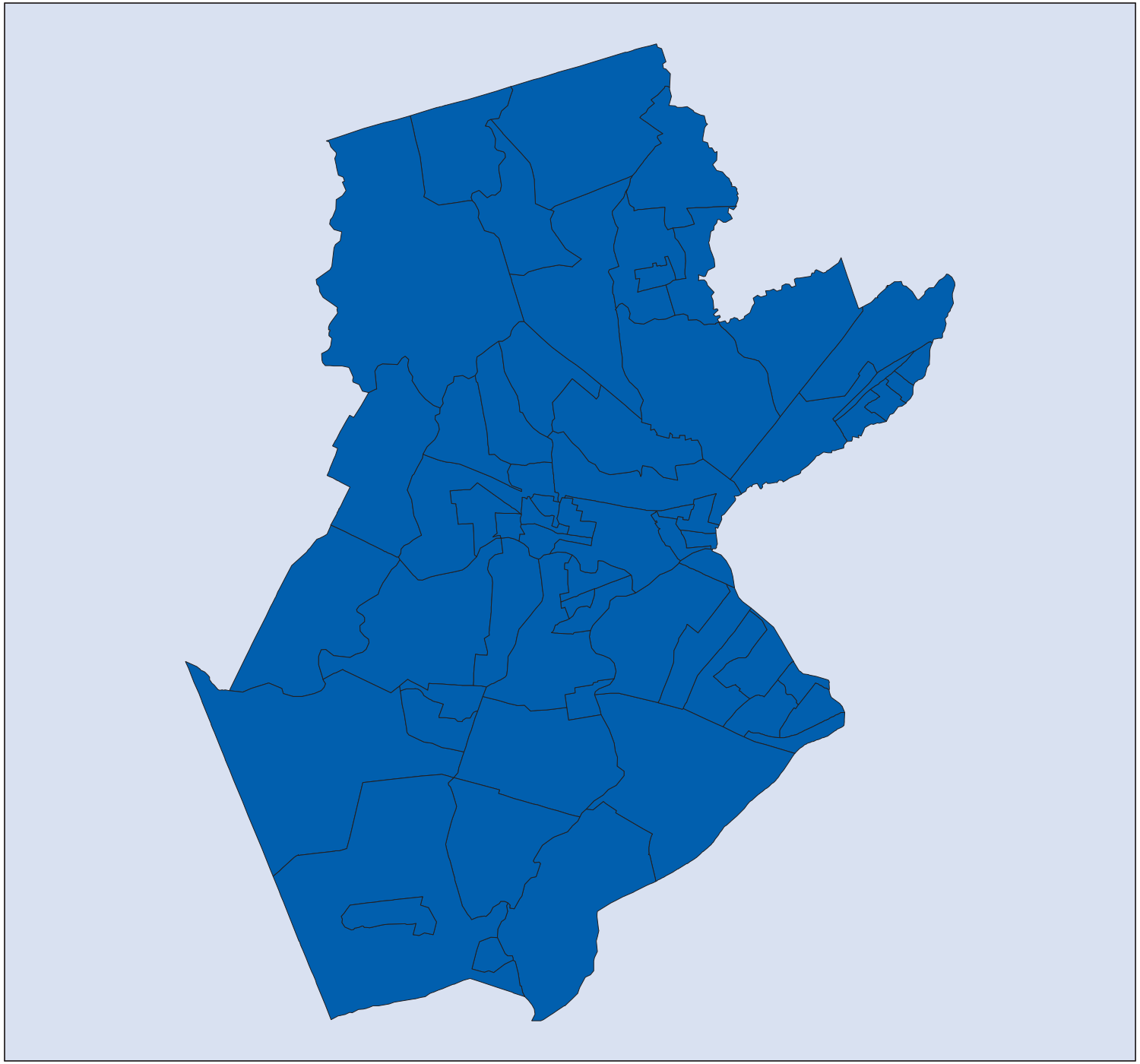
Counties :
- Somerset,NJ

Major Metro Area :

Time of report: February 06, 2008 2:37 pm

APPENDIX P

1000-year return period with upgraded geology (M6.5)



Study Region:
Somerset County

Scenario Description:
6.5 Probabilistic 1000 Year Upgrade Scenario

Percentage Of Buildings With Moderate and Greater Damage

- 90 to 100
- 80 to 90
- 70 to 80
- 60 to 70
- 50 to 60
- 40 to 50
- 30 to 40
- 20 to 30
- 10 to 20
- 0 to 10

5 2.5 0 5 Miles

Data from the HAZUS-MH GIS software and the New Jersey Geological Survey. February 13, 2008

Building Damage by Count by General Occupancy

February 06, 2008

	# of Buildings					
	None	Slight	Moderate	Extensive	Complete	Total
New Jersey						
Somerset						
Commercial	*2,083*	*247*	*121*	*22*	*2*	*2,475*
Industrial	*449*	*47*	*24*	*4*	*0*	*525*
Government	*93*	*10*	*5*	*1*	*0*	*108*
Agriculture	*63*	*8*	*3*	*1*	*0*	*74*
Single Family	*77,032*	*5,632*	*1,294*	*194*	*29*	*84,180*
Religion	*122*	*13*	*6*	*1*	*0*	*142*
Other Residential	*5,128*	*521*	*207*	*35*	*5*	*5,897*
Education	*69*	*7*	*3*	*1*	*0*	*81*
Total	**85,039**	**6,485**	**1,663**	**258**	**36**	**93,482**
Region Total	**85,039**	**6,485**	**1,663**	**258**	**36**	**93,482**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/states were selected at the time of study region creation.

HAZUS-MH Loss Estimation

Estimated Economic Loss ($ Billions)

Category	Description	Range
General Building Stock	Building Damage	0.10 - 0.40
	Building Contents	< 0.1
	Business Interruption	0.00 - 0.10
Infrastructure	Lifelines Damage	
	Total	0.20 - 0.60

Estimated Building Damage(Thousands of Buildings)

Description	Residential	Commercial	Other	Total
Minor	3 - 15	< 1.0	< 1.0	4 - 16
Major	< 1.0	< 1.0	< 1.0	< 1.0
Total	4 - 15	< 1.0	< 1.0	4 - 16

Estimated Casualties : Night Time

Severity Level	Description	# Persons
Level 1	Medical Aid	30 - 120
Level 2	Hospital Care	< 20
Level 3	Life-threatening	< 20
Level 4	Fatalities	< 20

Estimated Shelter Needs

Type	Households	People
Displaced Households	90 - 400	
Public Shelter		

Comments :

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, goetechnical, and observed ground motion data.

Earthquake Information

Location :

Origin Time:

Magnitude : 6.50

Epicenter Latitude/Longitude :
/

Depth & Type :/P

Fault Name :
NA

Maximum PGA : 0.00

Ground Motion /Attenuation :

Information Sources:

Comments :

Population and Building Exposure (2002 D&B) (2000 Census)

Population: 297,490

Building Exposure : ($ Millions)

Residential	22,917
Commerical	5,887
Other	2,681
Total	31,485

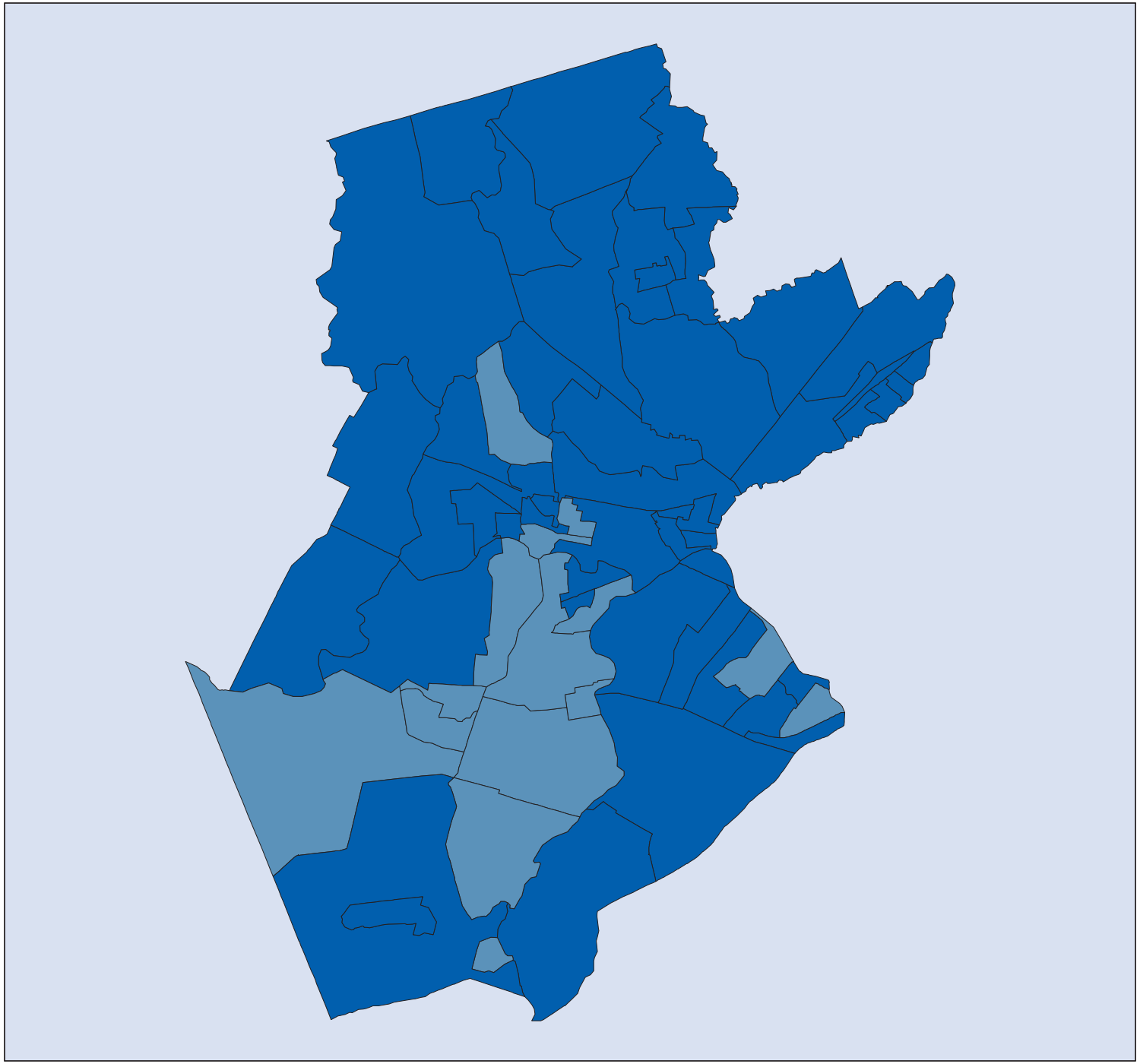
State: 20 - 80

Counties :
- Somerset,NJ

Major Metro Area :

APPENDIX Q

2500-year return period with upgraded geology (M5.5)



5 2.5 0 5 Miles

Study Region:
Somerset County

Scenario Description:
5.5 Probabilistic 2500 Year Upgrade Scenario

Percentage Of Buildings With Moderate and Greater Damage

- 90 to 100
- 80 to 90
- 70 to 80
- 60 to 70
- 50 to 60
- 40 to 50
- 30 to 40
- 20 to 30
- 10 to 20
- 0 to 10

NEW JERSEY GEOLOGICAL SURVEY 1835

Data from the HAZUS-MH GIS software and the New Jersey Geological Survey.
February 13, 2008

Building Damage by Count by General Occupancy

February 11, 2008

	# of Buildings					
	None	Slight	Moderate	Extensive	Complete	Total
New Jersey						
Somerset						
Commercial	*1,523*	*475*	*354*	*98*	*25*	*2,475*
Industrial	*334*	*94*	*74*	*19*	*4*	*525*
Government	*69*	*19*	*15*	*4*	*1*	*108*
Agriculture	*46*	*16*	*9*	*2*	*1*	*74*
Single Family	*64,230*	*14,285*	*4,389*	*808*	*469*	*84,180*
Religion	*94*	*25*	*17*	*5*	*1*	*142*
Other Residential	*3,952*	*1,084*	*593*	*164*	*104*	*5,897*
Education	*52*	*15*	*11*	*3*	*1*	*81*
Total	**70,298**	**16,012**	**5,461**	**1,104**	**606**	**93,482**
Region Total	**70,298**	**16,012**	**5,461**	**1,104**	**606**	**93,482**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/states were selected at the time of study region creation.

HAZUS-MH Loss Estimation

Estimated Economic Loss ($ Billions)

Category	Description	Range
General Building Stock	Building Damage	0.40 - 1.80
	Building Contents	0.00 - 0.10
	Business Interruption	0.10 - 0.30
Infrastructure	Lifelines Damage	
	Total	0.70 - 2.70

Estimated Building Damage(Thousands of Buildings)

Description	Residential	Commercial	Other	Total
Minor	10 - 40	0 - 1	< 1.0	10 - 40
Major	0 - 3	< 1.0	< 1.0	0 - 3
Total	10 - 40	0 - 1	< 1.0	11 - 50

Estimated Casualties : Night Time

Severity Level	Description	# Persons
Level 1	Medical Aid	160 - 700
Level 2	Hospital Care	40 - 140
Level 3	Life-threatening	< 20
Level 4	Fatalities	10 - 30

Estimated Shelter Needs

Type	Households	People
Displaced Households	700 - 3,000	
Public Shelter		

Comments :

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, goetechnical, and observed ground motion data.

Earthquake Information

Location :

Origin Time:

Magnitude : 5.50

Epicenter Latitude/Longitude :

/

Depth & Type :/P

Fault Name :
NA

Maximum PGA : 0.00

Ground Motion /Attenuation :

Information Sources:

Comments :

Population and Building Exposure (2002 D&B) (2000 Census)

Population: 297,490

Building Exposure : ($ Millions)

Residential	22,917
Commerical	5,887
Other	2,681
Total	31,485

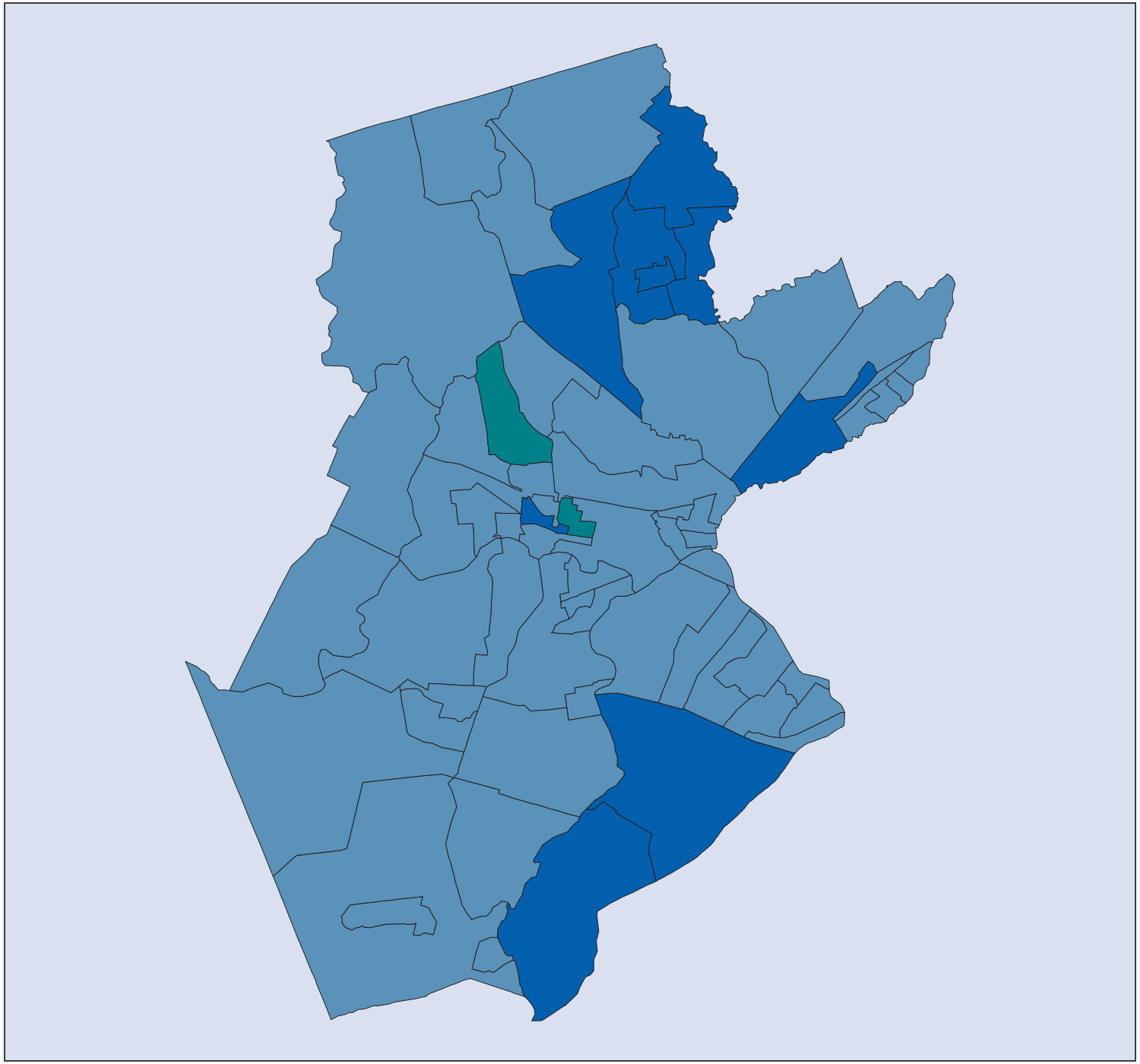
State: 160 - 600

Counties :
- Somerset,NJ

Major Metro Area :

APPENDIX R

2500-year return period with default geology (M6)



5 2.5 0 5 Miles

Study Region:
Somerset County

Scenario Description:
6.0 Probabilistic 2500 Year Default Scenario

Percentage Of Buildings With Moderate and Greater Damage

- 90 to 100
- 80 to 90
- 70 to 80
- 60 to 70
- 50 to 60
- 40 to 50
- 30 to 40
- 20 to 30
- 10 to 20
- 0 to 10

NEW JERSEY GEOLOGICAL SURVEY 1835

Data from the HAZUS-MH GIS software and the New Jersey Geological Survey. February 13, 2008

Building Damage by Count by General Occupancy

February 11, 2008

	# of Buildings					
	None	Slight	Moderate	Extensive	Complete	Total
New Jersey						
Somerset						
Commercial	*1,189*	*560*	*522*	*174*	*31*	*2,475*
Industrial	*257*	*111*	*114*	*37*	*6*	*525*
Government	*53*	*23*	*23*	*7*	*1*	*108*
Agriculture	*36*	*19*	*14*	*4*	*1*	*74*
Single Family	*57,432*	*18,476*	*6,625*	*1,329*	*317*	*84,180*
Religion	*77*	*31*	*24*	*9*	*2*	*142*
Other Residential	*3,517*	*1,293*	*799*	*241*	*48*	*5,897*
Education	*40*	*18*	*17*	*5*	*1*	*81*
Total	**62,601**	**20,530**	**8,138**	**1,806**	**407**	**93,482**
Region Total	**62,601**	**20,530**	**8,138**	**1,806**	**407**	**93,482**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/states were selected at the time of study region creation.

HAZUS-MH Loss Estimation

Estimated Economic Loss ($ Billions)

Category	Description	Range
General Building Stock	Building Damage	0.60 - 2.40
	Building Contents	0.00 - 0.20
	Business Interruption	0.10 - 0.50
Infrastructure	Lifelines Damage	
	Total	0.90 - 3.80

Estimated Building Damage(Thousands of Buildings)

Description	Residential	Commercial	Other	Total
Minor	13 - 50	0 - 2	< 1.0	14 - 60
Major	1 - 3	< 1.0	< 1.0	1 - 4
Total	14 - 60	0 - 2	< 1.0	15 - 60

Estimated Casualties : Night Time

Severity Level	Description	# Persons
Level 1	Medical Aid	200 - 800
Level 2	Hospital Care	40 - 160
Level 3	Life-threatening	< 20
Level 4	Fatalities	10 - 40

Estimated Shelter Needs

Type	Households	People
Displaced Households	800 - 3,000	
Public Shelter		

Comments :

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, goetechnical, and observed ground motion data.

Earthquake Information

Location :

Origin Time:

Magnitude : 6.00

Epicenter Latitude/Longitude :

/

Depth & Type :/P

Fault Name :
NA

Maximum PGA : 0.00

Ground Motion /Attenuation :

Information Sources:

Comments :

Population and Building Exposure (2002 D&B) (2000 Census)

Population: 297,490

Building Exposure : ($ Millions)

Residential	22,917
Commerical	5,887
Other	2,681
Total	31,485

State: 160 - 600

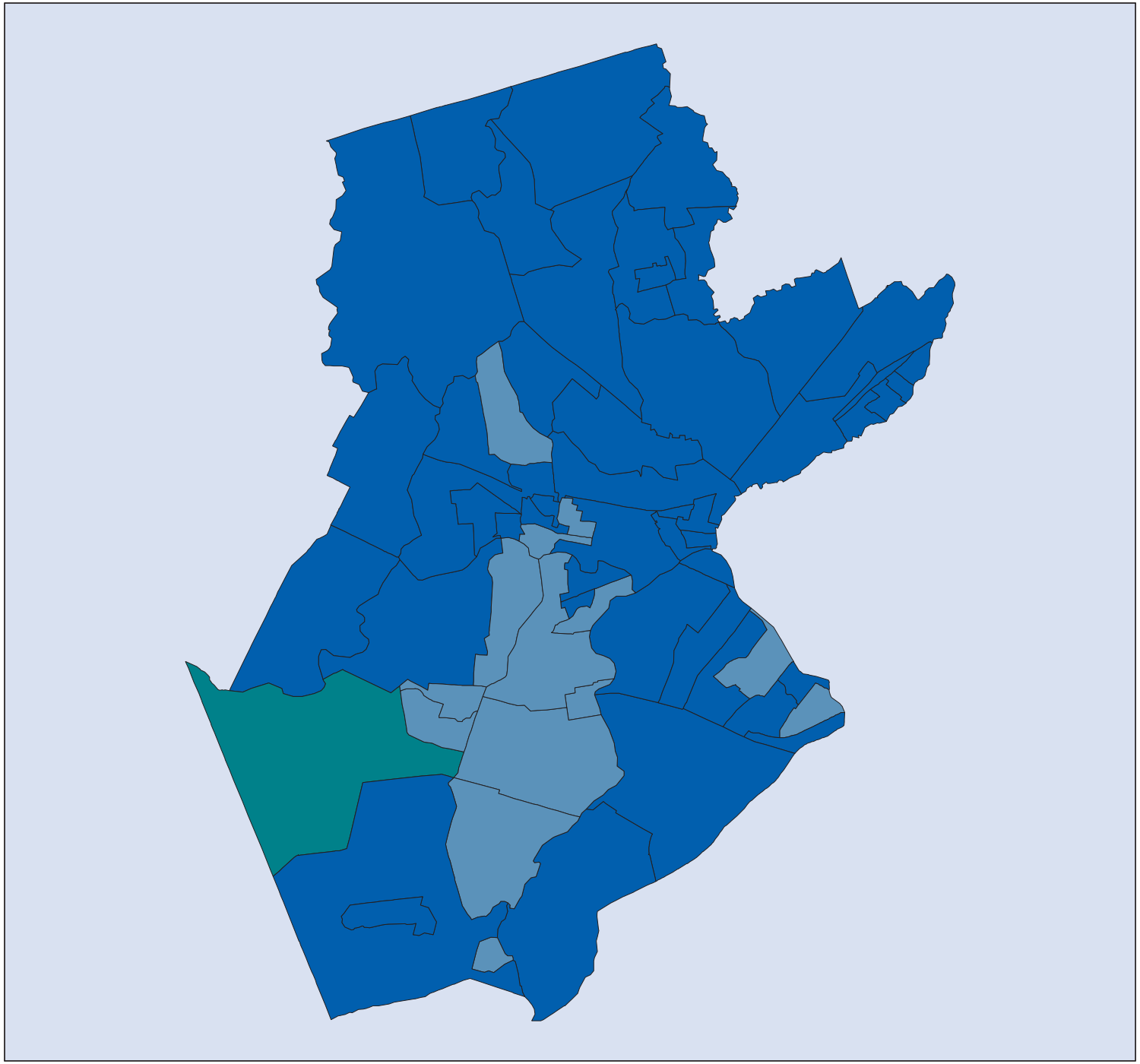
Counties :
- Somerset,NJ

Major Metro Area :

Time of report: February 11, 2008 11:58 am

APPENDIX S

2500-year return period with upgraded geology (M6)



5 2.5 0 5 Miles

Study Region:
Somerset County

Scenario Description:
6.0 Probabilistic 2500 Year Upgrade Scenario

Percentage Of Buildings With Moderate and Greater Damage

- 90 to 100
- 80 to 90
- 70 to 80
- 60 to 70
- 50 to 60
- 40 to 50
- 30 to 40
- 20 to 30
- 10 to 20
- 0 to 10

NEW JERSEY GEOLOGICAL SURVEY 1835

Data from the HAZUS-MH GIS software and the New Jersey Geological Survey.
February 13, 2008

Building Damage by Count by General Occupancy

February 11, 2008

	# of Buildings					
	None	Slight	Moderate	Extensive	Complete	Total
New Jersey						
Somerset						
Commercial	*1,522*	*475*	*353*	*97*	*28*	*2,475*
Industrial	*333*	*94*	*74*	*19*	*5*	*525*
Government	*68*	*19*	*15*	*4*	*1*	*108*
Agriculture	*46*	*16*	*9*	*2*	*1*	*74*
Single Family	*64,202*	*14,273*	*4,374*	*784*	*547*	*84,180*
Religion	*93*	*25*	*17*	*5*	*2*	*142*
Other Residential	*3,946*	*1,081*	*589*	*158*	*122*	*5,897*
Education	*52*	*15*	*11*	*3*	*1*	*81*
Total	**70,264**	**15,997**	**5,442**	**1,073**	**706**	**93,482**
Region Total	**70,264**	**15,997**	**5,442**	**1,073**	**706**	**93,482**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/states were selected at the time of study region creation.

HAZUS-MH Loss Estimation

Estimated Economic Loss ($ Billions)

Category	Description	Range
General Building Stock	Building Damage	0.50 - 1.80
	Building Contents	0.00 - 0.10
	Business Interruption	0.10 - 0.30
Infrastructure	Lifelines Damage	
	Total	0.70 - 2.80

Estimated Building Damage(Thousands of Buildings)

Description	Residential	Commercial	Other	Total
Minor	10 - 40	0 - 1	< 1.0	10 - 40
Major	0 - 3	< 1.0	< 1.0	0 - 3
Total	11 - 40	0 - 1	< 1.0	11 - 50

Estimated Casualties : Night Time

Severity Level	Description	# Persons
Level 1	Medical Aid	180 - 700
Level 2	Hospital Care	40 - 150
Level 3	Life-threatening	< 20
Level 4	Fatalities	10 - 30

Estimated Shelter Needs

Type	Households	People
Displaced Households	800 - 3,000	
Public Shelter		

Comments :

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, goetechnical, and observed ground motion data.

Earthquake Information

Location :

Origin Time:

Magnitude : 6.00

Epicenter Latitude/Longitude :

/

Depth & Type :/P

Fault Name :
NA

Maximum PGA : 0.00

Ground Motion /Attenuation :

Information Sources:

Comments :

Population and Building Exposure (2002 D&B) (2000 Census)

Population: 297,490

Building Exposure : ($ Millions)

Residential	22,917
Commerical	5,887
Other	2,681
Total	31,485

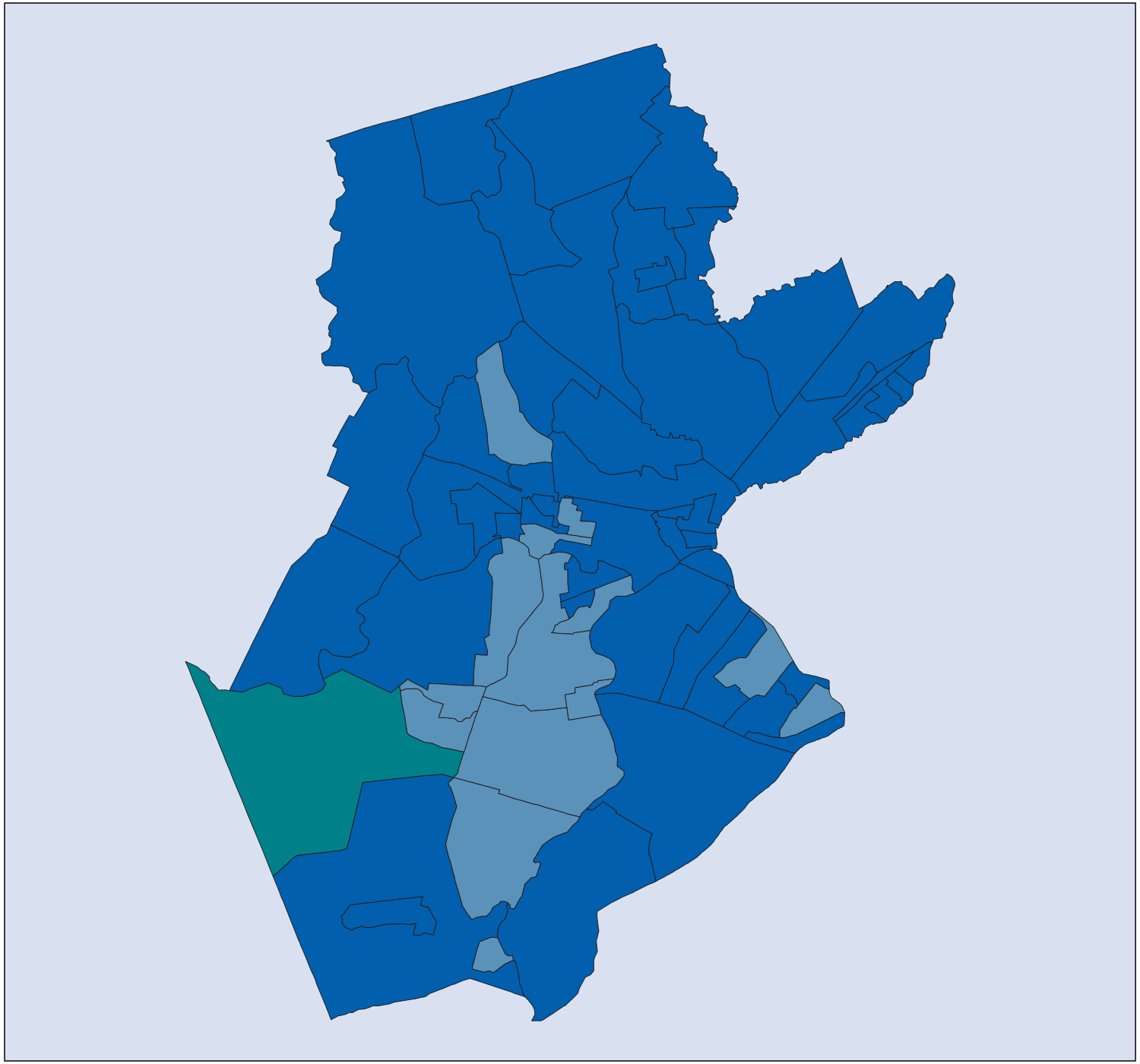
State: 170 - 700

Counties :
- Somerset,NJ

Major Metro Area :

APPENDIX T

2500-year return period with upgraded geology (M6.5)



Study Region:
Somerset County

Scenario Description:
6.5 Probabilistic 2500 Year Upgrade Scenario

Percentage Of Buildings With Moderate and Greater Damage

- 90 to 100
- 80 to 90
- 70 to 80
- 60 to 70
- 50 to 60
- 40 to 50
- 30 to 40
- 20 to 30
- 10 to 20
- 0 to 10

5 2.5 0 5 Miles

Data from the HAZUS-MH GIS software and the New Jersey Geological Survey. February 13, 2008

Building Damage by Count by General Occupancy

February 11, 2008

	# of Buildings					
	None	Slight	Moderate	Extensive	Complete	Total
New Jersey						
Somerset						
Commercial	*1,521*	*474*	*352*	*97*	*31*	*2,475*
Industrial	*333*	*94*	*74*	*19*	*5*	*525*
Government	*68*	*19*	*15*	*4*	*1*	*108*
Agriculture	*46*	*16*	*9*	*2*	*1*	*74*
Single Family	*64,173*	*14,262*	*4,366*	*769*	*610*	*84,180*
Religion	*93*	*25*	*17*	*5*	*2*	*142*
Other Residential	*3,940*	*1,079*	*587*	*154*	*137*	*5,897*
Education	*52*	*15*	*11*	*3*	*1*	*81*
Total	**70,227**	**15,983**	**5,431**	**1,053**	**788**	**93,482**
Region Total	**70,227**	**15,983**	**5,431**	**1,053**	**788**	**93,482**

Totals only reflect data for those census tracts/blocks included in the user's study region and will reflect the entire county/state only if all of the census blocks for that county/states were selected at the time of study region creation.

HAZUS-MH Loss Estimation

Estimated Economic Loss ($ Billions)

Category	Description	Range
General Building Stock	Building Damage	0.50 - 1.80
	Building Contents	0.00 - 0.10
	Business Interruption	0.10 - 0.30
Infrastructure	Lifelines Damage	
	Total	0.70 - 2.90

Estimated Building Damage(Thousands of Buildings)

Description	Residential	Commercial	Other	Total
Minor	10 - 40	0 - 1	< 1.0	10 - 40
Major	0 - 3	< 1.0	< 1.0	0 - 3
Total	11 - 40	0 - 1	< 1.0	11 - 50

Estimated Casualties : Night Time

Severity Level	Description	# Persons
Level 1	Medical Aid	180 - 700
Level 2	Hospital Care	40 - 160
Level 3	Life-threatening	< 20
Level 4	Fatalities	10 - 30

Estimated Shelter Needs

Type	Households	People
Displaced Households	800 - 3,000	
Public Shelter		

Comments :

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, goetechnical, and observed ground motion data.

Earthquake Information

Location :

Origin Time:

Magnitude : 6.50

Epicenter Latitude/Longitude :

/

Depth & Type :/P

Fault Name :
NA

Maximum PGA : 0.00

Ground Motion /Attenuation :

Information Sources:

Comments :

Population and Building Exposure (2002 D&B) (2000 Census)

Population: 297,490

Building Exposure : ($ Millions)

Residential	22,917
Commerical	5,887
Other	2,681
Total	31,485

State: 180 - 700

Counties :
- Somerset,NJ

Major Metro Area :

APPENDIX U

Seismic velocity data

Abbreviations are:

P-Wave=compressional wave
S-Wave=shear wave
gp spc = distance of geophone from source (feet)
pick = arrival time of wave at geophone (milliseconds)
int time = interval travel time between geophones (milliseconds)
int vel = interval velocity--wave velocity between geophones (feet/second)
avg vel = wave velocity calculated by averaging the interval velocities
slope=slope of best-fit regression line (milliseconds/ft)
regression velocity = wave velocity calculated from best-fit line to first arrivals

Rock

P-WAVE

gp spc	pick	int time	int vel.	**AVG VEL**	SLOPE	**REGRESSION VELOCITY**	comments
0	8.8			ft/sec		ft/sec	
6	11.5	2.7	2222.222222	**1774.453024**	0.63833	**1566.579634**	shallow layer
12	16.9	5.4	1111.111111				
18	20.6	3.7	1621.621622				
24	23.4	2.8	2142.857143				
30	24.8	1.4	4285.714286	**5095.238095**	0.18333	**5454.545455**	Water table
36	26	1.2	5000				
42	27	1	6000				
48	27.6	0.6	10000	**12500**	0.07667	**13043.47826**	bedrock--shale
54	28	0.4	15000				
60	28.4	0.4	15000				
66	29	0.6	10000				

S-WAVE

0	14.2						
6	19.4	5.2	1153.846154	**1189.730366**	0.835	**1197.60479**	
12	23.8	4.4	1363.636364				
18	28.7	4.9	1224.489796				
24	34.6	5.9	1016.949153				
30	37.6	3	2000	**4414.285714**	0.27667	**3614.457831**	
36	41.6	4	1500				
42	43.1	1.5	4000				
48	43.8	0.7	8571.428571				
54	44.8	1	6000				

Zion 1

P-WAVE

gp spc	pick	int time	int vel.	**AVG VEL**	SLOPE	**REGRESSION VELOCITY**	comments
0	4.6			ft/sec		ft/sec	
6	7.6	3	2000	**2333.333333**	0.48	**2083.333333**	
12	11.2	3.6	1666.666667				
18	13	1.8	3333.333333				
24	14.3	1.3	4615.384615	**5034.965035**	0.18333	**5454.545455**	water table
30	15.4	1.1	5454.545455				
36	15.9	0.5	12000	**14357.14286**	0.08429	**11864.40678**	bedrock--shale
42	16.6	0.7	8571.428571				
48	17.1	0.5	12000				
54	17.5	0.4	15000				
60	18.2	0.7	8571.428571				
66	18.4	0.2	30000				

S-WAVE

0	8.9						
6	13.4	4.5	1333.333333	**1456.140351**	0.69167	**1445.783133**	
12	17.2	3.8	1578.947368				
18	18	0.8	7500	**13796.2963**	0.13139	**7610.993658**	no water table in shear
24	18.5	0.5	12000				
30	19.5	1	6000				
36	20.7	1.2	5000				
42	21.6	0.9	6666.666667				
48	22.4	0.8	7500				
54	22.9	0.5	12000				
60	23.7	0.8	7500				
66	23.8	0.1	60000				

Zion 2

P-WAVE

gp spc	pick	int time	int vel.	**AVG VEL**	SLOPE	**REGRESSION VELOCITY**	comments
0	4.1			ft/sec		ft/sec	
6	8.2	4.1	1463.414634	**2843.490351**	0.39643	**2522.522523**	
12	11.4	3.2	1875				
18	13.8	2.4	2500				
24	15.9	2.1	2857.142857				
30	17.2	1.3	4615.384615				
36	18.8	1.6	3750				
42	19.7	0.9	6666.666667	**6848.484848**	0.15905	**6287.42515**	
48	20.6	0.9	6666.666667				
54	21.7	1.1	5454.545455				
60	22.8	1.1	5454.545455				
66	23.4	0.6	10000				

S-WAVE

0	6						
6	14.1	8.1	740.7407407	**1851.66236**	0.62381	**1603.053435**	
12	18.4	4.3	1395.348837				
18	20.9	2.5	2400				
24	23.6	2.7	2222.222222				
30	26	2.4	2500				
36	26.7	0.7	8571.428571	**6110.805861**	0.30143	**3317.535545**	use regression vel on shear
42	28.2	1.5	4000				
48	30.6	2.4	2500				
54	33.2	2.6	2307.692308				
60	34.6	1.4	4285.714286				
66	35	0.4	15000				

Jacques

P-WAVE

gp spc	pick	int time	int vel.	**AVG VEL**	SLOPE	**REGRESSION VELOCITY**	comments
0	5.3			ft/sec		ft/sec	
6	9.5	4.2	1428.571429	**1428.571429**	0.7	**1428.571429**	unconsolidated shallow layer
12	10.9	1.4	4285.714286	**4078.144078**	0.25833	**3870.967742**	water table
18	12.2	1.3	4615.384615				
24	14	1.8	3333.333333				
30	14.8	0.8	7500	**6700**	0.15667	**6382.978723**	weathered bedrock
36	15.6	0.8	7500				
42	16.4	0.8	7500				
48	17.4	1	6000				
54	18.6	1.2	5000				

S-WAVE

0	7.1						
6	12.3	5.2	1153.846154	**1153.846154**	0.86667	**1153.846154**	unconsolidated shallow layers
12	14.5	2.2	2727.272727	**2743.932591**	0.39683	**2520**	
18	16.9	2.4	2500				
24	19	2.1	2857.142857				
30	22.9	3.9	1538.461538				
36	24.6	1.7	3529.411765				
42	26.9	2.3	2608.695652				
48	29	2.1	2857.142857				
54	30.8	1.8	3333.333333				

Dutchtown

P-WAVE						**REGRESSION**
gp spc	pick	int time	int vel.	**AVG VEL**	SLOPE	**VELOCITY**
0	9.6			ft/sec		ft/sec
6	12.4	2.8	2142.857143	**1928.571429**	0.525	**1904.761905**
12	15.9	3.5	1714.285714			
18	17.2	1.3	4615.384615	**4735.632015**	0.21647	**4619.615032**
24	18.4	1.2	5000			
30	19.6	1.2	5000			
36	20.8	1.2	5000			
42	21.9	1.1	5454.545455			
48	23.6	1.7	3529.411765			
54	25	1.4	4285.714286			
60	26.2	1.2	5000			
66	27.2	1	6000			

S-WAVE						
0	14.1					
6	18	3.9	1538.461538	**1407.528642**	0.71667	**1395.348837**
12	22.7	4.7	1276.595745			
18	23.6	0.9	6666.666667	**4541.341991**	0.26167	**3821.656051**
24	25.6	2	3000			
30	27	1.4	4285.714286			
36	28.1	1.1	5454.545455			
42	30.6	2.5	2400			
48	32.7	2.1	2857.142857			
54	33.6	0.9	6666.666667			
60	34.8	1.2	5000			
66	35.8					

Van Holten

P-WAVE						**REGRESSION**
gp spc	pick	int time	int vel.	**AVG VEL**	SLOPE	**VELOCITY**
0	3.9			ft/sec		ft/sec
6	6.7	2.8	2142.857143	**3271.915082**	0.32333	**3092.783505**
12	8.6	1.9	3157.894737			
18	10.3	1.7	3529.411765			
24	11.8	1.5	4000			
30	13.5	1.7	3529.411765			
36	14.4	0.9	6666.666667	**8587.301587**	0.12857	**7777.777778**
42	15.1	0.7	8571.428571			
48	15.6	0.5	12000			
54	16.2	0.6	10000			
60	17.6	1.4	4285.714286			
66	18.2	0.6	10000			

S-WAVE						
0	9.3					
6	11.7	2.4	2500	**2195.454545**	0.49667	**2013.422819**
12	14.7	3	2000			
18	17.9	3.2	1875			
24	21.1	3.2	1875			
30	23.3	2.2	2727.272727			
36	24.5	1.2	5000	**5352.304558**	0.22667	**4411.764706**
42	26.6	2.1	2857.142857			
48	28.3	1.7	3529.411765			
54	29.3	1	6000			
60	29.8	0.5	12000			
66	31.9					

York

P-WAVE						**REGRESSION**
gp spc	pick	int time	int vel.	**AVG VEL**	SLOPE	**VELOCITY**
0	5			ft/sec		ft/sec
6	8.6	3.6	1666.666667	**2080.382228**	0.57833	**1729.106628**
12	11.8	3.2	1875			
18	14.9	3.1	1935.483871			
24	19.2	4.3	1395.348837			
30	20.9	1.7	3529.411765			
36	21.8	0.9	6666.666667	**8753.357753**	0.1419	**7046.979866**
42	22.5	0.7	8571.428571			
48	23.4	0.9	6666.666667			
54	24.7	1.3	4615.384615			
60	25	0.3	20000			
66	26	1	6000			

S-WAVE						
0	9.5					
6	16.3	6.8	882.3529412	**1303.565309**	0.82857	**1206.896552**
12	20.9	4.6	1304.347826			
18	23.4	2.5	2400			
24	29.3	5.9	1016.949153			
30	35.5	6.2	967.7419355			
36	40.3	4.8	1250			
42	42.5	2.2	2727.272727	**5277.597403**	0.23333	**4285.714286**
48	45.7	3.2	1875			
54	46.3	0.6	10000			
60	47.7	1.4	4285.714286			
66	48.5	0.8	7500			

River Road

P-WAVE

gp spc	pick	int time	int vel.	**AVG VEL**	SLOPE	**REGRESSION VELOCITY**	comments
0	5			ft/sec		ft/sec	
6	8.6	3.6	1666.666667	**1666.666667**	0.6	**1666.666667**	
12	10.8	2.2	2727.272727	**3060.965779**	0.32167	**3108.80829**	water table
18	13.1	2.3	2608.695652				
24	15	1.9	3157.894737				
30	16.6	1.6	3750				
36	17.8	1.2	5000	**6944.444444**	0.13905	**7191.780822**	weathered bedrock
42	19	1.2	5000				
48	19.9	0.9	6666.666667				
54	20.7	0.8	7500				
60	21.3	0.6	10000				
66	22.1	0.8	7500				

S-WAVE

0	5.5						
6	11.1	5.6	1071.428571	**1217.532468**	0.83333	**1200**	
12	15.5	4.4	1363.636364				
18	17.3	1.8	3333.333333	**2553.114468**	0.43571	**2295.081967**	
24	19.3	2	3000				
30	22.3	3	2000				
36	25.2	2.9	2068.965517				
42	27.5	2.3	2608.695652				
48	30.1	2.6	2307.692308				

North
Branch

P-WAVE

gp spc	pick	int time	int vel.	**AVG VEL**	SLOPE	**REGRESSION VELOCITY**
0	8			ft/sec		ft/sec
6	11.4	3.4	1764.705882	**2764.705882**	0.38333	**2608.695652**
12	13.1	1.7	3529.411765			
18	15.1	2	3000			
24	16	0.9	6666.666667	**8684.52381**	0.10833	**9230.769231**
30	16.8	0.8	7500			
36	17.3	0.5	12000			
42	18	0.7	8571.428571			
48	18.5	0.5	12000	**18500**	0.05833	**17142.85714**
54	18.8	0.3	20000			
60	19	0.2	30000			
66	19.5	0.5	12000			

S-WAVE

0	12.2					
6	15.9	3.7	1621.621622	**1621.621622**	0.61667	**1621.621622**
12	19.6	3.7	1621.621622			
18	23.3	3.7	1621.621622			
24	25.5	2.2	2727.272727	**4919.191919**	0.27833	**3592.814371**
30	27.7	2.2	2727.272727			
36	28.2	0.5	12000			
42	30.9	2.7	2222.222222			
48	31.6	0.7	8571.428571	**5518.925519**	0.19667	**5084.745763**
54	32.5	0.9	6666.666667			
60	33.8	1.3	4615.384615			
66	35.1					

Griggstown

P-WAVE

gp spc	pick	int time	int vel.	**AVG VEL**	SLOPE	**REGRESSION VELOCITY**	comments
0	9.8			ft/sec		ft/sec	
6	15.6	5.8	1034.482759	**1117.241379**	0.9	**1111.111111**	shallow layer
12	20.6	5	1200				
18	21.8	1.2	5000	**5227.272727**	0.18333	**5454.545455**	water table
24	22.9	1.1	5454.545455				
30	23.7	0.8	7500	**11877.55102**	0.10952	**9130.434783**	bedrock--shale
36	23.9	0.2	30000				
42	24.6	0.7	8571.428571				
48	25.6	1	6000				
54	26	0.4	15000				
60	26.7	0.7	8571.428571				
66	27.5	0.8	7500				

S-WAVE

0	17.3						
6	29.8	12.5	480	**644.8913043**	1.65333	**604.8387097**	
12	42.3	12.5	480				
18	49.2	6.9	869.5652174				
24	57.2	8	750				
30	61.6	4.4	1363.636364	**2522.294372**	0.40571	**2464.788732**	
36	64.1	2.5	2400				
42	68.1	4	1500				
48	69.5	1.4	4285.714286				
54	71.7	2.2	2727.272727				
60	73.8	2.1	2857.142857				

Blackwells

P-WAVE

gp spc	pick	int time	int vel.	**AVG VEL**	SLOPE	**REGRESSION VELOCITY**	comments
0	4.8			ft/sec		ft/sec	
6	10.5	5.7	1052.631579	**1528.337243**	0.68333	**1463.414634**	shallow layer
12	13.4	2.9	2068.965517				
18	17.5	4.1	1463.414634				
24	19.4	1.9	3157.894737	**2873.76979**	0.28333	**3529.411765**	water table
30	20.9	1.5	4000				
36	21.7	0.8	7500	**8684.52381**	0.11667	**8571.428571**	weathered bedrock
42	22.2	0.5	12000				
48	22.9	0.7	8571.428571				
54	23.8	0.9	6666.666667				

S-WAVE

0	18.3						
6	32.2	13.9	431.6546763	**819.5955832**	1.41	**709.2198582**	
12	38	5.8	1034.482759				
18	47.8	9.8	612.244898				
24	52.8	5	1200	**2131.184012**	0.47429	**2108.433735**	
30	56.2	3.4	1764.705882				
36	59.2	3	2000				
42	61.8	2.6	2307.692308				
48	65.2	3.4	1764.705882				
54	66.8	1.6	3750				

Opie

P-WAVE

gp spc	pick	int time	int vel.	**AVG VEL**	SLOPE	**REGRESSION VELOCITY**	comments
0	8.2			ft/sec		ft/sec	
6	12.1	3.9	1538.461538	**1501.831502**	0.67	**1492.537313**	
12	16.3	4.2	1428.571429				
18	20.2	3.9	1538.461538				
24	21.5	1.3	4615.384615	**5641.025641**	0.15	**6666.666667**	water table
30	22.4	0.9	6666.666667				
36	23.1	0.7	8571.428571	**13928.57143**	0.08	**12500**	bedrock--shale
42	23.5	0.4	15000				
48	24.1	0.6	10000				
54	24.7	0.6	10000				
60	24.9	0.2	30000				
66	25.5	0.6	10000				

S-WAVE

0	17.8						
6	37.6	19.8	303.030303	**593.6715282**	1.9	**526.3157895**	
12	49.9	12.3	487.804878				
18	56.8	6.9	869.5652174				
24	65.2	8.4	714.2857143				
30	67.8	2.6	2307.692308	**2316.401618**	0.48214	**2074.074074**	
36	74	6.2	967.7419355				
42	76.9	2.9	2068.965517				
48	80.4	3.5	1714.285714				
54	81.9	1.5	4000				
60	84.7	2.8	2142.857143				
66	86	1.3	4615.384615				

SEISMIC SOIL CLASS MAP FOR SOMERSET COUNTY, NEW JERSEY

Prepared by Scott D. Stanford, New Jersey Geological Survey
for the
New Jersey State Police, Office of Emergency Management
2008

EXPLANATION

- Soil Class A--hard rock with less than 10 feet of soil cover. Shear-wave velocity greater than 5000 ft/s (1500 m/s) (HAZUS number 1).
- Soil Class C--very dense soil and soft rock. Shear-wave velocity between 1200 and 2500 ft/s (360 and 760 m/s) (HAZUS number 3).
- Soil Class D--stiff soil. Shear-wave velocity between 600 and 1200 ft/s (180 and 360 m/s) (HAZUS number 4).
- Soil Class E--soft soil. Shear-wave velocity less than 600 ft/s (180 m/s) (HAZUS number 5).

The soil class designations are defined in the 1997 National Earthquake Hazards Reduction Program (NEHRP) Provisions. Soil classes were assigned using Standard Penetration Test data, shear-wave velocity measurements, and geologic map data (listed below), according to the procedures described in sections 4.1.2.1, 4.1.2.2, and 4.1.2.3 of the NEHRP Provisions (Federal Emergency Management Agency, 1998). Equation 4.1.2.3-2 was used to assign soil class in layered cases.

This map shows the extent of natural soils. Man-made fill overlies these soils in parts of the county. This fill includes a wide range of materials. The behavior of fill during seismic shaking should be assessed on a site-specific basis.

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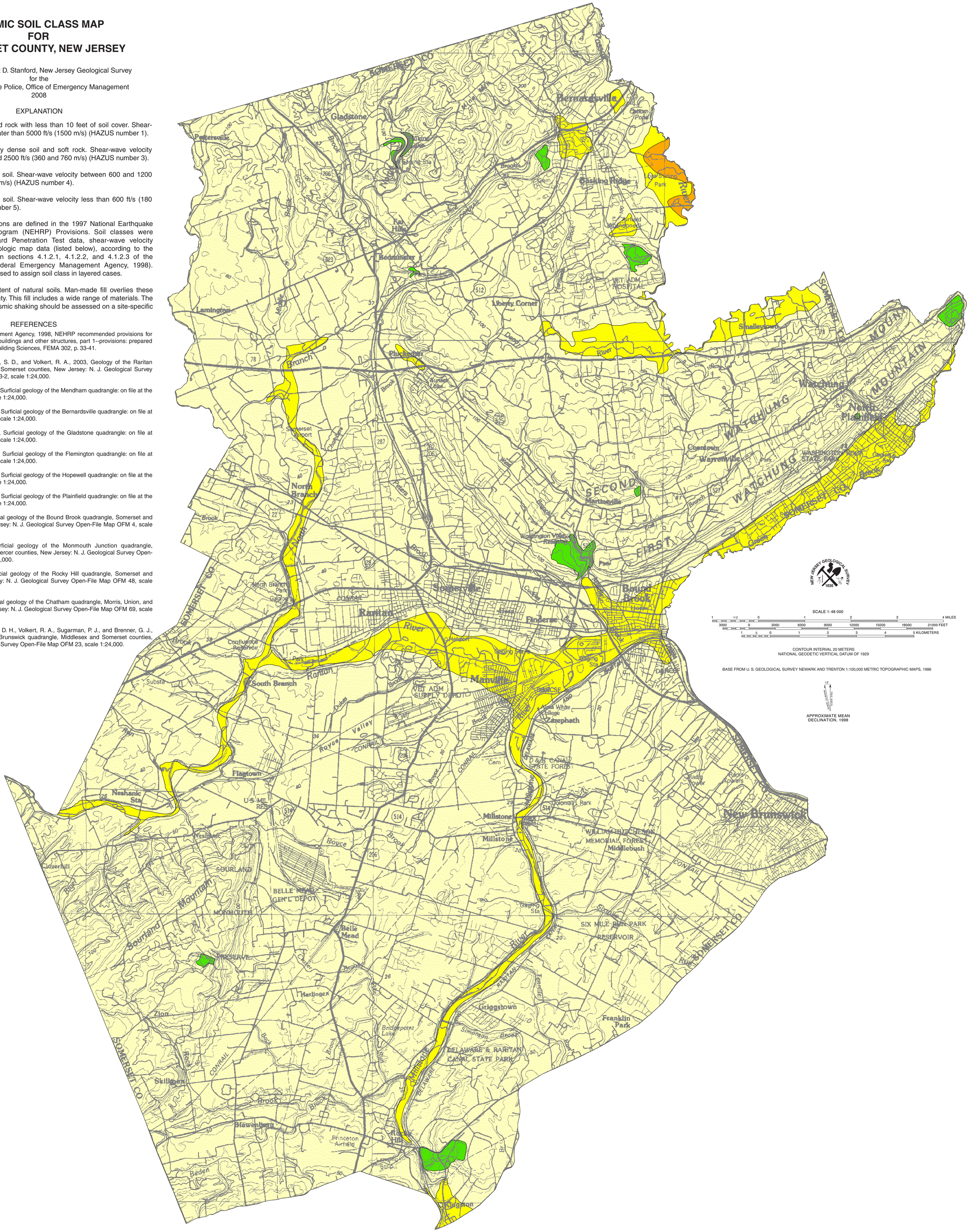

SOIL LIQUEFACTION SUSCEPTIBILITY FOR SOMERSET COUNTY, NEW JERSEY

Prepared by Scott D. Stanford, New Jersey Geological Survey
for the
New Jersey State Police, Office of Emergency Management

2008

EXPLANATION

- Category 0--none
- Category 1--very low
- Category 2--low
- Category 3--moderate
- Category 4--high

Categories are from the HAZUS User's Manual, Table 9.1 (National Institute of Building Sciences, 1997), with modifications reflecting local geologic conditions. Geologic data are from the maps listed below.

This map shows the liquefaction susceptibility of natural soils. Man-made fill overlies these soils in parts of the county. This fill includes a wide range of materials. The behavior of fill during seismic shaking should be assessed on a site-specific basis.

REFERENCES

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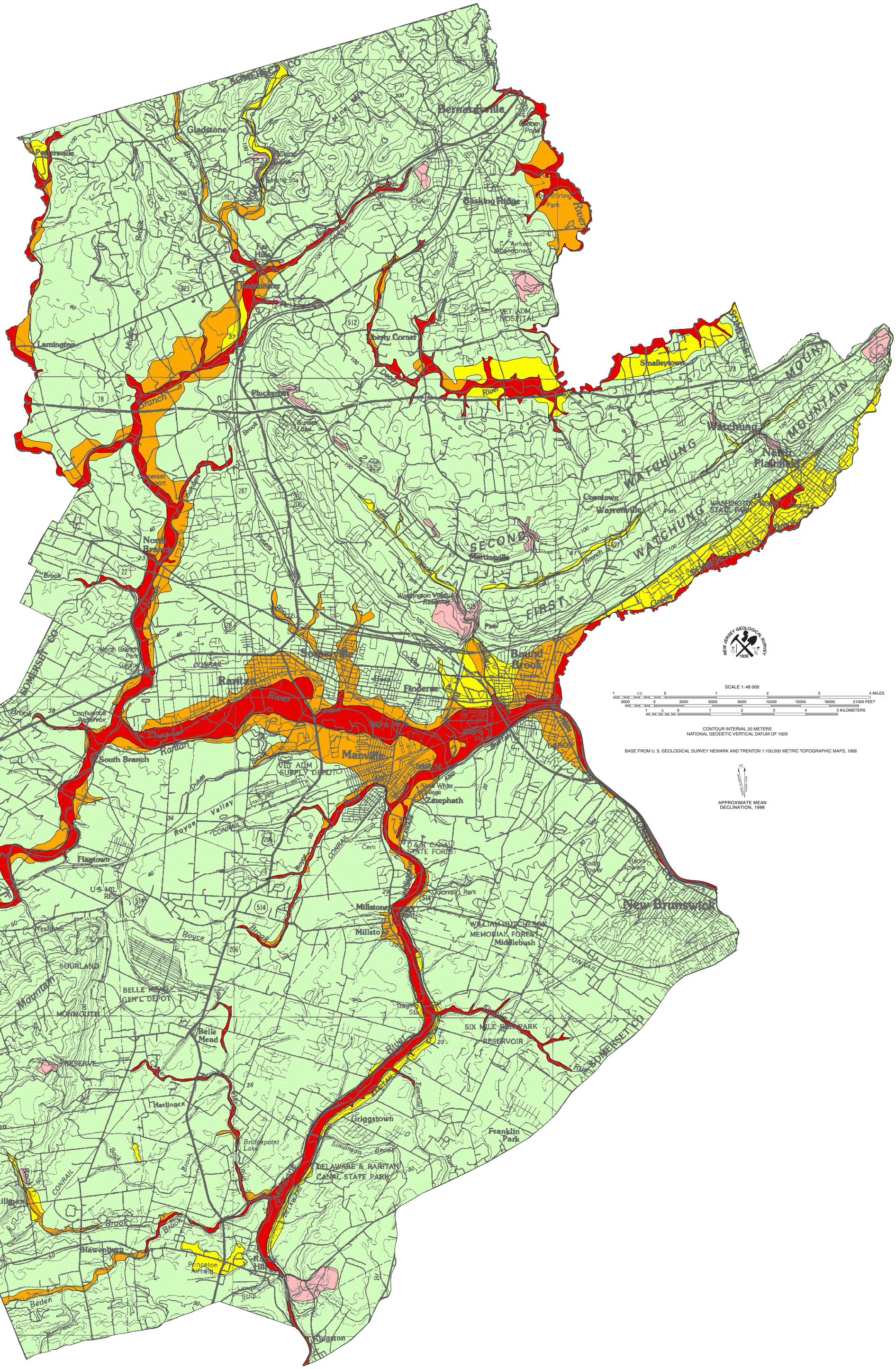

NEW JERSEY GEOLOGICAL SURVEY 1835

SCALE 1:48 000

1 1/2 0 1 2 3 4 MILES
3000 0 3000 6000 9000 12000 15000 18000 21000 FEET
1 .5 0 1 2 3 4 5 KILOMETERS

CONTOUR INTERVAL 20 METERS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

BASE FROM U. S. GEOLOGICAL SURVEY NEWARK AND TRENTON 1:100,000 METRIC TOPOGRAPHIC MAPS, 1986

APPROXIMATE MEAN DECLINATION, 1998

LANDSLIDE SUSCEPTIBILITY FOR SOMERSET COUNTY, NEW JERSEY

Prepared by Scott D. Stanford, New Jersey Geological Survey
for the
New Jersey State Police, Office of Emergency Management

2008

EXPLANATION

- None--HAZUS number 0
- Landslide Class AII--strongly cemented rock, slope angle 20-30 degrees (HAZUS number 2)
- Landslide Class AIV--strongly cemented rock, slope angle 30-40 degrees (HAZUS number 5)
- Landslide Class AVI--strongly cemented rock, slope angle greater than 40 degrees (HAZUS number 7).
- Landslide Class BIII--weakly cemented rock and soil, slope angle 10-15 degrees (HAZUS number 3)
- Landslide Class BIV--weakly cemented rock and soil, slope angle 15-20 degrees (HAZUS number 4).
- Landslide Class BV--weakly cemented rock and soil, slope angle 20-30 degrees (HAZUS number 7).
- Landslide Class BVI--weakly cemented rock and soil, slope angle 30-40 degrees (HAZUS number 8).
- Landslide Class CV--shale and clayey soil, slope angle less than 10 degrees (HAZUS number 6).
- Landslide Class CVI--shale and clayey soil, slope angle 10-15 degrees (HAZUS number 8).
- Landslide Class CVII--shale and clayey soil, slope angle 15-20 degrees (HAZUS number 9).
- Landslide Class CIX--shale and clayey soil, slope angle 20-30 degrees (HAZUS number 9).

Landslide classes are from the HAZUS User's Manual, Table 9.2 (National Institute of Building Sciences, 1997). Slope angles were measured from the following U. S. Geological Survey 7.5 minute quadrangles: Bernardsville, Bound Brook, Chatham, Flemington, Gladstone, Hopewell, Mendham, Monmouth Junction, Plainfield, Raritan, Rocky Hill (all with 20-foot contour interval), and New Brunswick (10-foot contour interval). Slope materials were determined from the geologic maps listed in the References.

NEW JERSEY GEOLOGICAL SURVEY 1835

SCALE 1:48 000

1 0 1 2 3 4 MILES
3000 0 3000 6000 9000 12000 15000 18000 21000 FEET
1 .5 0 1 2 3 4 5 KILOMETERS

CONTOUR INTERVAL 20 METERS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

BASE FROM U. S. GEOLOGICAL SURVEY NEWARK AND TRENTON 1:100,000 METRIC TOPOGRAPHIC MAPS, 1986

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