

## II. CURRENT SITUATION

Florida has experienced near catastrophic events with loss of life and property on a massive scale due to hurricanes and a wide array of other disasters. Our 35 coastal counties lie along 8,436 miles of coastline, including tidal inlets, bays, and other waterways. The proximity of the population concentrations throughout the Gulf of Mexico and the Atlantic Ocean areas, coupled with generally low coastal elevations, significantly increase the state's vulnerability to hurricane damage, tidal surges, and storm-related flooding. This vulnerability has manifested itself in the need for thousands of safe public shelter spaces of which the State of Florida is experiencing a critical shortfall.

Florida's growing population, which is increasing at an average rate of more than 383,577 new residents per year and predicted to exceed 19,655,100 persons by the year 2010 (Florida Statistical Abstract 2005), of which, nearly 80 percent are continuing to settle in coastal areas especially susceptible to hurricane force winds and the damage caused by storm surge. Some of the new residents that are moving to inland counties are choosing to live in large manufactured housing communities that are also susceptible to the effects of hurricanes; such as severe winds and debris impact, and inland rainfall flooding. Therefore, the statewide sheltering deficit situation is not just a coastal phenomenon. Most interior counties also have significant shelter deficits. The future safety of all our citizens prior to and during a hurricane will require substantial additions to the statewide public hurricane shelter inventory.

Another major contributor to the growing statewide hurricane shelter deficit has been the standard capabilities of facilities traditionally used as shelters. Many of the designated shelters did not meet major hurricane-resistance design and construction guidelines, or shelter inventories included buildings which were vulnerable to other potentially hazardous conditions. Furthermore, hurricane shelter space capacities have often been based on an "over-estimation" of usable shelter space. These over-estimations have been caused by lack of reductions for interior walls, utility rooms, restrooms, and other spaces that were not usable as shelter space. The implementation of the ARC 4496 guidelines through shelter evaluations by local, state and prime contracted surveyors, is identifying these structures, either for elimination from the inventory, for appropriate retrofits to enable them to meet the guidelines, or confirmation of meeting ARC 4496 guidelines.

The ARC 4496 guidelines currently in use were nearly a decade in development. In 1983, the Southern Building Code Congress International researched and considered development of shelter selection criteria, but nothing was formally published at the time. The only other guidance available in 1983 was the Federal Emergency Management Agency's publication *TORNADO PROTECTION -- Selecting and Designing Safe Areas in Buildings* (TR-83B, October 1982). Other attempts at conducting structural shelter evaluations were performed in the 1980's, but again no formal guidelines were prepared. Only after a shelter in McClellanville, South Carolina was inundated with 10 feet of storm surge during Hurricane Hugo was a task force created to prepare and publish hurricane shelter selection guidelines. Subsequently, *Guidelines for Hurricane Evacuation Shelter Selection* (ARC 4496, July 1992)

was published by the American Red Cross.

Even before the publishing of ARC 4496, wind engineering experts were considering the effects of wind load issues on hurricane shelters. When developing the national state-of-the-art wind design standard *Minimum Design Loads for Buildings and Other Structures* (ASCE 7-88), the American Society of Civil Engineers classified hurricane shelters as an “essential facility.” This classification indicates the degree of hazard to human life, and that an additional safety margin was necessary for a building intended for use as a hurricane shelter. The essential facility classification requires buildings designated as hurricane shelters to be designed and constructed to the same requirements as hospitals, police stations and emergency communications facilities.

In 1994, ARC 4496 became the basis for the development of the Division’s shelter survey procedure. The criteria focuses on survivability and uses nationally recognized expert guidance, publications and standards. It should be noted that the Division’s shelter selection criteria is consistent with the procedures Miami-Dade County used prior to Hurricane Andrew. Several buildings that were considered hurricane shelters prior to 1992 had been removed from the County’s inventory; many of these buildings were so heavily damaged that they were demolished after the storm. It is important that this lesson not be lost due to the passage of time.

The Division has endeavored to eliminate the shelter deficit with a multifaceted program. This program includes: 1) construction of new facilities using public shelter design criteria; 2) survey of existing buildings, both public and private, to identify additional shelter capacity; 3) where cost effective (and practical), support of mitigation and retrofitting to increase shelter capacity; 4) incorporation of hurricane shelter design criteria into new public building construction projects; 5) improvement of public information/education and behavioral analyses; and 6) shelter demand reduction through decreased evacuation need.

### **Findings of the Division’s Shelter Survey Program**

Prior to 1993, throughout much of Florida, the practice was to evaluate a potential hurricane shelter only using mass care criteria. The structural effects of major hurricanes on buildings were not considered. When established hurricane guidelines (i.e., ARC 4496) are applied, the listed numbers of hurricane evacuation shelter spaces typically dropped dramatically. The guidelines identify the vulnerability of a building to hurricane effects (high winds, debris impact, storm surge, and inland flooding inundation). Application of the guidelines frequently identified characteristics (i.e., long span roofs, unreinforced masonry, unprotected windows, etc.) present in the hurricane shelter buildings. These building construction characteristics have historically performed poorly under major hurricane conditions.

Since 1993, the Division staff and consultant surveyors have conducted on-site shelter surveys of over 3,500 facilities in 65 counties, thus completing the initial baseline survey (Franklin and Monroe Counties have no hurricane shelters that can meet ARC 4496, so were excluded from survey). In each case, local emergency managers selected the sites, based on

local sheltering needs.

Table 2.1 lists the most common vulnerabilities found during the surveys. The Table includes only a sampling of the counties surveyed to indicate the range of vulnerabilities. The vulnerabilities have been identified based upon ARC 4496 guidelines.

**TABLE 2.1**

<b>Summary of Survey Findings by Region</b>						
<b>Region</b>	<b>Number of Buildings Surveyed in Sample</b>	<b>Storm Surge, %</b>	<b>Inland Rainfall Floodplains (site/access roads), %</b>	<b>Unreinforced Masonry Walls, %</b>	<b>Unshuttered Windows/Skylights, %</b>	<b>Open Span Roof, %</b>
Region 1 – Bay, Escambia, Holmes, Okaloosa, Santa Rosa, Walton and Washington	116	0	2	68	87	28
Region 2 – Calhoun, Franklin, Gadsden, Gulf, Jackson, Jefferson, Leon, Liberty and Wakulla	139	4	6	33	50	40
Region 3 – Alachua, Bradford, Columbia, Dixie, Gilchrist, Hamilton, Lafayette, Madison, Suwannee, Taylor and Union	125	4	5	42	82	31
Region 4 – Baker, Clay, Duval, Flagler, Nassau, Putnam and St. Johns	26	0	5	38	85	31
Region 5 – Citrus, Hernando, Levy, Marion and Sumter	377	5	4	42	94	40

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Region 6 – Brevard, Lake, Orange, Osceola, Seminole and Volusia	164	1	0	59	88	33
Region 7 – DeSoto, Hardee, Highlands, Okeechobee and Polk	191	0	1	74	99	47
Region 8 – Hillsborough, Manatee, Pasco and Pinellas	387	2	7	41	92	43
Region 9 – Charlotte, Collier, Glades, Hendry, Lee and Sarasota	323	63	19	28	54	52
Region 10 – Indian River, Martin, Palm Beach and St. Lucie	25	0	0	4	100	68
Region 11 – Broward, Miami- Dade and Monroe	N/A	N/A	N/A	N/A	N/A	N/A
<b>Average %</b>	<b>187</b>	<b>8</b>	<b>5</b>	<b>43</b>	<b>83</b>	<b>41</b>

The “Number of Buildings Surveyed” column reflects the number of buildings fully surveyed in each county. In many cases, the surveyor was able to eliminate buildings based on a preliminary survey (i.e., utility buildings, portable classrooms, older unreinforced masonry buildings, etc.). Generally, this allowed the surveyor to concentrate full surveys on those facilities at each site with more hurricane shelter potential. If possible, any gyms or cafeterias on a campus were fully surveyed, due to the tendency to use such buildings for mass care shelters. When possible, the surveyors attempted to identify at least one other potential shelter building at each site.

The “Storm Surge” column is included to identify structures that are vulnerable to potential storm surge (greater than one foot deep in the building). Mitigation measures can be implemented for structures that are vulnerable to less than one foot of storm surge. Generally, surges in excess of one foot inundation of a building are difficult and costly to mitigate.

Because flooding can be expected with the heavy rainfall that normally accompanies hurricanes, care must be taken to avoid placing shelter occupants at risk from rising floodwaters. ARC 4496 guidelines recommend against locating hurricane shelters in a 100-year floodplain. The “Inland Floodplains” column indicates those structures potentially affected by flooding.

The “Unreinforced Masonry Walls” column is included due to the propensity for poor performance of such systems under major hurricane conditions.

“Unshuttered Windows / Skylights” is included because of the high vulnerability such systems have in both older and newer buildings. Unprotected windows on the building exterior are very vulnerable to windborne debris impact. Once breached, the window opening will allow hurricane force winds, rain and debris into the building interior, resulting in interior damage and subsequent roof system failures.

“Open Span Roof” systems also have performed poorly under hurricane conditions, especially when constructed of a flat, lightweight roof (common in gyms and cafeterias in Florida). Such systems are very vulnerable to the uplift and reverse bending forces prevalent under major hurricane conditions, unless sufficient bracing and connection detailing is applied.

While many other concerns were also found in the surveys, the above factors were selected for tabulation since they are typical examples of common vulnerabilities found in potential hurricane shelter buildings. These findings are consistent with those of local government agencies and engineering consultant firms. As an example, URS Corporation found similar results during a survey of potential hurricane shelters in Delaware. They found that 45 percent of the buildings had weak exterior walls (typically unreinforced masonry), 80 percent had unprotected windows, and 42 percent had open span roofs.

In addition, the overestimation of usable floor space is a common factor in the reduction of pre-defined shelter spaces. The total floor area of a building (i.e., the building’s “footprint”) was often used to calculate the shelter area. This resulted in counting space that was actually taken up in restrooms, kitchens, utility/electrical rooms, closets, and space needed for walkways. When surveyors evaluated a building, such unusable floor area was eliminated, often resulting in significant reduction of reported shelter capacity.

## **Statewide Progress in Shelter Retrofitting and Enhanced Hurricane Protection Area**

**Construction**

This past spring, county emergency management offices were polled for current information on retrofit projects and enhanced hurricane protection area (EHPA) construction, resulting in the table below. Table 2.2 shows listings of retrofitted spaces (either local, state, or federal funds) and EHPA spaces created through August 2006, and projected gains (contracted or under construction) between September 2006 and August 2007.

**Table 2.2**

<b>2006 Hurricane Evacuation Shelter Deficit Reduction Progress</b> <b>“Post-1995 Success Stories”</b> <b>Shelter Capacity that Meets ARC 4496 Guidelines</b>				
NOTE: For sake of simplicity, all General Population Hurricane Shelter capacities are calculated based on 20 sq.ft. per evacuee, and Persons with Special Needs (PSN) Hurricane Shelters on 60 sq.ft. per client.				
County Name	1995 - August, 2006		September, 2006 - August, 2007	
	<b>Retrofit &amp; As-Is Shelter Capacity</b> (# spaces @ 20sqft per evacuee for General Population Shelters and @ 60sqft per client for SpNS)	<b>New School EHPA Capacity</b> (# spaces @ 20sqft per evacuee for General Population Shelters and @ 60sqft per client for SpNS)	<b>Projected Retrofit Shelter Capacity</b> (# spaces @ 20sqft per evacuee for General Population Shelters and @ 60sqft per client for SpNS)	<b>Projected New School EHPA Capacity</b> (# spaces @ 20sqft per evacuee for General Population Shelters and @ 60sqft per client for SpNS)
Alachua	5,406	166	0	1,789
Baker	0	306	0	0
Bay	13,443	192	821	0
Bradford	1,285	0	0	0
Brevard	22,913	7,757	600	0
Broward	0	39,356	0	0
Calhoun	0	0	0	0
Charlotte	3,127	0	0	0
Citrus	4,750	138	0	0
Clay	1,901	1,632	1,627	0
Collier	11,458	11,260	0	0
Columbia	0	2,297	0	0

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DeSoto	2,505	119	0	0
Dixie	2,051	83	0	0
Duval	13,821	5,309	10,537	2,000
Escambia	10,402	1,349	3,521	0
Flagler	3,480	650	0	0
Franklin	0	0	0	0
Gadsden	0	2,535	0	0
Gilchrist	3,344	0	0	0
Glades	537	594	0	0
Gulf	0	103	0	0
Hamilton	501	1,200	0	0
Hardee	0	632	0	0
Hendry	5,203	1,000	0	0
Hernando	1,678	1,445	0	0
Highlands	1,136	967	0	200
Hillsborough	30,868	52,441	0	7,000
Holmes	179	1,839	0	0
Indian River	7,286	0	0	0
Jackson	896	2,138	532	0

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Jefferson	0	809	0	0
Lafayette	298	0	0	0
Lake	1,766	16,772	0	3,803
Lee	24,529	10,659	0	0
Leon	22,354	517	0	0
Levy	1,893	0	257	0
Liberty	602	548	0	0
Madison	4,311	0	0	0
Manatee	17,866	13,465	0	0
Marion	5,370	2,193	0	0
Martin	8,804	4,900	0	0
Miami-Dade	71,624	14,553	0	0
Monroe	0	0	0	0
Monroe/FIU	197	0	0	0
Nassau	234	3,765	0	0
Okaloosa	3,037	0	0	0
Okeechobee	1,928	1,011	0	0
Orange	2,463	5,997	0	3,650
Osceola	11,113	3,703	558	0

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Palm Beach	6,880	44,366	0	5,000
Pasco	15,835	6,854	0	0
Pinellas	23,951	12,533	0	0
Polk	1,955	38,929	801	0
Putnam	260	811	0	0
Santa Rosa	4,988	352	0	0
Sarasota	23,158	18,436	0	0
Seminole	11,111	1,000	4,098	0
St. Johns	4,795	6,741	0	0
St. Lucie	12,333	3,222	0	0
Sumter	344	200	0	0
Suwannee	0	203	0	0
Taylor	0	2,424	0	0
Union	939	345	0	0
Volusia	15,597	6,353	0	2,200
Wakulla	0	400	0	0
Walton	3,122	1,258	550	0
Washington	2,677	153	570	0
<b>Subtotals:</b>	<b>454,504</b>	<b>358,980</b>	<b>24,252</b>	<b>25,642</b>

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<b>Totals:</b>	<b>843,484</b>		<b>49,894</b>	
<b>GRAND TOTAL:</b>		<b>863,378</b>		
* - As-Is hurricane shelter space is pre-retrofit space that meets ARC 4496, but accounts for less than four (4) percent of total capacity shown. ** - Charlotte County’s Liberty Elem. School and Port Charlotte Middle School retrofit spaces are recognized by the Division as meeting minimum ARC 4496 criteria for exiting storms only; Category 3 or stronger landfalling hurricanes may inundate these facilities with storm surge.				