1.0 INTRODUCTION

1.1 PURPOSE

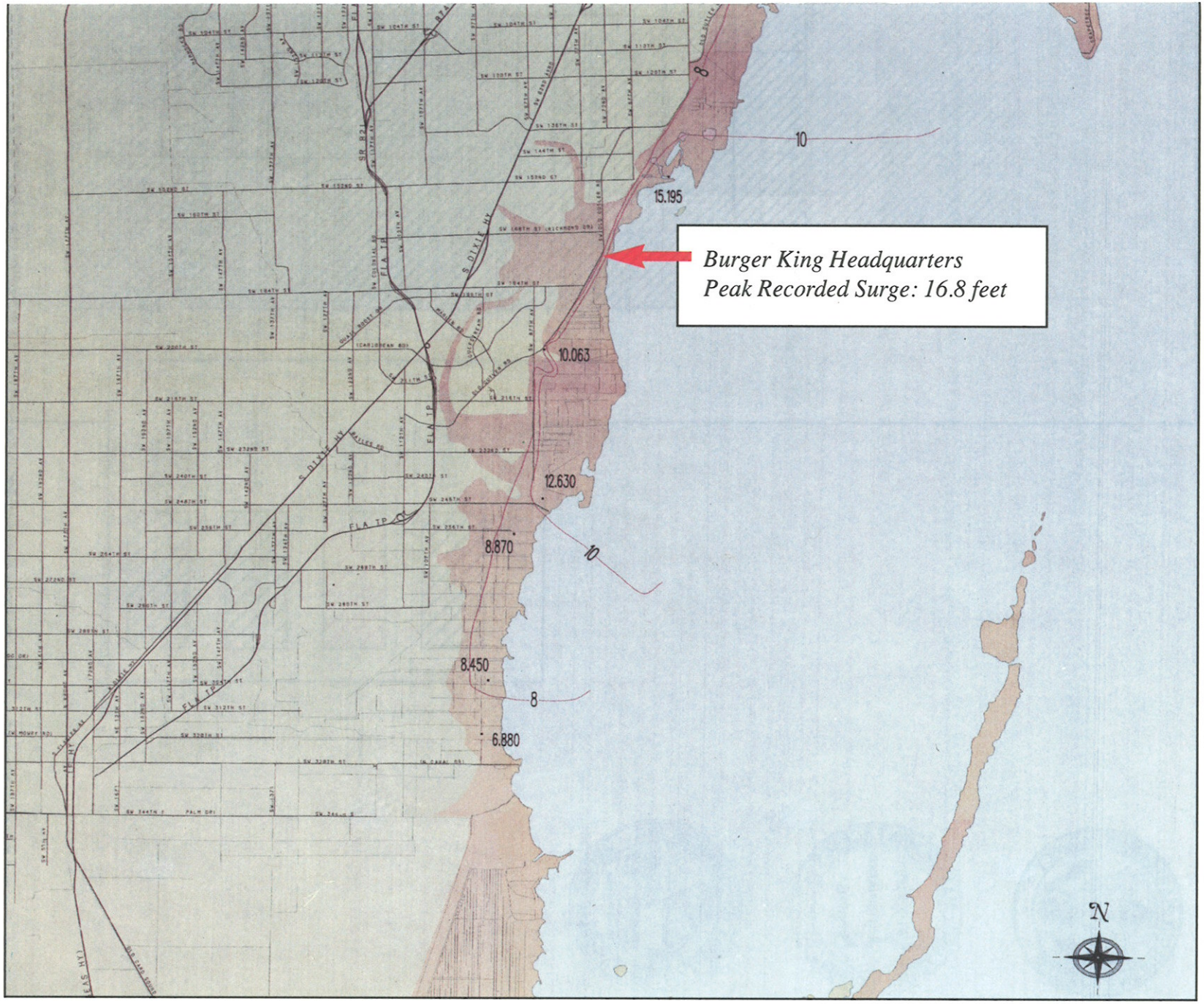
The purposes of this report are to present the Building Performance Assessment Team's observation of the successes and failures of buildings in withstanding the effects of Hurricane Andrew in southern Dade County, Florida; to comment on the failure modes of damaged buildings; and to provide recommendations for improvements intended to enhance the performance of buildings in future hurricanes.

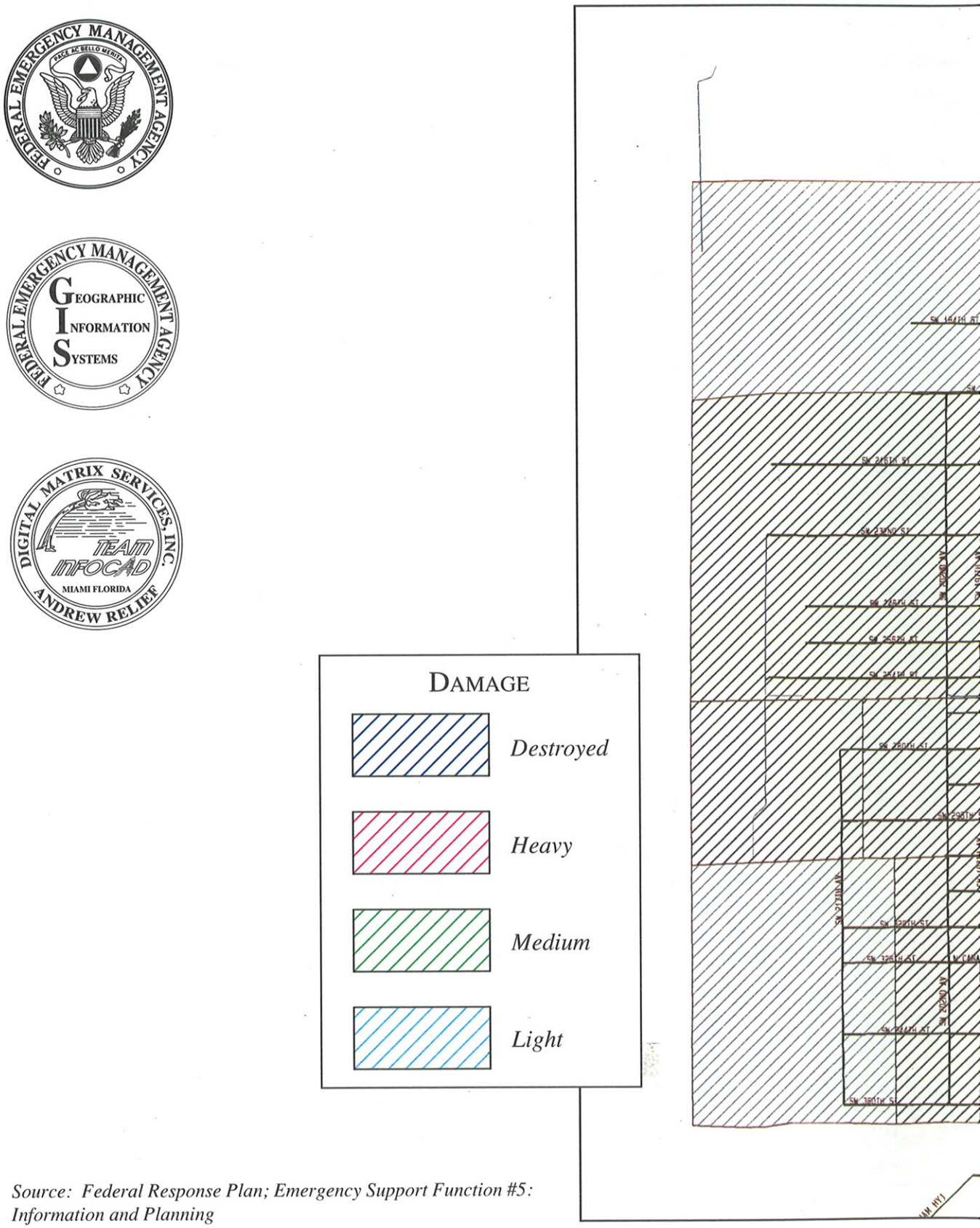
1.2 HISTORY AND BACKGROUND

Hurricane Andrew came ashore in southern Dade County during the early morning hours of August 24, 1992. Although the storm produced high winds and a high storm surge, the effects of the storm surge and wave action were confined to a relatively small area of the coastal floodplain (SEE FIGURE 1). Therefore, the flood damage from Andrew, unlike that from many other hurricanes of its size and magnitude, was minimal. Wind damage resulting from Andrew was widespread, however (SEE FIGURE 2). Consequently, considerable public interest has focused on the determination of actual windspeeds resulting from this hurricane.

The range of sustained windspeeds for a Category 4 storm, such as Hurricane Andrew, is from 131 mph to 155 mph. On September 11, 1992, the team met with various people involved in determining the wind speeds generated by Hurricane Andrew. The assessment team was informed that measurements taken over water at Fowley Rocks indicated a peak 2-minute sustained wind speed as high as 141 mph before the anemometer (a gauge for measuring the velocity of wind) stopped reporting. At the National Hurricane Center (150 feet above the ground), peak wind gusts reached speeds of over 160 mph . Wind speeds closer to the ground, and nearer to the storm

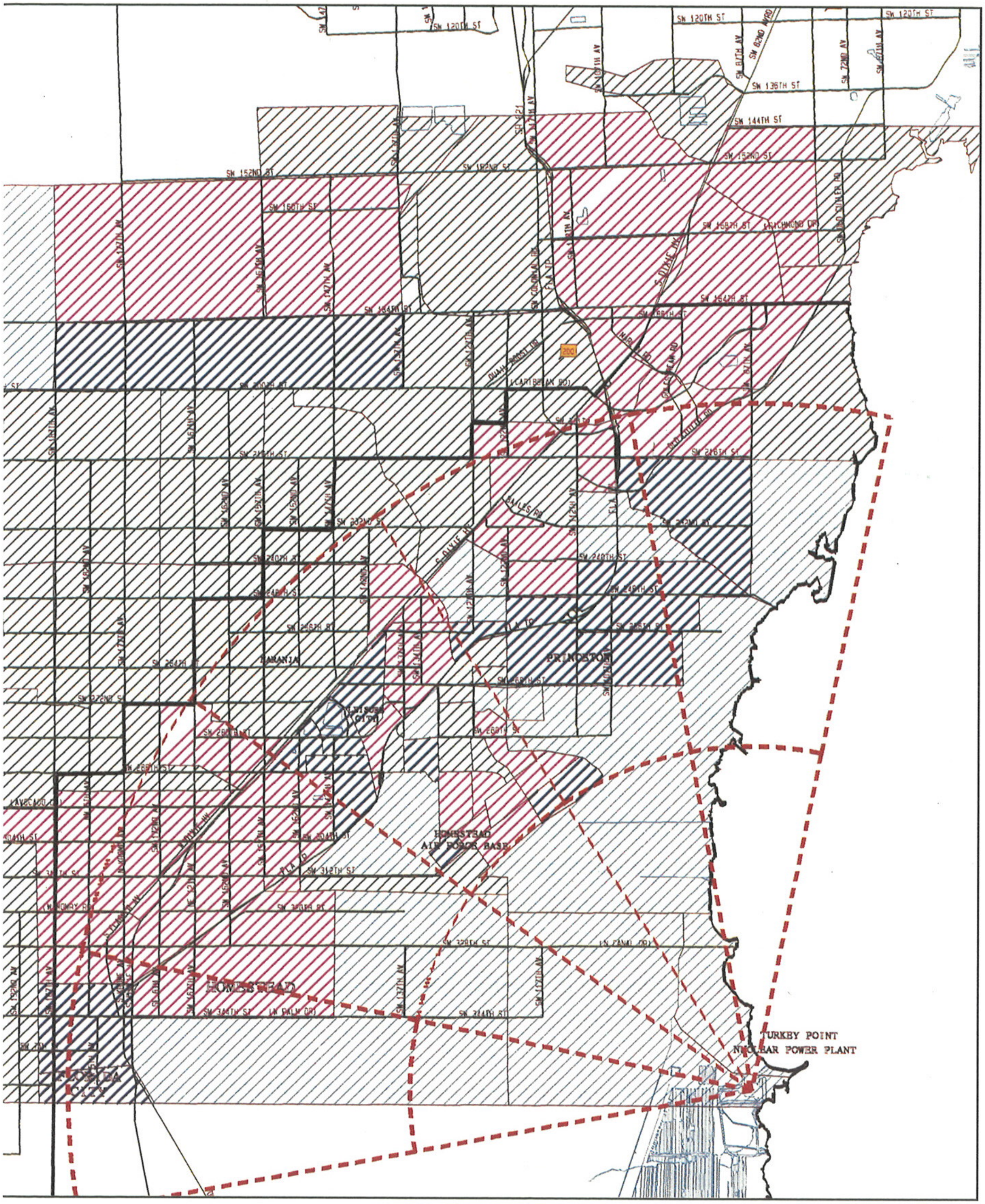
FIGURE 1. *Storm surge associated with Hurricane Andrew.*


Burger King Headquarters
Peak Recorded Surge: 16.8 feet
15.195
10.063
12.630
8.870
8.450
6.880
10
8
N



Source: Federal Response Plan; Emergency Support Function #5: Information and Planning

FIGURE 2. *Damage zones as a result of Hurricane Andrew, Dade County, Florida*


SW 120TH ST
SW 136TH ST
SW 144TH ST
SW 152ND ST
SW 160TH ST
SW 168TH ST
SW 184TH ST
SW 216TH ST
SW 248TH ST
PRINCETON
NARANJA
HOMESTEAD AIR FORCE BASE
SW 312TH ST
SW 328TH ST
SW 344TH ST
HOMESTEAD
TURKEY POINT NUCLEAR POWER PLANT

center, have not been precisely determined. This may be due to varying degrees of exposure as a result of ground surface irregularities, the distance between anemometer sites, and the potential inaccuracy of anemoneters at excessively high winds.

In 1957, to address the need for hurricane-resistant construction, Dade County developed and began enforcing the South Florida Building Code (herein referred to as the Code). The Code contains both detailed prescriptive and performance measures for meeting minimum load requirements. The Code requires that structures be able to resist wind pressures produced by a velocity of "not less than 120 mph at a height of 30 feet above the ground." The code also requires that safety factors varying from 1.0 to 4.0 be applied in structural designs depending on which building component is being designed. The Code also has high wind pressure and fastest-mile wind speed requirements for buildings located in coastal zones, in accordance with Florida State requirements. Fastest-mile wind speed for a given storm is generally recorded by weather instruments that automatically record wind speeds averaged over the time interval required for the passage over the anemometer, located 30 feet above the ground, of a horizontal column of air with a length of 1 mile. Though it appears that, in some areas, the wind speeds associated with Hurricane Andrew exceeded those prescribed in the Code, properly designed and constructed buildings should have experienced fewer storm-related damages when factors of safety required by the Code are taken into consideration.

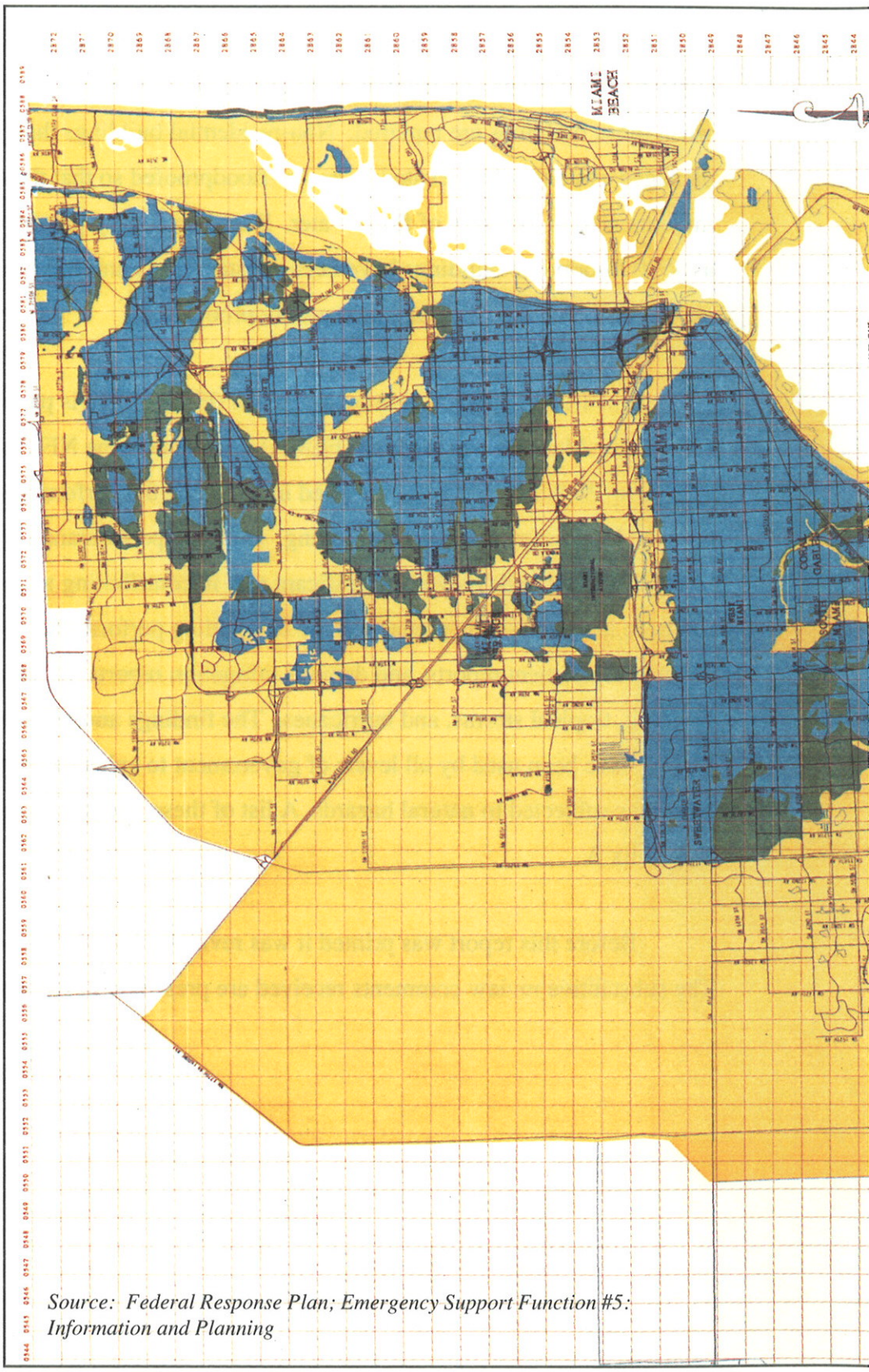
The National Flood Insurance Program (NFIP) was created by an Act of Congress in 1968 to make flood insurance available to property owners in floodprone areas in return for a community's commitment to enact and administer floodplain management regulations. These regulations require that new and substantially improved buildings in floodprone areas be built in such a manner as to reduce flood hazards and loss of life and property resulting from floods.

In 1972, Dade County was issued a Flood Insurance Rate Map (FIRM) from the NFIP that shows the flood zones in the county (SEE FIGURE 3 ON PAGES 12 AND 13). The community adopted, and began enforcing, NFIP-compliant floodplain management

regulations in 1974. An important provision that the county was required to include in its floodplain management regulations is the requirement that the lowest floor of substantially damaged residential buildings be elevated to the base flood elevation (BFE) when those buildings are repaired. Non-residential buildings that have been substantially damaged can either be elevated or be dry-floodproofed so that they are substantially impermeable to the entry of flood water. Based on county-provided estimates, as many as 4500 floodprone buildings have been substantially damaged by Hurricane Andrew and may have to be either elevated or dry-floodproofed.

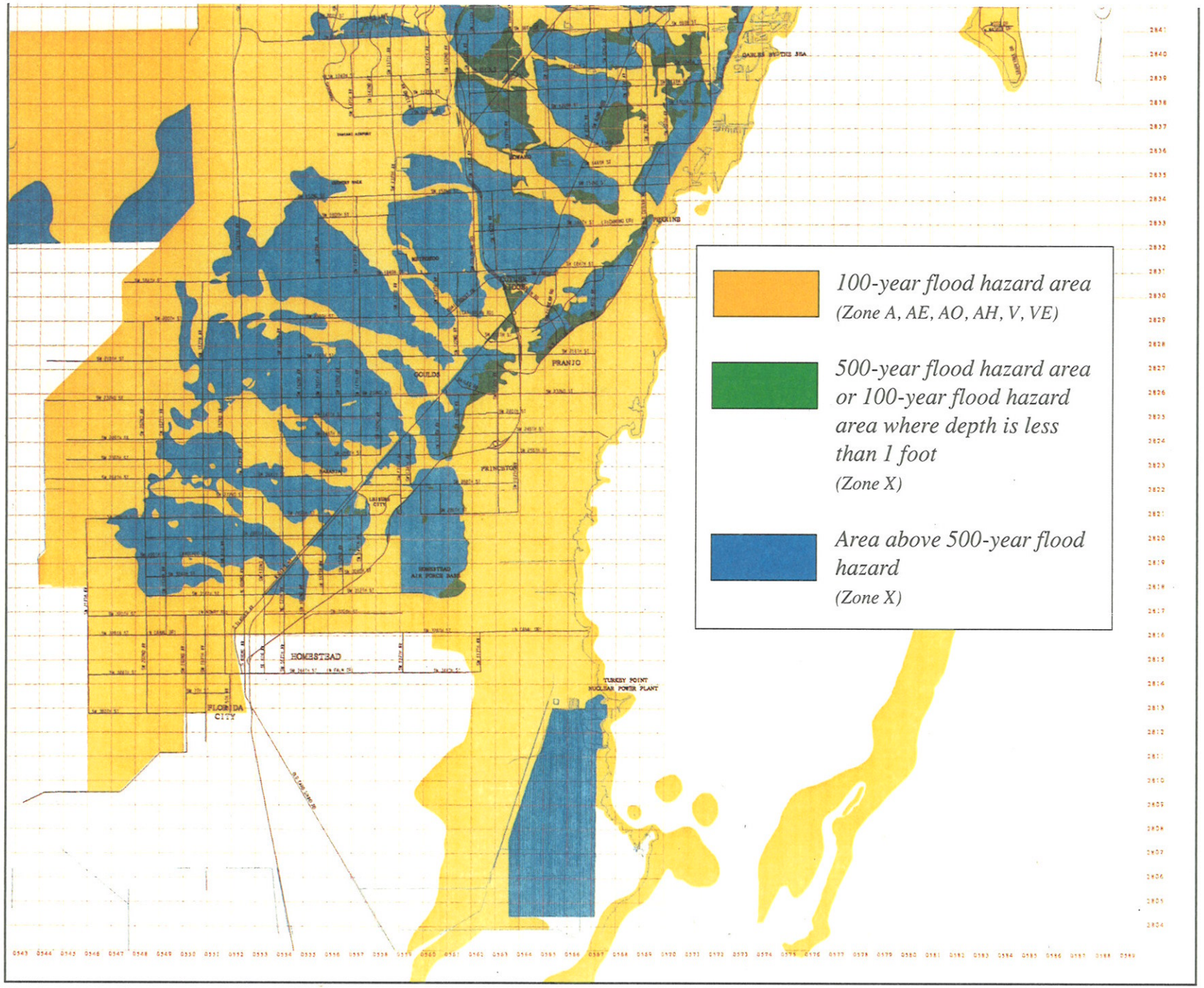
The Federal Insurance Administration (FIA), which is part of the Federal Emergency Management Agency (FEMA), administers the NFIP. Since the creation of FEMA in 1979, FIA has been involved in assessing the performance of buildings affected by riverine and coastal flooding. Building performance has also been assessed in cases where winds played a significant role in contributing to damages. To date, FIA has been involved in the preparation of 26 building performance assessment reports, damage assessment reports, and damage mitigation reports for areas subject to riverine flooding, tropical storms, and hurricanes. The findings and recommendations of these reports have been used by all levels of government to enhance the performance of buildings subjected to natural hazards. A list of these documents can be found in Appendix A.

Before this report was printed it was reviewed by other offices within FEMA. The substantive review comments received are presented in Appendix C.



Source: Federal Response Plan; Emergency Support Function #5: Information and Planning

FIGURE 3. *Dade County flood zones as identified on the Flood Insurance Rate Map*


100-year flood hazard area
(Zone A, AE, AO, AH, V, VE)
500-year flood hazard area or 100-year flood hazard area where depth is less than 1 foot
(Zone X)
Area above 500-year flood hazard
(Zone X)
HOMESTEAD
FLORIDA CITY
GOULDS
PRANTO
PRINCETON
HOMESTEAD AIR FORCE BASE
TURKEY POINT NUCLEAR POWER PLANT