3.2.2: Estimating Losses

44 CFR 201.4(c)(2)(iii) – The State risk assessment shall include the following elements:

An overview and analysis of potential losses to the identified vulnerable structures, based on estimates provided in local risk assessments as well as the State risk assessment. The State must estimate the potential dollar losses to State-owned or operated buildings, infrastructure, and critical facilities located in the identified hazard areas.

For the identified hazards ranked as the highest priority of concern by the HMC, losses were estimated for various hazard scenarios. For other identified hazards and where less data was available, an overall exposure analysis was conducted. The exposure analysis considers the overall value of assets in the hazard area or ranked county, whereas loss estimation calculates anticipated losses from specific hazard scenarios (e.g. 100-year flood or Magnitude 7.7 Earthquake).

Summary of Losses

Each hazard identified for inclusion in this plan is presented in separate sections with details regarding estimated damages sustained and future losses that might be realized based on various scenarios. In summary, the following table provides a comparison of damages sustained to property and crops for hazards tracked through the National Climatic Data Center (NCDC). The tables below have been updated to reflect the general category of hazards prone to Mississippi and include the totals presented in the last plan to compare to the current totals.

Property Damage

Hazard Type							
	Coastal Storms	Drought	Extreme Winter Weather	Flood	Severe Weather	Tornado	Year Totals
2007	$0	$2,650,000	$0	$4,190,000	$9,124,000	$6,995,000	**$22,959,000**
2008	$25,240,000	$0	$3,390,000	$41,638,000	$94,175,000	$146,930,000	**$311,373,000**
2009	$1,000	$0	$0	$10,432,000	$12,863,000	$23,669,000	**$46,965,000**
2010	$0	$500,000	$32,705,000	$15,885,000	$7,599,000	$365,713,000	**$422,402,000**
2011	$55,000	$0	$25,845,000	$1,027,000,000	$17,643,000	$872,937,000	**$1,943,480,000**
2012	$7,375,000	$0	$0	$6,874,000	$8,611,000	$9,804,000	**$32,664,000**
2013	$0	$0	$540,000	$4,204,000	$4,867,000	$43,287,000	**$52,898,000**
2014	$0	$0	$50,000	$6,311,000	$6,279,000	$196,959,000	**$209,599,000**
2015	$0	$0	$61,000	$2,528,000	$3,675,000	$13,865,000	**$20,129,000**
2016	$0	$1,740,000	$0	$20,461,000	$7,558,000	$6,889,000	**$36,648,000**
2017	$137,000	$0	$2,945,000	$13,301,000	$9,903,000	$30,150,000	**$56,436,000**
2018	$279,000	$0	$270,000	$9,758,000	$8,521,000	$8,330,000	**$27,158,000**
2019	$0	$0	$0	$10,028,000	$7,489,000	$37,902,000	**$55,419,000**
2020	$111,091,000	$0	$0	$6,838,000	$7,494,000	$99,203,000	**$224,626,000**

2021	$11,297,000	$0	$5,764,000	$13,210,000	$7,291,000	$7,590,000	**$45,152,000**
2022	$0	$0	$0	$105,000	$3,994,000	$6,293,000	**$10,392,000**
Event Totals	**$155,475,000**	**$4,890,000**	**$71,570,000**	**$1,192,763,000**	**$217,086,000**	**$1,876,516,000**	

Source: NCDC and *2023 Plan totals

Crop Damage

Hazard Type							
	Coastal Storms	**Drought**	**Extreme Winter Weather**	**Flood**	**Severe Weather**	**Tornado**	**Year Totals**
2007	$0	$778,900,000	$0	$150,000	$480,000	$0	**$779,530,000**
2008	$1,100,000	$0	$0	$42,805,000	$1,588,000	$7,045,000	**$52,538,000**
2009	$0	$0	$0	$2,950,000	$2,303,000	$652,000	**$5,905,000**
2010	$0	$27,200,000	$0	$50,000	$106,000	$24,380,000	**$51,736,000**
2011	$0	$0	$240,000	$2,702,000	$841,000	$14,315,000	**$18,098,000**
2012	$0	$0	$0	$0	$0	$0	**$0**
2013	$0	$0	$0	$0	$0	$0	**$0**
2014	$0	$0	$0	$0	$0	$10,190,000	**$10,190,000**
2015	$0	$8,844,000	$0	$0	$0	$0	**$8,844,000**
2016	$0	$4,440,000	$0	$0	$0	$0	**$4,440,000**
2017	$0	$0	$0	$0	$0	$4,210,000	**$4,210,000**
2018	$0	$0	$0	$0	$0	$300,000	**$300,000**
2019	$0	$0	$0	$0	$1,000	$2,918,000	**$2,919,000**
2020	$0	$0	$0	$0	$0	$24,102,000	**$24,102,000**
2021	$0	$0	$0	$15,000	$0	$0	**$15,000**
2022	$0	$0	$0	$0	$1,000	$232,000	**$233,000**
Event Totals	**$1,100,000**	**$819,384,000**	**$240,000**	**$48,672,000**	**$5,320,000**	**$88,344,000**	

HAZUS-MH

Computer models are utilized to examine the effects and consequences of disasters because alternative mechanisms for understanding these effects may prove impossible to safely replicate in the field. Simulation models typically ingest tremendous quantities of data about pre-event conditions and then alter the data according to a set of rules driven by empirical relationships (a Category 3 storm will cause a storm surge of 15') or mechanistic components using detailed numeric solutions (winds of 120 mph will increase surface water speeds due to friction, wind friction water will pile up against a coastline as shoreline depth decreases, accumulation of water will cause a storm surge of 15'). Alterations in the data provide the user with results that may be misinterpreted. Thus, two basic factors affect the accuracy and value of modeling results: a) the quality of data used to initialize the model; and b) the level of understanding and detail used to simulate processes affecting input data.

HAZUS-Multi-Hazard (HAZUS-MH) is a suite of modeling software driven by geographic information systems (GIS) software. HAZUS provides three levels of analysis based on the level of effort and expertise employed by the user (reference: http://www.fema.gov/HAZUS/HAZUS-multi-hazard-analysis-levels). Users can improve the accuracy of HAZUS loss estimates by furnishing more detailed data about the community or additional engineering expertise on the building inventory. The following describes the information and expertise needed for each level:

> Level 1: A basic estimate of earthquake, flood, and hurricane wind losses is produced based on national databases and expert-based analysis parameters included in the HAZUS software. This is commonly referred to as an "out-of-the-box" or "default" loss estimates. FEMA's Basic HAZUS-MH course (E313) enables a user to run Level 1 loss estimation. There may be exceptions for what is considered Level 1 based on unique conditions for a specific study region. For example, if available in HAZUS-compatible format, soil maps can play a significant role in enhancing the quality of an earthquake loss estimate in a particular region.
>
> Level 2: More accurate loss estimates are produced by including detailed information on local hazard conditions or by replacing the national default inventories with more accurate local inventories of buildings, essential facilities, and other infrastructure. Although there is no standard way to perform a Level 2 study, priority should be given to information that better defines the hazard. Sensitivity studies guide the user in focusing time and resources on the type of information required to improve the loss estimate for their study region. There are many professionals able to assist with a Level 2 analysis. These include geologists and hydrologists to improve hazard map data, GIS professionals to improve national default inventories, and engineers to improve the classifications of building types and vulnerabilities. Some background in loss estimation and experience in using HAZUS is normally required for a Level 2 analysis.
>
> Level 3: These state-of-the-art loss estimates utilize all of the hazard and inventory improvements included in a Level 2 study, plus expert adjustment of analysis parameters and use of advanced HAZUS capabilities, such as the Advanced Engineering Building Module (AEBM) and the Potable Water System Analysis Model (POWSAM). A Level 3 effort requires participation by earth scientists, structural engineers, land-use planners, and emergency managers to provide an accurate inventory and assessment of community vulnerability.

HAZUS model runs for Mississippi's State Hazard Mitigation Plan are typically conducted at Level 1, because each increasing level of modeling complexity requires substantial investments of time and effort. Basic Level 1 data input was derived from the 2000 Census and does not adequately reflect changes in population distribution, location of assets, and similar changes. Further, existing state-owned data sets, such as 2' or better resolution coastal elevation data, do not exist in a format easily consumed by HAZUS and are not used. Instead, the "canned" 30-m resolution National Elevation Dataset data are used. Significant time and effort is needed to combine and format local data for use by HAZUS. While HAZUS is an excellent modeling tool, re-running it every three years without improving the input baseline data simply churns out inaccurate and results that reflect a minimal level of change. In computer modeling terms, "garbage-in equals garbage-out".

This plan update strongly recommends an ongoing modeling effort with baseline data sets consistently updated throughout the hazard planning and mitigation process. Running models such as HAZUS should be separated from the funding of the State Hazard Mitigation Plan and performed in-house on an ongoing basis. This would allow the most current and accurate modeling efforts to be updated to the plan without restricting efforts because of time constraints and funding levels associated with this plan.

Flood Mapping

HAZUS and similar models rely predominantly upon FEMA D-FIRM and emerging RiskMap products for flood planning. As noted, Mississippi is heavily vested in updating and modernizing the flood mapping program. However, newer data sets that further improve flood estimates are available for many areas of the state and may be manipulated beyond the HAZUS modeling system.

The general process used is to create a regional digital elevation model from datasets using common resolutions. In this instance, the traditional 30-m National Elevation Dataset is replaced with a 2' resolution LIDAR data set to indicate bare-earth elevations. This base elevation data set is loaded and viewed in a capable 3D application such as ESRI's ArcScene.

Potential flood elevations are based on the current sea state as measured above Mean Sea Level (MSL) and are initially depicted by constructing a flat plane representative of the area of interest as shown in the illustration below. The plane is assigned an elevation equal to that of mean sea level.

The blue area in **Figure 3.2.1** depicts the area of interest for potential storm surge modeling along coastal Mississippi using Hurricane Katrina data. Hurricane Katrina produced the highest storm surge ever recorded on the U.S. coast at an astonishing 27.8 feet in Pass Christian, Mississippi. This exceeded the previous U.S. record of 22.8 feet, which also occurred at Pass Christian, during 1969's Hurricane Camille. According to the NHC Katrina final report, Hurricane Katrina brought a surge of 24 - 28 feet to a 20-mile stretch of the Mississippi coast. The entire 90 miles of coastline from eastern Louisiana to western Alabama received a storm surge characteristic of a Category 3 hurricane.

Figure 3.2.1
Storm Surge Map

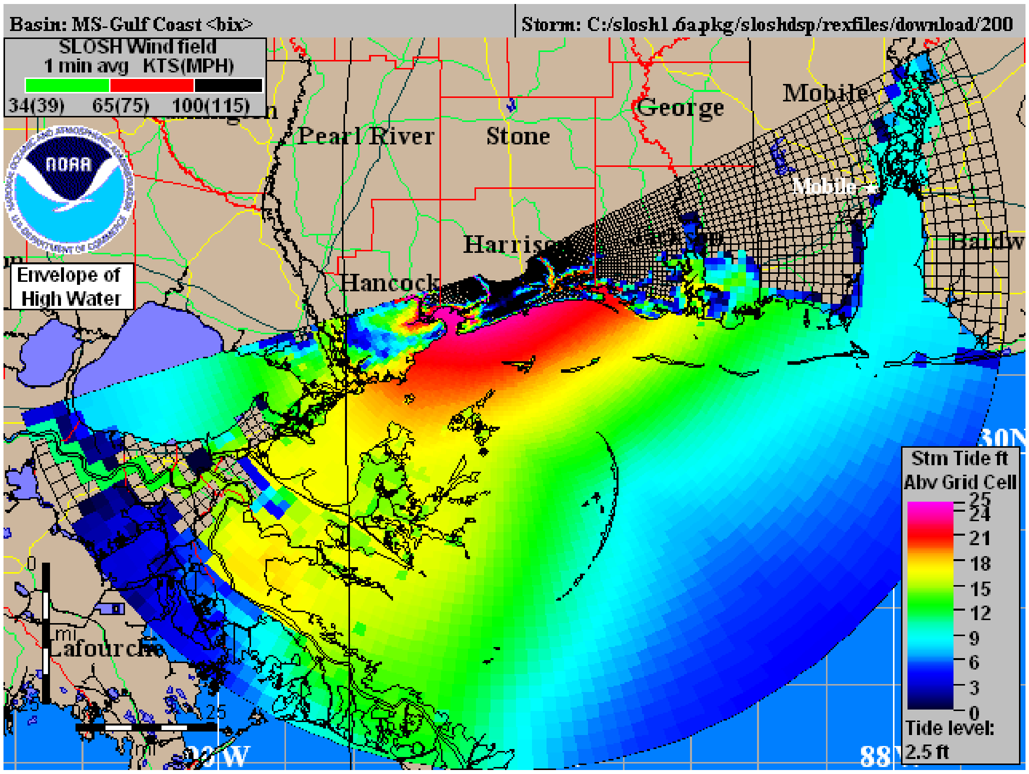

Figure 3.2.1 graphically depicts the results of a SLOSH module for Hurricane Katrina. This image does not show the height above mean sea level of the surge, but rather how high the surge was above the surface.

The plane is initially intersected in 3D space with the baseline elevation model. The intersection is compared with accepted shoreline locations thereby validating the basic modeling approach. The plane is then elevated in 1' increments and the resulting intersection is recorded for each potential flood elevation. This concept is illustrated in Figure 3.2.3 using Katrina's maximum inundation depth plus 20' to simulate extreme circumstances. The net result is a series of lines and polygons depicting locations likely to flood.

While more sophisticated modeling tools are available, they are not typically suitable for use with large geographies because they require extensive technical training and additional high-resolution data sets such as soil models and velocity of the flood waters. The above-described approach is lightweight, errs on the side of caution, and is a proven methodology that provides easy-to-interpret results as shown in Figure 3.2.4.

Figure 3.2.2
Katrina's Maximum Inundation