METRO-DADE

Dade County Metropolitan Planning Organization
Dade County Office of Emergency Management

Post, Buckley, Schuh & Jernigan, Inc.
The Gothard Group, Inc.
Herbert Saffir Consulting Engineers
Marlin Engineering, Inc.

040090/95

DADE COUNTY TRANSPORTATION SYSTEM HURRICANE EMERGENCY PREPAREDNESS STUDY

Study Products

- Computerized Database Containing All System Inventories
- Report Listing Transportation Elements and Their Susceptibility to Hurricane Damage
- Storm Surge Atlases
- Maps Depicting the Location of Numerous Physical and Functional Transportation Facilities and Demographic Information Important for Hurricane Susceptibility.
- Report Documenting Behavioral Response and Evacuation Clearance Time Forecasts
- Recommendations for Agency Preparedness Plans and Training
- Appendices of Technical Methods and Data

INTRODUCTION

The Dade County Metropolitan Planning Organization (MPO) undertook a study to review, and where appropriate, enhance hurricane emergency preparedness planning addressing key elements of the Dade County area transportation system. The firm of Post, Buckley, Schuh & Jernigan, Inc. was retained by the MPO to lead the consultant team conducting the study, which was financed by US DOT Planning Emergency Relief (PLER) funds administered through the MPO. Project work was closely coordinated with the Dade County Office of Emergency Management (OEM), and integrated input from transportation planning, operating, and supporting agencies at local, state, and federal levels, as well as incorporating recently updated information from the South Florida Water Management District and the National Hurricane Center.

The objectives of the study were to systematically identify principal physical, functional, and personnel resources within the transportation system, to evaluate the system's ability and readiness to deal with hurricane events, and to review and assess procedures associated with transportation system hurricane preparedness and response. Principal tasks of the study were:

1. Inventory key transportation system components, pertinent of the transportation system, and key human resources of the system relevant to hurricane preparedness and response;

2. Assess susceptibility of transportation system to hurricane occurrence by evaluating exposure, vulnerability, and survivability issues; and

3. Review transportation system preparedness procedures and identify both effective and less effective points in them, and to develop and offer proposals for refinement.

Coordination between the MPO and the various transportation agencies was a key element in performing the study. Information was gathered from a number of sources at all levels, including:

Federal - FEMA- Federal Emergency Management Administration
State - Florida DOT, Florida Highway Patrol
County - MPO, OEM ,Transit Agency, and Departments of Public Works, Information Technology, Planning, Police, Fire, Seaport and Airport
City - Coral Gables, Hialeah, Homestead, Miami, Miami Beach, and North Miami

TASK 1

The first task inventoried the existing physical and functional condition of the transportation system within the study area. In addition, the key management and technical personnel designated for emergency preparedness and response of the transportation sector were identified. Information was gathered at Federal, State, County and City levels. Data collection and compilation would not have been successful without the valuable cooperation of these agencies.

Information from multiple sources was acquired and integrated within the County's ARC/INFO GIS, a Geographic Information System, to perform database development and facilitate maintenance, conduct analyses, and produce strongly effective, informative presentations. GIS

provides a vital capability to automate and enhance the kinds of spatial analyses, fundamental for purposes of transportation system hurricane preparedness planning and assessment.

GIS is a powerful tool which allows data from a wide and disparate variety of sources to be integrated based on location, then spatially analyzed, manipulated, and summarized, and finally presented in a map format or other graphical display. For the transportation system study, the GIS maps represent a compilation of principal physical elements, major functional components, and primary personnel data for the county transportation system, and incorporate important County demographic and geographic features and hurricane impact characteristics against which they are compared and analyzed. The database and maps variously address specific components such as roads and their features, traffic signals and their installation type, and typical structures; functional system elements, such as the local roadway network, and the transit system and includes siting agencies such as major local police and fire departments which support emergency situation transportation functions; and locating key personnel and staff of the major transportation operating agencies.

TASK 2

The second task evaluated the transportation system in three ways: what happens to the system before landfall as a result of the forecast and the reaction of the populace to it, what damages are incurred during the storm, and how the system functions after the hurricane has occurred. Evacuation forecasts were developed for a 1993 base year, and an innovative 2000 future year scenario. Existing conditions and system forecasts are portrayed using GIS technology. Assumptions regarding housing and population data, storm scenarios and evacuation areas, behavioral characteristics of the evacuating population, and the roadway network were fed into an intense transportation modeling effort to develop the evacuation forecasts.

Storm surge atlases were prepared showing potential limits and heights for a minimum of three hurricane categories. Maps depicting the locations of numerous physical and functional facilities important to the functioning of the transportation system immediately following a hurricane emergency are presented. A wind vulnerability analysis for key agency facilities and typical transportation elements was conducted by Dr. Herbert Saffir.

Also included is a wealth of demographic information important for hurricane susceptibility and evacuation analyses. A series of maps showing where people live and work in Dade County by various areal units, for 1990 (the Census year), 1993 (the base year), and 2000 (a future year projection) are offered.

The surge atlas, when combined with any previously developed facility or demographic maps, within a GIS environment, allows analyses important for identifying where both people and transportation facilities may be exposed to storm effects, and for initiating a *priori*, remedial actions which may help lessen damages during hurricanes, and allow quicker response in post-storm situations. Taking advantage of the GIS capabilities, hurricane wind impact tracks were superimposed on transportation system, population, and employment database variables to analyze the impact of different hurricane categories, storm tracks and wind speeds.

TASK 3

The third task provided an assessment of the existing emergency preparedness manuals of Metro-Dade County departments, local municipalities, and state agencies involved in supporting transportation system elements of the Dade County Plan. Guidelines as to how agencies can be better prepared to handle the impacts of hurricanes or other major emergencies upon the transportation system were developed.

Team Responsibilities

Post, Buckley, Schuh & Jernigan, Inc.

- Project Administration and Management
- Hurricane Storm Surge Analysis
- Hurricane Evacuation Modeling/Planning
- Data Assembly

Saffir Consulting Engineers

- Hurricane Wind Vulnerability Analysis

The Gothard Group

- Hurricane Recovery Issues/Priorities

Marlin Engineering

- Data Collection

THE EXHIBITS

The maps contained in this document serve to illustrate the results of several tasks performed during the course of the Dade County Transportation System Hurricane Emergency Preparedness Study.

Storm Surge Maps

One of the first tasks consisted of developing revised hurricane salt water surge flooding limits based upon application of the National Hurricane Center model for forecasting storm surges, combined with new information recently made available by the South Florida Water Management District and recent Dade County spot elevation data. The first map indicates the maximum inland extent of salt water flooding which is expected for three storm intensities, hurricanes of Saffir-Simpson Categories 1, 3, and 5. In addition to showing the sequential and increasing flooding anticipated with the increasingly strong storms, the map displays the thirteen County Commission Districts superimposed on the countywide surge atlas, illustrating the power of GIS system to integrate different geographic databases into a single presentation. In this case, the map facilitates the pre-storm estimation of where and to what extent potential storm surges my pose a threat to the urbanized area, and which of the County Commission Districts are most exposed to potential salt water inundation.

The second map depicts the twenty-eight local municipalities in Dade. By utilizing the GIS system, cross correlation of the municipal boundaries and the storm surge limits can be performed to show the potential for hurricane induced salt water flooding, and extent of the surge experienced, based on the strength of the storm.

The Storm Surge Atlas was the basis of determining the 1995 Hurricane Evacuation Areas depicted on the third map. While the evacuation areas have been expanded from those formerly slated for evacuation, based on information developed in the study, they do not exactly match areas potentially subject to flooding as presented in the surge atlas. The Dade County Office of Emergency Management (OEM), which is responsible County for hurricane preparedness, as well as for preparedness and response actions for other emergency situations, reviewed the surge atlas developed in the study to update the Countywide Evacuation Map. OEM staff determined that there may be areas which may experience a limited salt water intrusion that would not be life-threatening, and would therefore not be in need of evacuation. This updated atlas is an important product of the study, and provides an increased margin of safety for reducing potential surge impacts for residents.

Urban Infrastructure

The next three exhibits, the fourth, fifth, and sixth maps, represent three important facets of the County's infrastructure associated with both pre-storm preparedness efforts, and post-storm response actions.

The first of these maps depicts the locations of public hurricane shelters at the time that the data

was collected. The sites will most probably change over time, as new public shelter facilities are identified or developed. The GIS database can be easily updated or modified to reflect changes in the number, location, capacity of shelter sites within the Dade County, and new maps produced showing the updated revisions.

The next map shows the locations of the mobile home parks in Dade County. It is most important to know the locations and number of units at these sites, because they are the most vulnerable of all local residences to the potential wind and water impacts of hurricanes. In all but the mildest of events, residents of these parks will be evacuated, and by knowing their locations and estimates of their population, shelter needs required to provide refuge for mobile home residents can be logically planned. GIS greatly facilitates geographically matching shelter needs with capacity, as well as providing for updating records, thus assisting the emergency preparedness planning process.

The last of this series of infrastructures maps relates to the transportation system, and depicts the County's traffic signals, categorized by their location, and type of installation. The various types of installation are differently affected by hurricane winds; when cross-referenced with a potential storm's estimated strength, its approximate size, and its projected path, the number and locations of downed or damaged signals can be projected using GIS. Included in the database, but not shown on the map, is the type of signal controller at each signal. Controllers govern the signals, directing the length of time allotted to green and red signal phases and other aspects of automated traffic control, and are almost always located on ground-level at the intersection. When cross-referenced with the storm surge limits, it is possible to estimate the number of location of traffic signal controllers which may be flooded and damaged, based on the strength of the storm. With this knowledge, sites and requirements for manual traffic control by police or others subsequently can be much more accurately estimated and dispatched.

Analysis of a Hypothetical Hurricane

The next map depicts a hypothetical hurricane storm scenario. The storm track and the strength of the theoretical hurricane were chosen to illustrate a potentially worst-case scenario and to develop an analysis of what might be expected should such a strong storm make landfall near the downtown Miami and proceed northwesterly, threatening the most intensively developed part of the county. This is but one of a series of six scenarios tested, which vary the storm track and intensity, to assess the potential for damages to the transportation system, its infrastructure, its operations, and key personnel for selected transportation agencies. It is during such scenario testing where the true analytic power of GIS can be most fully applied. By employing GIS overlay, comparison, and segregation functions to separate areas subject to the bands of lesser, moderately strong, and most intense hurricane winds, a listing of the various transportation system elements and components exposed to the different strength winds can be prepared. Then, by calculating impacts on each of the affected physical elements and functional components of the transportation system by exposure category, an advance estimate of the impacts of the storm may be developed faster and far more efficiently than if manually performed. For example, knowing the locations of wire-strand traffic signals, combined with a test storm track enables both transportation and emergency management planners to forecast the severity of damage

expected and the number of downed signals to be repaired. Using GIS allows the emergency and transportation planning agencies to more rapidly propose, analyze, and estimate potential storm impacts before hurricane occurrence, thus enhancing both pre-storm preparedness and post-hurricane response readiness for a variety of potential storm situations.

Hurricane Evacuation Analysis

In the concluding tables and the final map essential evacuation modeling work performed during the Dade County Transportation System Hurricane Emergency Preparedness Study is illustrated. An intense modeling effort was performed to update outdated data and provide more current information to the Office of Emergency Management regarding hurricane evacuation.

The County was divided into a series of hurricane modeling zones, and a simplified transportation network of major streets and freeways was defined. The zones were specified to subdivide evacuation areas, and the population within each zone was totaled. For each of storm severity grouping, estimates of evacuating people and vehicles were developed based upon historic trends and more recent behavioral data acquired after Hurricane Andrew.

Three storm intensity groupings - a Category 1, a Category 2 and 3 group, and a Category 4 and 5 grouping - were modeled for a both base 1993 year and a 2000 future year. The latter was a unique and innovative approach, because estimating hurricane evacuation for a future year scenario is not normally performed in these types of studies. Evacuation response for each zone was estimated depending on the strength of the storm. Zone-by-zone evacuation responses were developed for those who would be expected to seek public shelters, for those who are anticipated to relocate to a friend's or relative's residence, and for those who could be expected to evacuate entirely out of Dade County. It should be noted that two evacuation areas were examined for each run: the first conformed to the previous 1994 evacuation areas. The second area included new areas, such as much of Kendall for a Category 5 evacuation notice, which would most probably be added as a result of new storm surge information. The latter added areas were largely encompassed by the new 1995 evacuation areas as defined by OEM. Other variables considered were three different response rates, as well as whether evacuation notice was given during peak travel hours, when background traffic would interfere with evacuation movements and extend the time needed to clear the road of evacuating vehicles, or whether evacuation was called for during non-peak periods. The evacuating vehicles were then assigned to the transportation network and routed to their respective destinations. Estimates of the level of congestion, and the clearance time necessary for all vehicles to reach their destinations, were then calculated.

The final map exhibits the anticipated ratios of the number of evacuating vehicles in relation to roadway capacities for the major highways links in Dade for the case of a Category 5 strength hurricane approaching the County, and the corresponding order for certain zones to evacuate. The resulting map graphically illustrates at a system level which roads would be expected to be the most heavily utilized during the evacuation, and where the highest levels of congestion would be expected to occur.

PROJECT SUMMARY

The Dade County MPO, using US DOT PLER funds obtained in the wake of Hurricane Andrew, the most devastating natural disaster to occur in the US to that time, initiated the Transportation System Hurricane Emergency Preparedness Study described in this document.

In close coordination with the Dade County Office of Emergency Management and the National Hurricane Center, and with the considerable cooperation of numerous local transportation and transportation-associated agencies, the project was completed in June 1995.

The objectives of the study were to systematically identify significant physical, functional, and personnel resources within the transportation system serving the County, to evaluate the various constituent parts of the system for hurricane exposure and damage potential, and to review and assess procedures concerned with hurricane preparedness for major agencies in the County transportation sector. The three principal tasks were to first inventory key facility and personnel resources relevant to hurricane preparedness, then assess susceptibility of identified components to hurricane by evaluating exposure, vulnerability, and survivability issues associated with each, and finally to review current transportation system agency preparedness plans and propose refinements to them.

The following narrative summarizes each of the main task efforts and findings, and presents a synopsis of the study's conclusions.

1. Transportation System Inventory

An inventory of the existing physical elements and functional components of the transportation system as well as the human resources designated for emergency preparedness and response was conducted. To accomplish this task, the research effort consisted of data collection including surveys and field observations. Information was gathered at Federal, State, County and City levels. After the data was collected, a database was developed within a computerized Geographical Information System (GIS), to automate the analysis of the data for the purpose of hurricane preparedness planning assessments and to simplify maintenance of the database. It includes survey results of building structures, and emergency management and response equipment for the agency related to the transportation system's emergency operation. The database also comprises an inventory of the roadway network which includes roadway identification, width, number of lanes, median type and width, shoulder type and width, traffic signal installation and control types, guide signs locations and structures. Existing and future year demographic information and personnel resources for hurricane emergency management and responses were assembled as well. The database should be conceptually viewed as a working file representing only existing conditions to date, requiring periodic updating, to maintain continuing applicability for hurricane preparedness.

2. Analysis of Hurricane Impacts

After the data was collected, analyses of potential wind and storm surge damages to the inventoried transportation system resources were performed. Analyses also include an evaluation of the potential impact on County's population and employment.

A major product of the study was the development of a new storm surge atlas showing potential limits and inundation levels for three hurricane categories. This atlas was the basis for determining the revised 1995 Hurricane Evacuation Areas. The Dade County Office of Emergency Management (OEM) reviewed the atlas and updated the County wide evacuation map and the evacuation areas were expanded to reflect the new surge limits. The inventory elements were superimposed in the surge limits to identify the extent to which both people and transportation facilities may be exposed to hurricane storm surge impacts. The analysis may help lessen damages during hurricanes, and facilitate a more prompt response in post storm situations.

A wind vulnerability analysis for key agency facilities was performed by Dr. Herbert Saffir. A series of hypothetical storm tracks was superimposed on GIS-based graphical representations of the transportation system elements, population, and employment databases. It is during such storm track testing where the true analytic power of GIS can be most fully explored. Calculations were performed on each of the various physical elements and functional components by exposure category, and a *priori* estimates of systemic impacts of the storms were developed far more efficiently than if manually executed.

The study developed an innovative approach to integrate GIS technology with the PBS&J -developed Hurricane Evacuation Clearance Time Model that has greatly enhanced the portrayal of the objectives of the model, which included defining the evacuation road network, reviewing general traffic control issues affecting traffic flow along critical roadway segments, and estimating evacuation clearance trips and time for a number of different scenarios for base and future years. Assumptions regarding the roadway network, housing and population, storm surge impact, and behavioral response characteristics of the evacuation population were fed into a detailed transportation modeling process which produced estimates of evacuation clearance times. Estimates were developed for a 1993 base year, and projections for an innovative year 2000 future scenario. For example, for the year 2000 it is projected that up to 945,000-1,237,000 people may evacuate for a Category 4-5 Hurricane. These figures represent those persons who would be directed to evacuate by the Office of Emergency Management as well as those who might evacuate on a discretionary basis, based on historical behavioral responses.

Potential public shelter demand associated with these numbers of Dade residents leaving their dwelling units ranges from 40,000 to 180,000 people for the year 2000. With a current public shelter demand capacity of roughly 50,000 spaces in Dade County, residents must understand the limits of local shelter resources and be encouraged to seek the home of a friend or relative in a non-surge flooded area. Likewise, new school projects, whether renovations or new construction, should be designed with hurricane

sheltering in mind.

In addition, the study quantified the forecast number of evacuating vehicles by evacuation road segment. Those segments having the most significance for clearance of time calculations were identified. Evacuation clearance times in Dade County for the future year 2000 range from 10 to 13 hours for a Category 1 hurricane, 14 to 23 hours for a Category 2-3 hurricane, and 33 to 45 hours for a Category 4-5 hurricane.

Looking at the statewide picture for a hypothetical Category 4-5 Hurricane impacting most of South Florida and part of the Tampa Bay area, the interchange of Florida Turnpike and I-75 at Wildwood is the major choke point for hurricane evacuation.

It is recommended that the roadways identified as most congested during evacuations should be evaluated for improvement projects in both short range and long range transportation planning activities. Additionally major development projects that are proposed for a Category 1 hurricane evacuation area should receive more scrutiny than projects in other areas of the county.

3. Review of Preparedness Procedures

Following analyses performed in prior tasks, existing emergency preparedness manuals were reviewed to assess how hurricane planning and readiness for the transportation system and its infrastructure were addressed. The manuals reviewed included the five most populated cities in Dade County, agencies in the transportation sector such as Dade County Public Works and the Metro-Dade Transit Agency, non-transportation agencies such as the Metro-Dade Police Department, and state agencies such as Florida Department of Transportation. Overall, the county, city and state agency plans reviewed addressed all the key elements such as purpose of the plan, action priorities, and other pivotal areas. Several plans contained information that is recommended for use in all plans, such as a reference list of legal authorities on which the plan is based, damage assessment forms and instructions, and procedures for requesting assistance and tracking expenditures. The plan review was not intended to diminish the value of the existing agency plans but rather to gauge whether the plans contain specific information relevant to the successful implementation of emergency response actions.

The first step toward improved emergency preparedness is enhancing coordination between agencies to avoid duplication of both emergency preparation and response activities and to increase effectiveness. Another major facet of preparing for major emergencies is an assessment of, and then development and implementation of, a management plan for equipment, supply, and personnel resources of an agency. This orderly and planned approach can save precious time and allow response efforts to be more effective during potentially chaotic emergency situations.

Perhaps the most valuable resource an agency must monitor and manage throughout an emergency is its personnel. In emergency conditions, extraordinary efforts and sacrifices

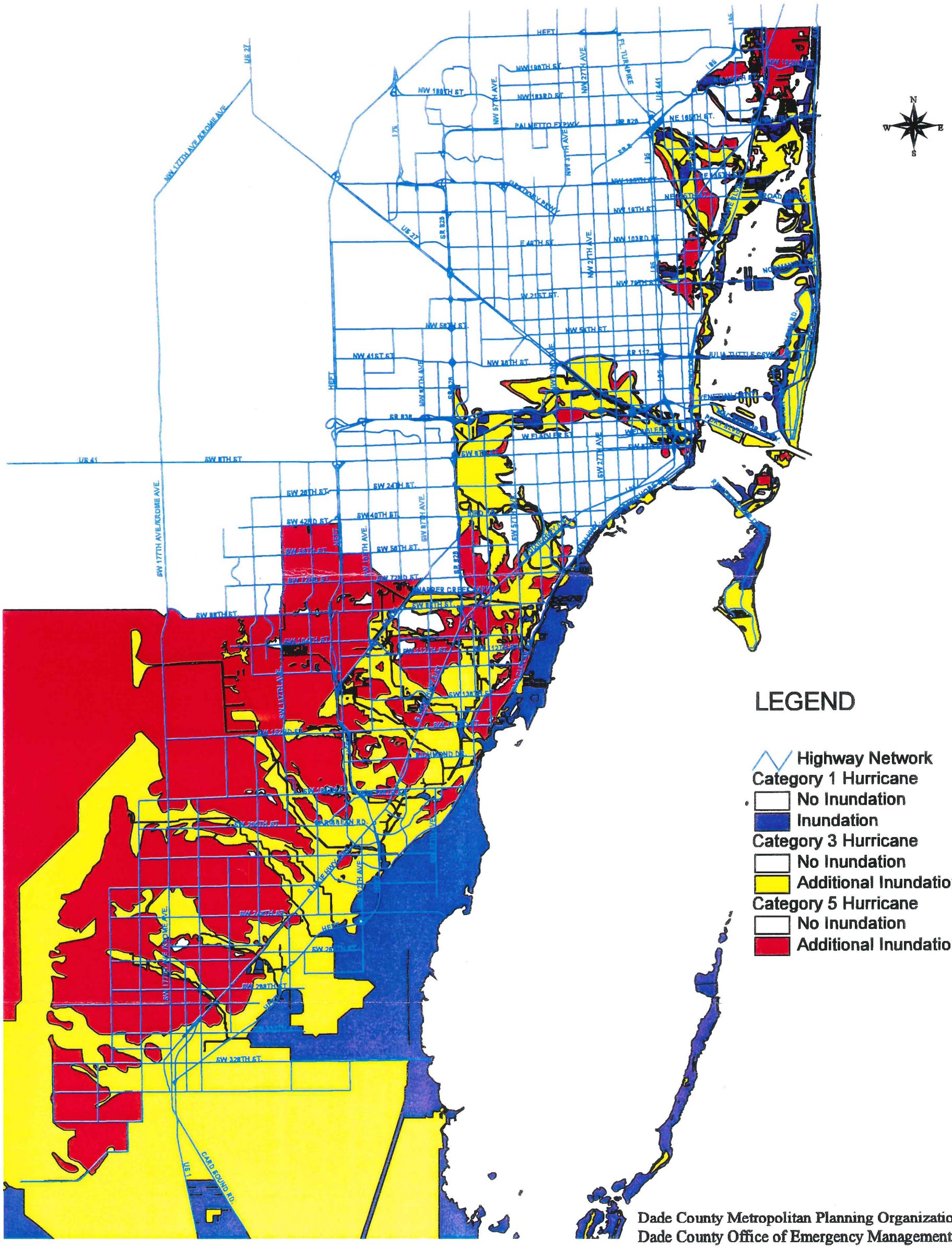
are often experienced by and called for on the part of agency employees. Agencies need to monitor their employees and have means of rotating them out for rest and to possibly attend details of personal impacts of hurricane emergencies.

Finally, the most important overall factor which must be considered is the public. The public wants and needs accurate, timely and credible information, and a functioning transportation system. Therefore, transportation agencies need to be prepared to effectively collect and disseminate travel and transportation system status information to the pubic during emergencies, and to respond in an organized manner to restore operation as quickly as possible.

CONCLUSION

This study has assembled several basic sets of data which define key elements of the Dade County Transportation System, and which also define the potential exposure of Dade County to hurricane impacts as a result of different hurricane storm intensities and tracks. By combining these data bases, emergency planners and transportation system staff can now better identify the level of potential impact from hypothetical hurricanes, or from an actual hurricane just before landfall. These analyses will permit decisions to be made for general hurricane preparedness in response to future hurricanes in general, and to individual storms specifically that should lead to better emergency planning and more effective response. By quantifying potential impacts, the community will be able to target its response and enhance its ability to deal with the effects. The framework, the transportation network and all its support elements for urban mobility, is a crucial component of hurricane preparedness, hurricane evacuation, and hurricane response. It provides the channels for reaching a safer location, for supplying emergency relief, and for the movement of supplies and resources to support recovery and reconstruction. As such, the results of this study will enable Dade County to move more effectively, and to better manage its transportation resources, to fulfill these important roles in the event of future hurricanes striking Dade County.

Dade County Hurricane Surge Limits



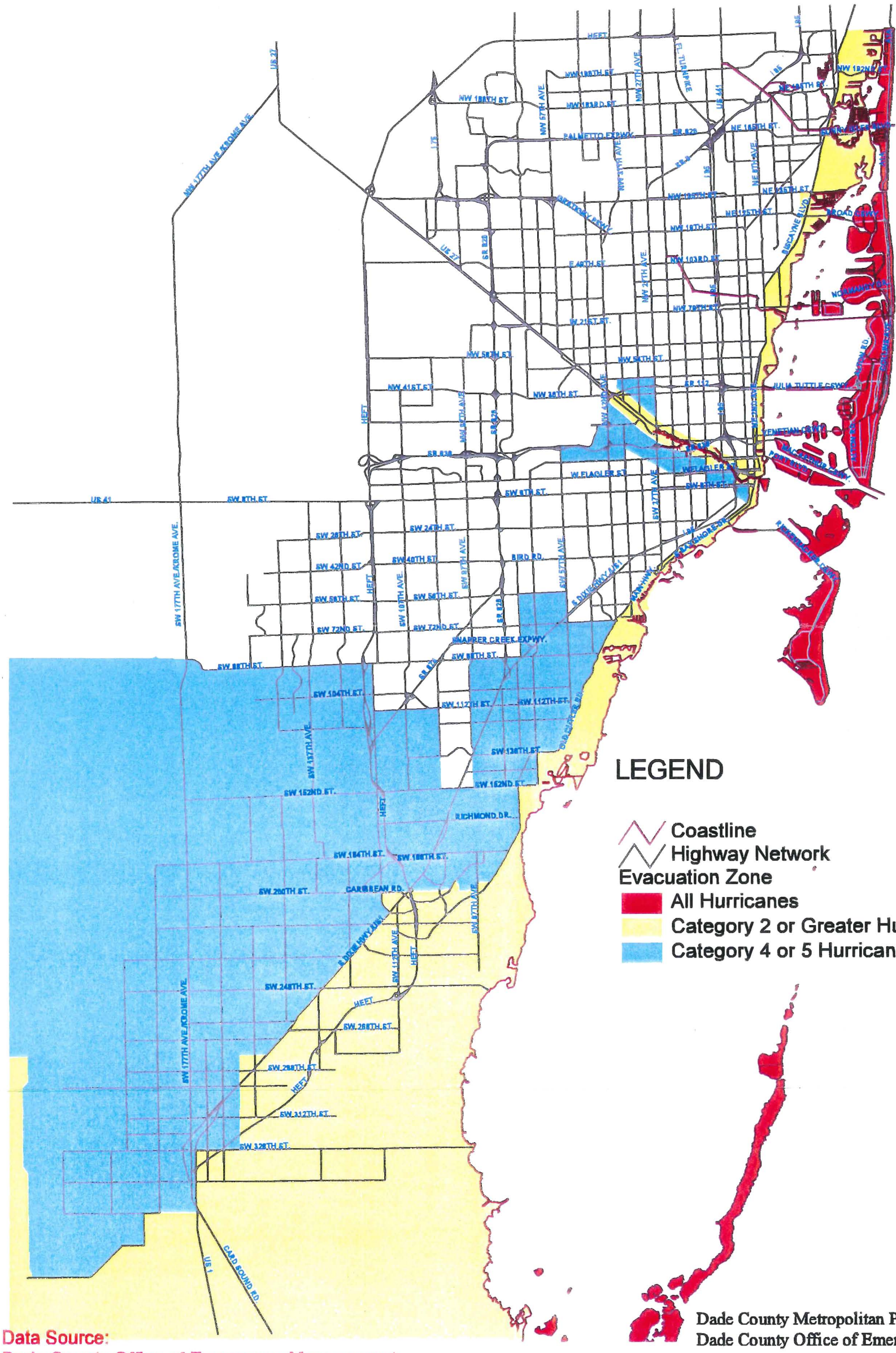
Dade County Metropolitan Planning Organization
Dade County Office of Emergency Management

PBSJ POST, BUCKLEY, SCHUH & JERNIGAN, INC.

Dade County Transportation System
Hurricane Emergency Preparedness Study

METRO-DADE

1995 Hurricane Evacuation Map



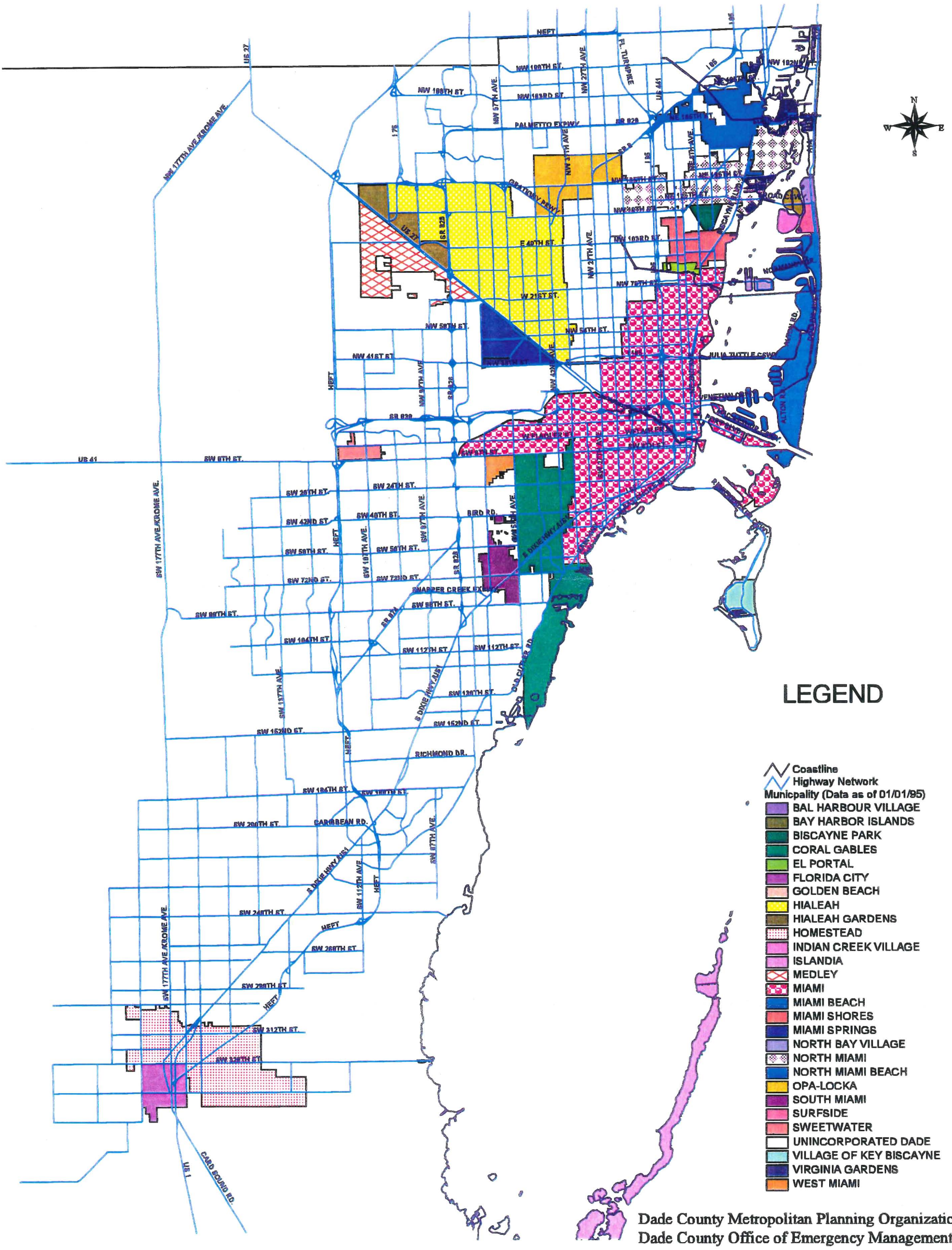
Data Source:
Dade County Office of Emergency Management

PBSJ POST, BUCKLEY, SCHUH & JERNIGAN, INC.

Dade County Transportation System
Hurricane Emergency Preparedness Study

METRO-DADE

Dade County Municipalities



LEGEND

- Coastline
- Highway Network

Municpality (Data as of 01/01/95)

- BAL HARBOUR VILLAGE
- BAY HARBOR ISLANDS
- BISCAYNE PARK
- CORAL GABLES
- EL PORTAL
- FLORIDA CITY
- GOLDEN BEACH
- HIALEAH
- HIALEAH GARDENS
- HOMESTEAD
- INDIAN CREEK VILLAGE
- ISLANDIA
- MEDLEY
- MIAMI
- MIAMI BEACH
- MIAMI SHORES
- MIAMI SPRINGS
- NORTH BAY VILLAGE
- NORTH MIAMI
- NORTH MIAMI BEACH
- OPA-LOCKA
- SOUTH MIAMI
- SURFSIDE
- SWEETWATER
- UNINCORPORATED DADE
- VILLAGE OF KEY BISCAYNE
- VIRGINIA GARDENS
- WEST MIAMI

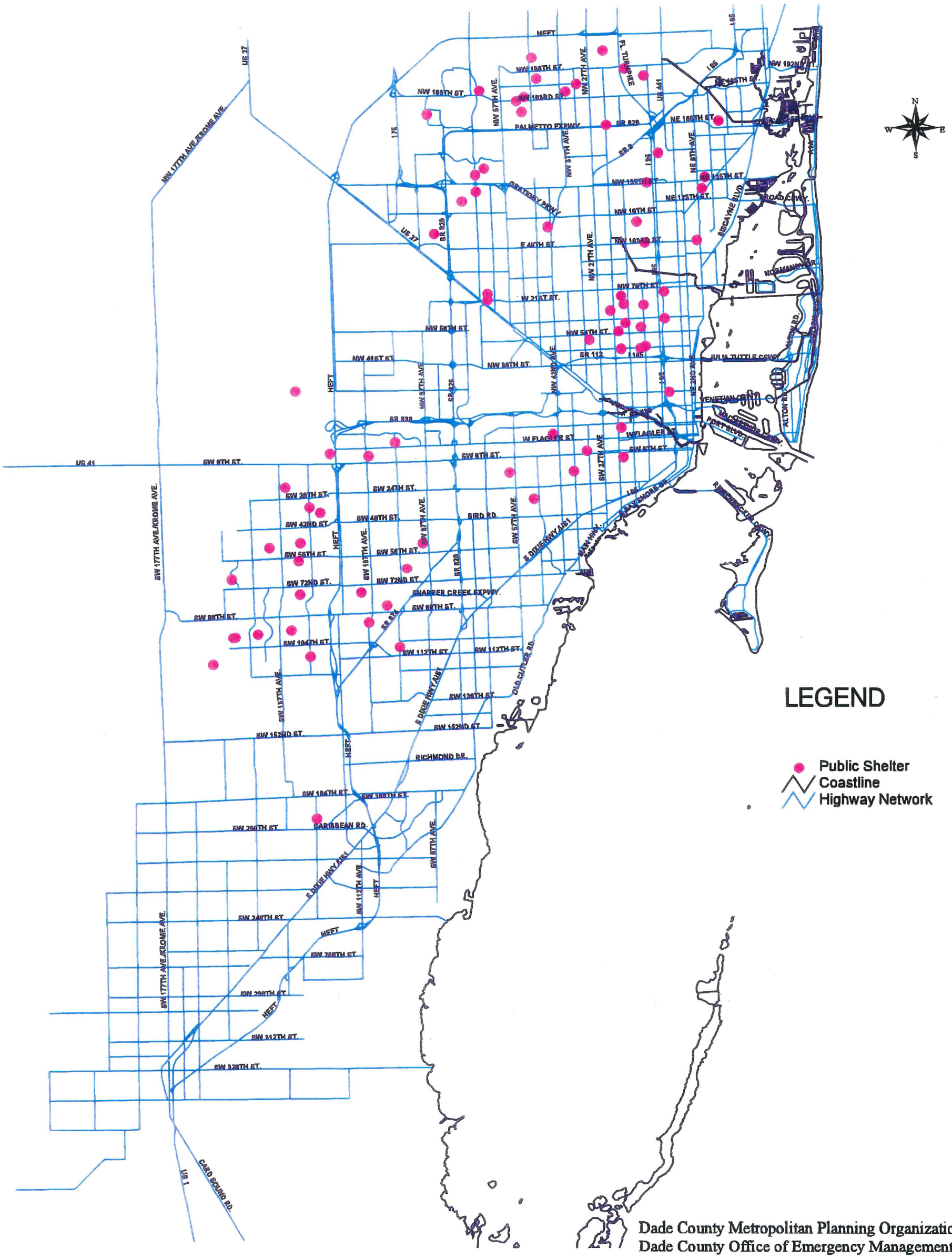
Dade County Metropolitan Planning Organization
Dade County Office of Emergency Management

PBSJ POST, BUCKLEY, SCHUH & JERNIGAN, INC.

Dade County Transportation System
Hurricane Emergency Preparedness Study

METRO-DADE

Dade County Public Hurricane Shelters



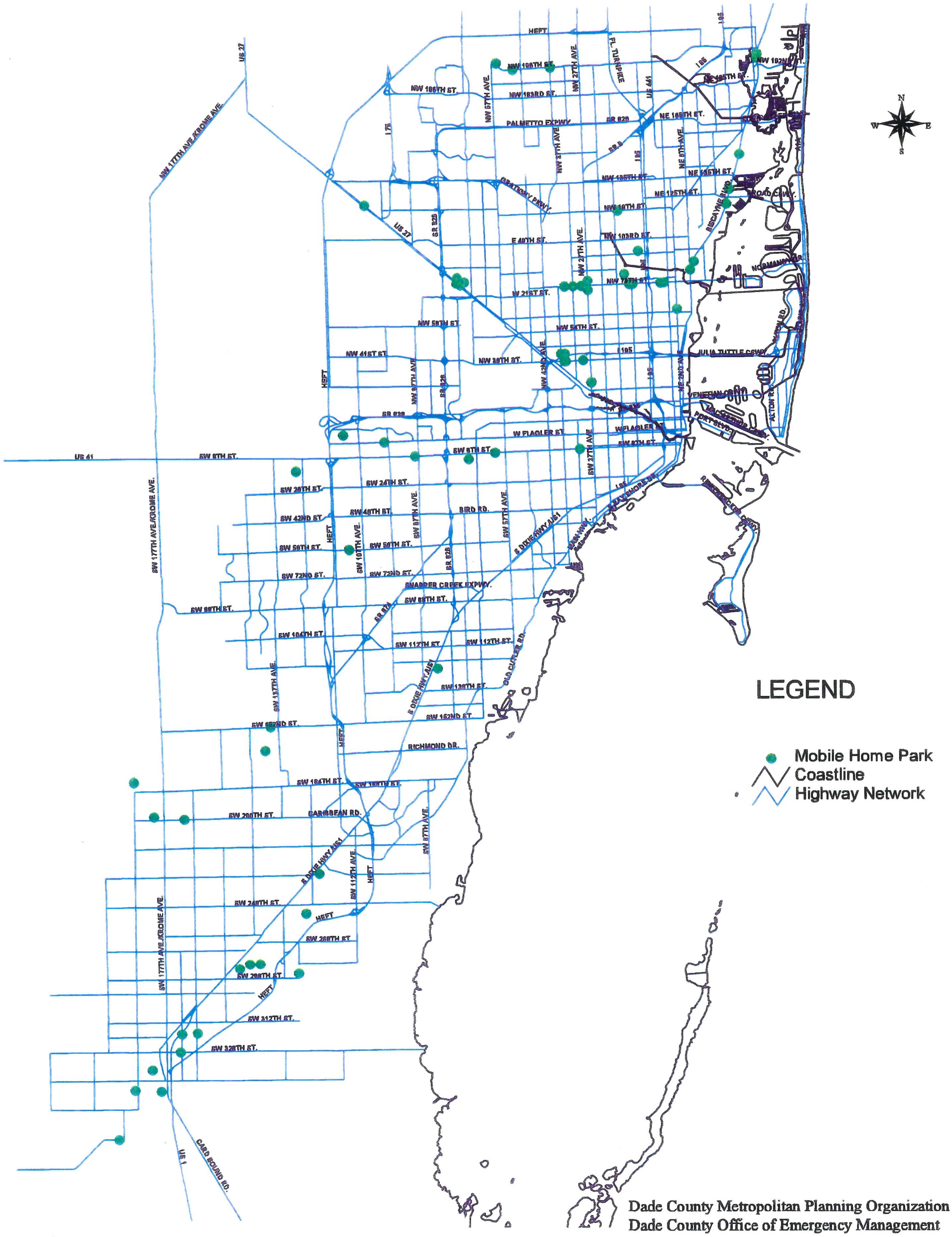
Dade County Metropolitan Planning Organization
Dade County Office of Emergency Management

PBS&J POST, BUCKLEY, SCHUH & JERNIGAN, INC.

Dade County Transportation System Hurricane Emergency Preparedness Study

METRO-DADE

Dade County Mobile Home Parks



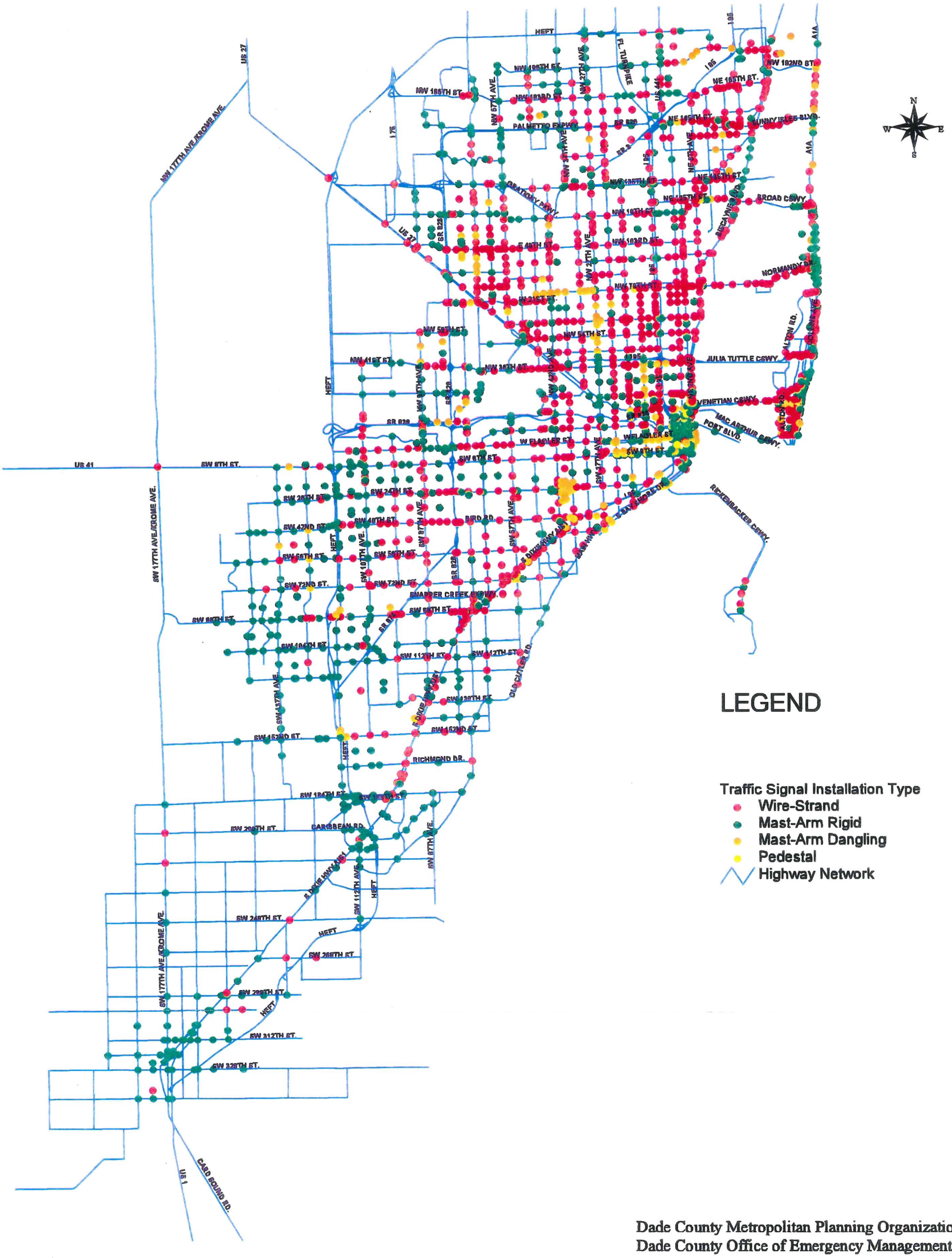
Dade County Metropolitan Planning Organization
Dade County Office of Emergency Management

PBSJ POST, BUCKLEY, SCHUH & JERNIGAN, INC.

Dade County Transportation System
Hurricane Emergency Preparedness Study

METRO-DADE

Traffic Signal Installation Types



LEGEND

Traffic Signal Installation Type

- Wire-Strand
- Mast-Arm Rigid
- Mast-Arm Dangling
- Pedestal
- Highway Network

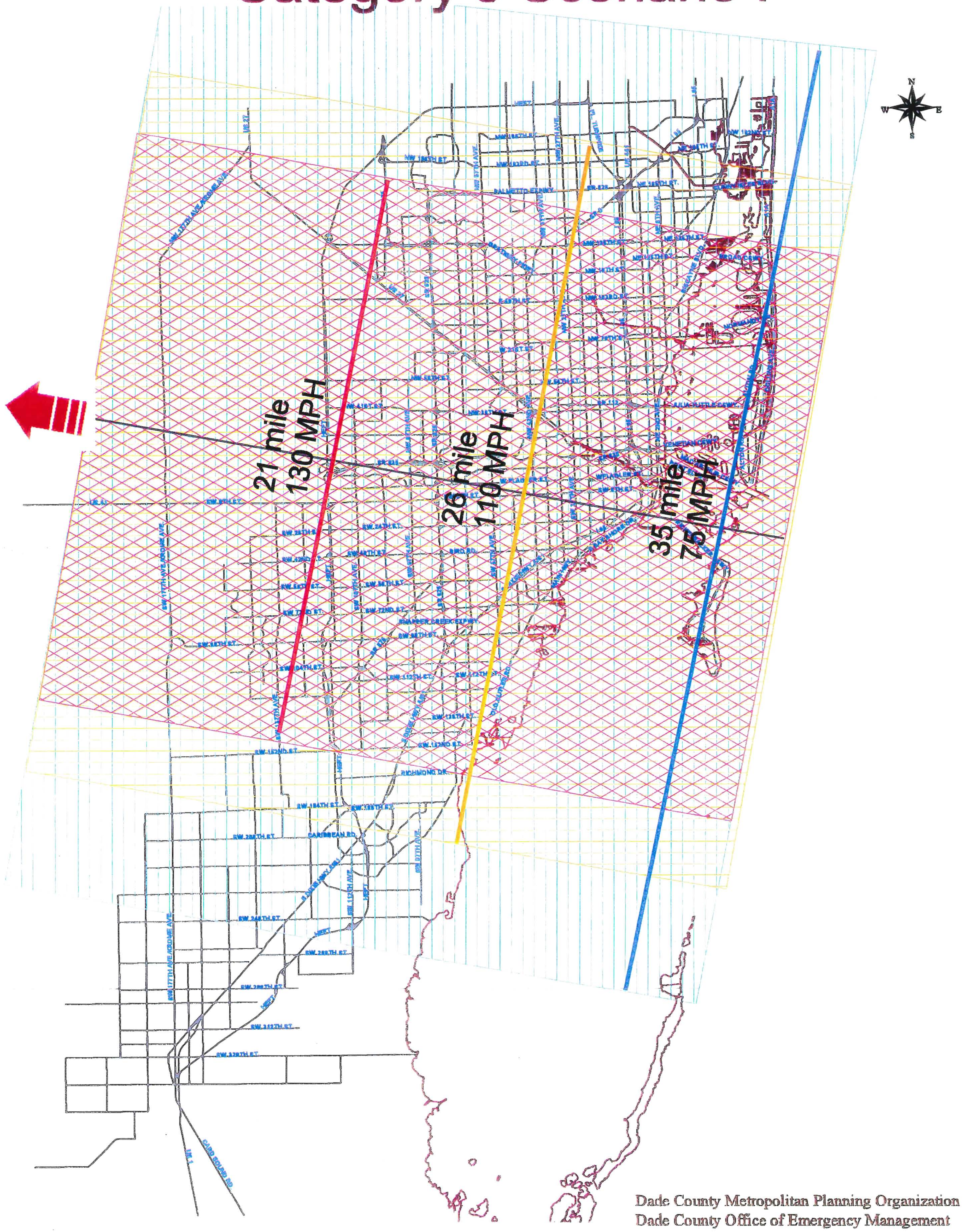
Dade County Metropolitan Planning Organization
Dade County Office of Emergency Management

PBS&J POST, BUCKLEY, SCHUH & JERNIGAN, INC.

Dade County Transportation System Hurricane Emergency Preparedness Study

METRO-DADE

Hurricane Impact Analysis - Category 5 Scenario I

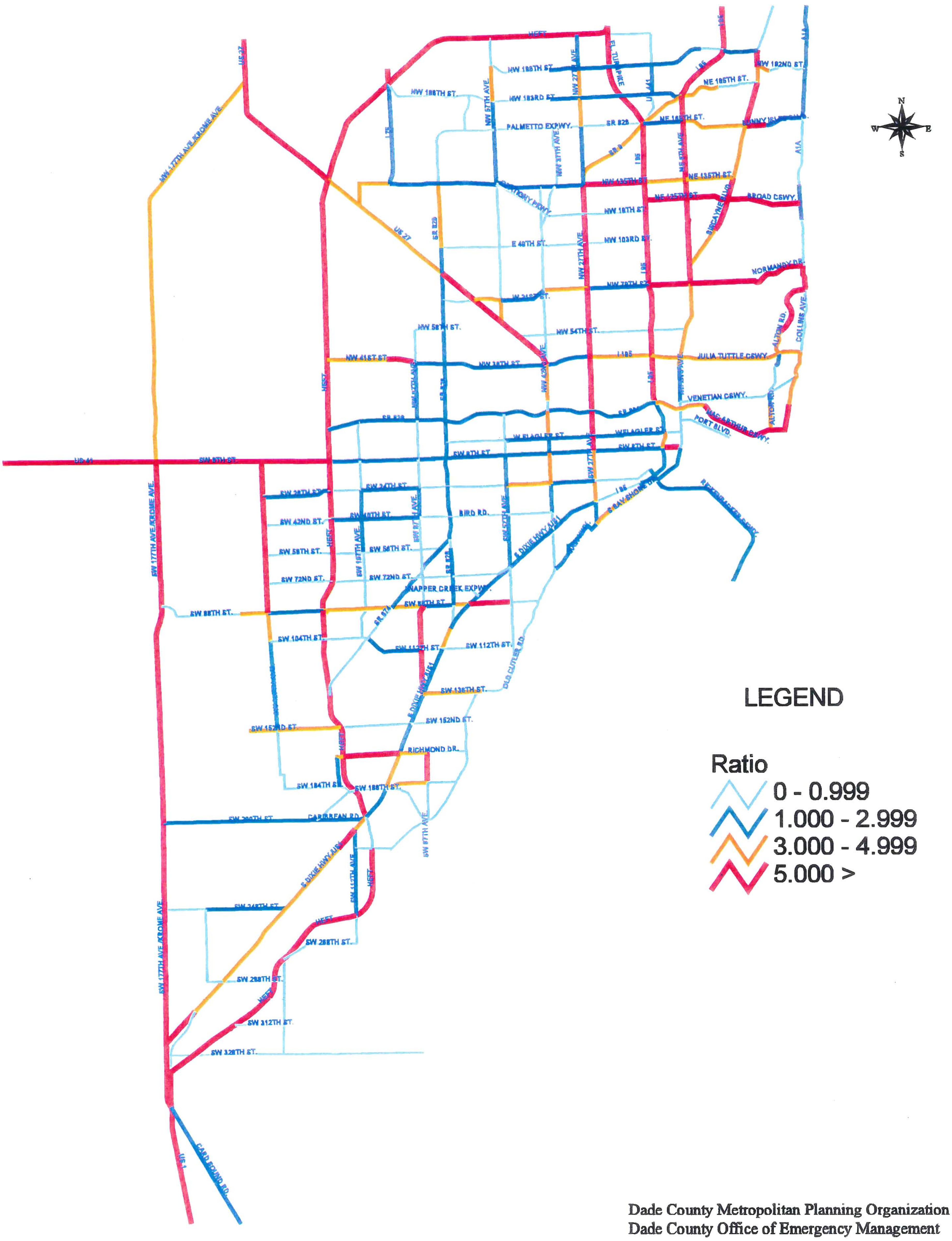


Dade County Transportation System
Hurricane Emergency Preparedness Study

PBSJ POST, BUCKLEY, SCHUH & JERNIGAN, INC.

METRO-DADE

1993 Evacuating Vehicles
To Service Volume Ratio - Category 4 & 5 Hurricanes



Dade County Metropolitan Planning Organization
Dade County Office of Emergency Management

PBSJ POST, BUCKLEY, SCHUH & JERNIGAN, INC.

Dade County Transportation System
Hurricane Emergency Preparedness Study

METRO-DADE

1993 BASE YEAR EVACUATING PEOPLE AND VEHICLE STATISTICS
BY STORM SCENARIO
Dade County Transportation System Hurricane
Emergency Preparedness Study

Scenario	Maximum People Leaving Dwelling Units*	Potential Public Shelter Demand	Vehicles Leaving Dwelling Units
Category 1 Hurricane			
Existing Evac Area - Base Participation Rates	316,600 people	33,100 people	133,000 vehicles
Existing Evac Area - Increased Participation Rates	410,500	50,300	169,000
Category 2-3 Hurricane			
Existing Evac Area - Base Participation Rates	560,500	67,800	229,200
Existing Evac Area - Increased Participation Rates	716,100	97,900	290,000
Expanded Evac Area - Base Participation Rates	641,000	80,700	259,500
Expanded Evac Area - Increased Participation Rates	795,100	110,900	317,400
Category 4-5 Hurricane			
Existing Evac Area - Base Participation Rates	780,800	100,300	312,400
Existing Evac Area - Increased Participation Rates	934,200	130,900	370,000
Expanded Evac Area - Base Participation Rates	869,400	117,700	345,900
Expanded Evac Area - Increased Participation Rates	1,025,100	148,800	404,400

* includes 100% of dwelling units in areas evacuated for potential life threatening storm surge flooding and all mobile home units; depending upon the scenario and zone location 5 to 20% of other residents are assumed to evacuate for the category 1 hurricane; 10 to 35% of other residents for the category 2-3 hurricane; and 15 to 65% of other residents for the category 4-5 hurricane.

YEAR 2000 BASE YEAR EVACUATING PEOPLE AND VEHICLE STATISTICS BY STORM SCENARIO
Dade County Transportation System Hurricane Emergency Preparedness Study

Scenario	Maximum People Leaving Dwelling Units*	Potential Public Shelter Demand	Vehicles Leaving Dwelling Units
Category 1 Hurricane			
Existing Evac Area - Base Participation Rates	365,000 people	39,600 people	152,900 vehicles
Existing Evac Area - Increased Participation Rates	478,600	60,300	196,400
Category 2-3 Hurricane			
Existing Evac Area - Base Participation Rates	664,100	81,500	270,200
Existing Evac Area - Increased Participation Rates	856,800	118,600	342,700
Expanded Evac Area - Base Participation Rates	757,800	96,400	305,600
Expanded Evac Area - Increased Participation Rates	940,700	132,100	374,300
Category 4-5 Hurricane			
Existing Evac Area - Base Participation Rates	945,200	121,500	376,400
Existing Evac Area - Increased Participation Rates	1,127,300	157,900	444,800
Expanded Evac Area - Base Participation Rates	1,053,700	142,800	417,500
Expanded Evac Area - Increased Participation Rates	1,236,900	179,500	486,300

* includes 100% of dwelling units in areas evacuated for potential life threatening storm surge flooding and all mobile home units; depending upon the scenario and zone location 5 to 20% of other residents are assumed to evacuate for the category 1 hurricane; 10 to 35% of other residents for the category 2-3 hurricane; and 15 to 65% of other residents for the category 4-5 hurricane.

1993 BASE YEAR HURRICANE EVACUATION CLEARANCE TIMES*
Dade County Transportation System Hurricane
Emergency Preparedness Study

CATEGORY 1 SCENARIOS	Base Participation peak / offpeak	Increased Participation peak / offpeak
Existing Evacuation Areas		
Rapid Response	10¼ / 9¼ hours	10¼ / 9¼ hours
Medium Response	11½ / 9¾	11½ / 9¾
Long Response	13 / 11	13 / 11
CATEGORY 2-3 SCENARIOS		
Existing Evacuation Areas		
Rapid Response	10¼ / 9¼	14¾ / 14
Medium Response	11½ / 9¾	15½ / 14½
Long Response	13 / 11	17 / 15
Expanded Evacuation Areas		
Rapid Response	12 / 11¼	15¾ / 15
Medium Response	12½ / 11¾	16¼ / 15¼
Long Response	13½ / 12½	17¼ / 16
CATEGORY 4-5 SCENARIOS		
Existing Evacuation Areas		
Rapid Response	23¼ / 22½	28¼ / 27½
Medium Response	24 / 22¾	28¾ / 27¾
Long Response	25 / 23¼	29¾ / 28
Expanded Evacuation Areas		
Rapid Response	26½ / 25¾	30¾ / 30
Medium Response	27¼ / 26	31½ / 30¼
Long Response	28 / 26¼	32¼ / 30½

* times reported under the column entitled "peak" refer to evacuation situations where levels of background traffic at the start of an evacuation are similar to peak period traffic levels on a typical workday; "off-peak" refers to evacuation situations where background traffic is light at the start of an evacuation; rapid, medium, and long response refer to the rate at which people respond to evacuation advisories and enter the road network. Response over a period less than five hours is rapid, medium is less than nine hours, and long is greater than nine hours. Clearance time refers to the amount of time needed to clear Dade County roadways of all evacuating vehicles and not the time any one vehicle spends on the network.

YEAR 2000 BASE YEAR HURRICANE EVACUATION CLEARANCE TIMES*
Dade County Transportation System Hurricane
Emergency Preparedness Study

CATEGORY 1 SCENARIOS	Base Participation peak / offpeak	Increased Participation peak / offpeak
Existing Evacuation Areas		
Rapid Response	10½ / 9½ hours	10½ / 9½ hours
Medium Response	11½ / 10	11½ / 10
Long Response	13 / 11	13 / 11
CATEGORY 2-3 SCENARIOS		
Existing Evacuation Areas		
Rapid Response	15 / 14¼	20¾ / 20
Medium Response	15¾ / 14½	21½ / 20¼
Long Response	16¾ / 15¼	22½ / 20¾
Expanded Evacuation Areas		
Rapid Response	17¼ / 16½	22 / 21
Medium Response	18 / 16¾	22½ / 21¼
Long Response	19 / 17¼	23½ / 21¾
CATEGORY 4-5 SCENARIOS		
Existing Evacuation Areas		
Rapid Response	33¼ / 32½	39½ / 38¾
Medium Response	34 / 32¾	40¼ / 39
Long Response	35 / 33	41¼ / 39¼
Expanded Evacuation Areas		
Rapid Response	37¾ / 37	43¾ / 43
Medium Response	38½ / 37¼	44½ / 43¼
Long Response	39½ / 37½	45½ / 43½

* times reported under the column entitled "peak" refer to evacuation situations where levels of background traffic at the start of an evacuation are similar to peak period traffic levels on a typical workday; "off-peak" refers to evacuation situations where background traffic is light at the start of an evacuation; rapid, medium, and long response refer to the rate at which people respond to evacuation advisories and enter the road network. Response over a period less than five hours is rapid, medium is less than nine hours, and long is greater than nine hours. Clearance time refers to the amount of time needed to clear Dade County roadways of all evacuating vehicles and not the time any one vehicle spends on the network.

PROJECT CONTACTS

Metropolitan Planning Organization

Mr. Frank Baron
MPO Secretariat - 9th Floor
Stephen Clark Government Center
111 N.W. 1st Street
Miami, Florida 33128
Phone: *305/375-1522*
Fax *305/375-4950*

Post, Buckley, Schuh & Jernigan, Inc.

Jack S. Schnettler, P.E.
Post, Buckley, Schuh & Jernigan, Inc.
2001 N.W. 107th Avenue
Miami, Florida 33172
Phone: *305/592-7275 x-369*
Fax *305/593-5337*

Don Lewis
Post, Buckley, Schuh & Jernigan, Inc.
314 North Calhoun Street
Tallahassee, Florida 32301
Phone: *904/224-7275*
Fax *904/224-8674*