



Analysis of Florida's One-Way Operations for Hurricane Evacuation

Compendium of Route By Route Technical Memoranda

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ANALYSIS OF FLORIDA'S ONE-WAY OPERATIONS FOR HURRICANE EVACUATION

Compendium of Route-by-Route Technical Memoranda

The largest evacuation in Florida's history occurred as the result of Hurricane Floyd in September 1999. Although all of Florida's evacuees were able to evacuate without harm, many spent long hours on congested highways with inadequate guidance on where to go to seek shelter. Long evacuation travel times raised questions as to the need and feasibility of reverse laning limited access facilities to reduce these times. To address these issues, Governor Jeb Bush appointed a Governor's Hurricane Evacuation Task Force, which was chaired by Walter Revell of H. J. Ross Associates, Inc.

The Task Force assigned a traffic management team the responsibility of conducting meetings around the state and identifying routes that might warrant one-way evacuation operations during a major hurricane threat. Seven routes were identified as follows:

- I-10 westbound - Jacksonville to Tallahassee
- I-10 eastbound - Pensacola to Tallahassee
- I-4 eastbound - Tampa to Orange County line
- I-75 northbound - Charlotte County to I-275
- Florida's Turnpike northbound - Ft. Pierce to Orlando
- State Road 528 westbound - SR 520 to SR 417
- I-75 Alligator Alley east and westbound - coast to coast

I-75 from I-275 to Wildwood was added as a result of the recently completed Tampa Bay Regional Hurricane Evacuation Study. I-10 eastbound from Pensacola to Tallahassee has been dropped due to need for bi-directional evacuation movements on I-10 in the Panhandle.

Throughout the process of analyzing each contraflow route in 2000-2001, FDOT and its consultant have learned that the review of contraflow plans must be an iterative and continuing process that recognizes changing geometrics, law enforcement priorities, resource availability, and evolving evacuation travel behavioral trends. Reports produced for each analyzed contraflow route have been developed at a planning level of analysis, which has helped to identify the benefits/disbenefits and general operational feasibility of each section. It has been suggested by some of the FDOT district staff that a more detailed engineering and design level of analysis be performed on each route as monies and schedule permit. In that regard, it is strongly recommended that a detailed review cycle be established where two contraflow routes per year are reviewed in detail by agency participants. The review would cover detailed operational features and a consideration of environmental/infrastructure changes that may have affected the feasibility of the operation or the timeframes for startup and shutdown.

The tragic events of September 11, 2001 have shifted resources and preparedness focus to preparing for possible terrorist strikes. Future analyses regarding the contraflow sections should address other emergency situations, which may necessitate contraflow implementation besides that of a hurricane threat.

This compendium is divided by the technical memoranda produced for each contraflow section. The technical memoranda are reproduced in exactly the same format as reviewed and approved by the FDOT, FHP and DCA. Since some contraflow routes were analyzed concurrently, there are five reports included in this compendium:

1. I – 10 Jacksonville (I-295) to Tallahassee/Monticello (US19)
2. State Road 528 (Beeline) from SR520 to SR 417
3. Florida Turnpike from SR70 to Milepost 253 North of Osceola Parkway
4. Interstate 75/Alligator Alley from Alico Road to US27
5. Interstate 75 from Charlotte County to Interstate 4, Interstate 4, and Interstate 75 from Interstate 275 to Wildwood



Analysis of Florida's One-Way Operations for Hurricane Evacuation

I-10 Jacksonville (I-295) to Tallahassee/Monticello (US 19)



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June 2000
with Winter 2002 Introductory Update
090853.21-0102

TECHNICAL MEMORANDUM

Analysis of Florida's One-Way Operations For Hurricane Evacuation

I-10 Jacksonville (I-295) to Tallahassee/Monticello (US 19)

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June 2000 (Final)
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ANALYSIS OF FLORIDA'S ONE-WAY OPERATIONS FOR HURRICANE EVACUATION

I-10 Jacksonville (I-295) to Tallahassee/Monticello (US 19)

INTRODUCTION

The largest evacuation in Florida's history occurred as the result of Hurricane Floyd in September 1999. Although all of Florida's evacuees were able to evacuate without harm, many spent long hours on congested highways with inadequate guidance on where to go to seek shelter. Long evacuation travel times raised questions as to the need and feasibility of reverse laning limited access facilities to reduce these times. To address these issues, Governor Jeb Bush appointed a Governor's Hurricane Evacuation Task Force, which was chaired by Walter Revell of H. J. Ross Associates, Inc.

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Winter 2002 Status

Throughout the process of analyzing each contraflow route in 2000-2001, FDOT and its consultant have learned that the review of contraflow plans must be an iterative and continuing process that recognizes changing geometrics, law enforcement priorities, resource availability, and evolving evacuation travel behavioral trends. Reports produced for each analyzed contraflow route have been developed at a planning level of analysis, which has helped to identify the benefits/disbenefits and general operational feasibility of each section. It has been suggested by some of the FDOT district staff that a more detailed engineering and design level of analysis be performed on each route as monies and schedule permit. In that regard, it is strongly recommended that a detailed review cycle be established where two contraflow routes per year are reviewed in detail by agency participants. The review would cover detailed operational features and a consideration of environmental/infrastructure changes that may have affected the feasibility of the operation or the timeframes for startup and shutdown.

The tragic events of September 11, 2001 have shifted resources and preparedness focus to preparing for possible terrorist strikes. Future analyses regarding the contraflow sections should address other emergency situations, which may necessitate contraflow implementation besides that of a hurricane threat.

This initial analysis models and examines the Interstate 10 westbound segment from Jacksonville at I-295 to Tallahassee/Monticello at US 19. To accomplish this analysis, PBS&J has been retained by FDOT (through FDOT's Florida Intrastate Highway System contract with RS&H) to assist FDOT, DCA and FDLE in analyzing the route operation. Four "slices" of analysis are provided and described below.

ENTER/EXIT ANALYSIS

Using the State of Florida's Reverse Lane Implementation Plan for Interstate 10 (Jacksonville to Tallahassee-March 2000 draft and June 2000 final), PBS&J examined how traffic will enter and exit the planned one-way operation. To understand what percent of evacuation traffic is entering the operations from I-10 westbound (just east of I-295), I-295 southbound (just north of I-10) and I-295 northbound (just south of I-10), PBS&J reviewed detailed evacuation traffic modeling that the firm had just completed for the Northeast Florida Regional Planning Council's Regional Hurricane Evacuation Study. The NEFRPC Study, coupled with recent post Floyd behavioral and traffic studies, also helped PBS&J ascertain traffic departure and ingress volumes at US 301 and I-75, which are important to consider.

In the absolute worst case Category 4-5 hurricane scenario, approximately 50,000 vehicles will attempt to use I-10 westbound through the beginning section of the operation. Origins of that traffic will be as follows:

Worst Case Category 4-5 Hurricane Entering Vehicles

Feeder Route	Total Evacuation Traffic Volume entering I-10 One Way Operation	Percent of Total
I-10 westbound east of I-295	30,000 vehicles	60%
I-295 northbound south of I-10	15,000 vehicles	30%
I-295 southbound north of I-10	5,000 vehicles	10%

Almost all of the 30,000 vehicles from I-10 westbound will be Duval County evacuees. About three quarters of the I-295 northbound feeder traffic will come from other northeast Florida coastal counties with the remaining quarter from Duval County. The I-295 southbound traffic is mostly Nassau and Duval County traffic with a small percentage of Camden County, Georgia traffic.

At US 301, approximately 10 percent of the westbound I-10 traffic will exit to go to destinations such as Gainesville. However, vehicles will be added back to the traffic stream as Baker County evacuees enter the operation. At I-75 (and at US 129 for vehicles in the contraflow lanes), roughly 20 to 30 percent of the evacuees will want to go northbound as they seek refuge along the Georgia I-75 corridor up to Atlanta. If southeast Florida and the Treasure Coast regions of Florida are evacuating in addition to east central and northeast Florida, I-10 will pick up as much westbound traffic (from vehicles coming northbound on I-75 up to I-10) as it is losing (from westbound vehicles on I-10 turning northbound on I-75).

Current plans call for the normal I-10 westbound traffic east of I-295 to crossover to the (reversed) eastbound I-10 lanes. The I-295 northbound and southbound traffic will enter the I-10 westbound lanes as they normally would. This should work reasonably well and will solve the horrendous traffic conflicts that occurred at this interchange during the Floyd evacuation. This entering scheme and configuration of four westbound travel lanes will yield an evacuation travel flow of up to 5,000 vehicles per hour.

The operation is now planned to end at US 19 with the two contraflow lanes taken down to one lane exiting on the normal eastbound on-ramp. Geometric and topographic features will not allow for two off-lanes. For this operation to work without creating a significant bottleneck, several operational elements must be in place:

- Traffic control personnel will need to be stationed at the US 19/US 27 intersections and at the roundabout in Monticello at the courthouse to direct evacuees and keep them moving
- Public information that is clear and understandable, which directs I-10 contraflow traffic that

desires to go northbound on I-75 to exit at US 129. (Current plans do not allow contraflow traffic to exit at I-75.) Traffic must be bled off at US 129 or it will put tremendous pressure on the ending operation at US 19.

- Public information well before and at US 19 which clearly shows contraflow traffic where they can go if they head south on US 19 to US 27 or where they can go if they go north on US 19 to US 90, Monticello, Thomasville, etc. Evacuees must keep moving at the exit ramp/US 19 location or the bottleneck will be aggravated.

For future seasons, FDOT, FHP, FDLE, FLNG, and DCA might consider a few other alternatives for ending the operation, particularly when just east central and northeast Florida are evacuating:

- Completely end the operation at I-75 by sending two westbound lanes northbound.
- Partially end the operation at I-75 by continuing a third westbound evacuation lane on the westbound shoulder.
- Completely end the operation at I-75 by sending one westbound lane northbound on I-75 and the other westbound lane southbound on I-75.

REGIONAL BOTTLENECK IMPACTS

The strongest positive impact that this one-way operation presents is that it solves the worst bottleneck in the region for any major storm threat where the public responds in large numbers. Local emergency management officials and traffic control/law enforcement personnel will still have to deal with severe congestion moving westbound on Atlantic Blvd., Beach Blvd, and J. Turner Butler Blvd., and congestion due to I-95 northbound through movements. However, proactive evacuation traffic management will be greatly enhanced by this operation and appreciated by the public.

VEHICULAR THROUGHPUT ANALYSIS

PBS&J modeled the route to determine the number of additional vehicles and people that can get through the one-way segment. This was accomplished by calculating clearance times required to process the worst-case evacuation travel demand on I-10 westbound for a Category 3 and Category 4-5 hurricane scenario with and without the one-way operation. In addition, worst individual household commute times through the route were estimated with and without the one-way operation. For scenarios where the one-way operation is in place, it was assumed that the reverse laning would be operational for no more than 12 hours. Scenarios were also differentiated for light and heavy background traffic conditions. In an urban area such as Jacksonville, the level of non-evacuating traffic also present on the road at the start of an evacuation can be quite variable depending on time of day and depending on whether people have to commute from work to home to begin their evacuation.

As can be seen in the attached tables (regarding clearance times and worst household commute times), the one-way operation on I-10 westbound could save up to seven hours of overall evacuation clearance time and up to six hours of individual household commute time. This is significant on two accounts. First, it allows the northeast Florida area the "luxury" of waiting until a hurricane warning is issued before ordering mass evacuation. Secondly, individual evacuees should see noticeable reductions in commute times. **However, if evacuees load the roadways as quickly as they did for Floyd (rapid response) the system will still be overwhelmed and some households will experience lengthy trips.** The figures presented in each table are based on modeling that seems to accurately reflect conditions that existed during the Floyd evacuation - this "validation" of the modeling should give us confidence in the other numbers presented. Translating the increased vehicular movement (an additional 2,000 vehicles per hour) to people, an additional 5,000 people per hour are able to evacuate the northeast Florida area due to the one-way operation. Looking over the length of an entire evacuation for a worst case Category 4-5 hurricane, this means some 35,000 people will be able to make their evacuation movement that otherwise might not have been able to.

EVACUATION CLEARANCE TIMES (IN HOURS)
I-10 Jacksonville (I-295) to Tallahassee/Monticello (US 19)
Analysis of Florida's One Way Operations For Hurricane Evacuation

	<u>Normal Lane Usage</u>		<u>W/One Way Operation</u>	
	<u>Light Background Traffic</u>	<u>Heavy Background Traffic</u>	<u>Light Background Traffic</u>	<u>Heavy Background Traffic</u>
<u>Category 3 Hurricane</u>				
Rapid Response/Loading	18.6 hours	19.7 hours	12.3 hours	13.1 hours
Medium Response/Loading	18.5 hours	20.4 hours	13.1 hours	14.6 hours
Long Response/Loading	18.8 hours	21.4 hours	13.3 hours	15.2 hours

	<u>Normal Lane Usage</u>		<u>W/One Way Operation</u>	
	<u>Light Background Traffic</u>	<u>Heavy Background Traffic</u>	<u>Light Background Traffic</u>	<u>Heavy Background Traffic</u>
<u>Category 4-5 Hurricane</u>				
Rapid Response/Loading	21.4 hours	22.5 hours	13.9 hours	14.8 hours
Medium Response/Loading	21.3 hours	23.1 hours	14.8 hours	16.4 hours
Long Response/Loading	21.6 hours	24.1 hours	15.1 hours	17.0 hours

Please Note: Times were developed using evacuation travel demand data developed in the recent 1998 Hurricane Evacuation Study published by the NEFRPC. Since one-way operations are not anticipated for a Category 1-2 hurricane response, times are shown only for the Category 3-5 hurricane response scenarios. Rapid response/loading means evacuees try to enter the evacuation road network over a 5 to 6 hour period of time (as occurred with Floyd). Medium response/loading means evacuees try to enter over an 8 to 9 hour

period and Long response/loading means evacuees try to enter over an 11 to 12 hour period.

**WORST HOUSEHOLD COMMUTE TIMES (IN HOURS)
I-10 Jacksonville (I-295) to Tallahassee/Monticello (US 19)
Analysis of Florida's One Way Operations For Hurricane Evacuation**

<u>Category 3 Hurricane</u>	<u>Normal Lane Usage</u>		<u>W/One Way Operation</u>	
	<u>Light Background Traffic</u>	<u>Heavy Background Traffic</u>	<u>Light Background Traffic</u>	<u>Heavy Background Traffic</u>
Rapid Response/Loading	11.1 Hours	12.2 Hours	7.4 Hours	8.5 Hours
Medium Response/Loading	8.2 Hours	10.1 Hours	3.0 Hours	4.3 Hours
Long Response/Loading	5.8 Hours	8.3 Hours	3.0 Hours	3.0 Hours

<u>Category 4-5 Hurricane</u>	<u>Normal Lane Usage</u>		<u>W/One Way Operation</u>	
	<u>Light Background Traffic</u>	<u>Heavy Background Traffic</u>	<u>Light Background Traffic</u>	<u>Heavy Background Traffic</u>
Rapid Response/Loading	13.8 Hours	14.9 Hours	10.0 Hours	11 Hours
Medium Response/Loading	10.9 Hours	12.8 Hours	4.5 Hours	6.0 Hours
Long Response/Loading	8.4 Hours	10.9 Hours	3.0 Hours	3.8 Hours

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period.

EVACUEE NOTIFICATION/EVACUATION SHUT-DOWN TIME FRAMES

As Jacksonville and the northeast Florida area are an origin for significant numbers of evacuees and a potential destination for significant numbers of South Georgia and downstate Florida evacuees, it will be important to implement evacuation shut down procedures so that evacuees aren't stranded on I-95 and I-10 as a storm arrives. This could be a particularly dangerous situation if sustained tropical storm winds or hurricane winds begin to affect the roadway and evacuees are still on the facility. Late in an evacuation, it will be important to make a coordinated decision about when to tell evacuees to stop entering I-95 and I-10.

Since the region and state's population will respond differently for various storm events, the time at which evacuees should be advised to stop entering I-95, I-10 and I-295 should be based on actual traffic conditions and not modeled predictions such as clearance times calculated in the regional and statewide studies (which indicate when an evacuation should begin). There are FDOT permanent traffic count stations located along the facilities which should be used for travel speed monitoring (sites 0157, 0132, and 0833). Traffic conditions can be further monitored through Civil Air Patrol support and/or highway patrolmen stationed on the ground at strategic locations. Hourly snapshots of traffic volumes and average travel speeds at these locations, coupled with storm information regarding radius of tropical storm winds and forward speed, will be critical to making prudent shutdown decisions. As average travel speeds are monitored hour to hour and the information fed back to the state and county EOC's, data must be interpreted and the public notified of evacuation shut down.

The best indicator of evacuation traffic congestion and progression is average travel speed. Identifying the most congested sites in the appropriate direction, PBS&J would propose that the state and counties notify the public to stop entering I-95, I-295 and I-10 in the hourly times frames shown. This should greatly help prevent people from being stuck on the roadway system as hazardous conditions arrive.

EVACUEE NOTIFICATION TIME FRAMES

From The Northeast Florida Hurricane Evacuation Study - 1998

(Expressed in Hours Before Expected Sustained Tropical Storm Winds to Discourage New Evacuees From Entering Regional Interstate Facilities)

Average Travel Speed of Evacuation Traffic at congestion Monitoring Sites	I-10 Westbound (site 0833)	I-95 Northbound (site 0132) in Nassau County
5 mph	10 Hours	14 Hours
15 mph	3½ Hours	4½ Hours
25 mph	2 Hours	3 Hours
35 mph	1½ Hours	2 Hours
45 mph	1 Hour	1½ Hours
55 mph	1 Hour	1¼ Hours
65 mph	1 Hour	1 Hour

Please Note: These notification time frames should not be confused with the time required to shut down the one-way operation. Trial exercises during May 2000 showed that it would take a minimum of three hours for the FHP and FDOT to shut down the operation.

Analysis of Florida's One-Way Operations for Hurricane Evacuation

**State Road 528 (Beeline)
from SR 520 to SR 417**

Prepared By



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TECHNICAL MEMORANDUM

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State Road 528 (Beeline) from SR 520 to SR 417

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ANALYSIS OF FLORIDA'S ONE-WAY OPERATIONS FOR HURRICANE EVACUATION

State Road 528 (Beeline) from SR 520 to SR 417

INTRODUCTION

The largest evacuation in Florida's history occurred as the result of Hurricane Floyd in September 1999. Although all of Florida's evacuees were able to evacuate without harm, many spent long hours on congested highways with inadequate guidance on where to go to seek shelter. Long evacuation travel times raised questions as to the need and feasibility of reverse laning limited access facilities to reduce these times. To address these issues, Governor Jeb Bush appointed a Governor's Hurricane Evacuation Task Force, which was chaired by Walter Revell of H. J. Ross Associates, Inc.

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This initial analysis models and examines the SR 528 (Beeline) segment from SR 520 to SR 417. To accomplish this analysis, PBS&J has been retained by FDOT (through FDOT's Florida Intrastate Highway System contract with RS&H) to assist FDOT, DCA and FDLE in analyzing the route operation. Four "slices" of analysis are provided and described below.

ENTER/EXIT ANALYSIS

Using the State of Florida's Contra Flow Implementation Plan for SR 528 (Summer 2000 draft), PBS&J examined how traffic will enter and exit the planned one-way operation. To understand what percent of evacuation traffic is entering the operations from SR 520 northbound (west of I-95), SR 528 westbound (from I-95 to SR 407) and SR 407 southbound (from I-95 to SR 528), PBS&J reviewed detailed evacuation traffic modeling that the firm had just completed for the East Central Florida Regional Planning Council's Regional Hurricane Evacuation Study. The ECFRPC Study, coupled with recent post Floyd behavioral and traffic studies, also helped PBS&J ascertain traffic departure volumes at the terminus of the operation.

In the absolute worst case Category 4-5 hurricane scenario, approximately 47,000 vehicles will attempt to use SR 528 westbound through the beginning section of the operation. Origins of that traffic will be as follows:

Worst Case Category 4-5 Hurricane Entering Vehicles

Feeder Route	Total Evacuation Traffic Volume entering SR 528 Contra Flow Operation	Percent of Total
SR 520 northbound west of I-95	3,800 vehicles	9%
SR 528 westbound from I-95 to SR 407 interchange	37,000 vehicles	78%
SR 407 southbound from I-95 to SR 528 (Beeline)	6,300 vehicles	13%
SR 520 southbound at SR 528 (Beeline)	Negligible	0%

Most of the vehicles using the SR 528 contraflow operation will be Brevard County evacuees. With no major highways connecting with the operation throughout the planned segment of SR 528, it is not anticipated that significant numbers of vehicles will be added or lost.

Current plans call for the two normal westbound lanes on SR 528 to be split just to the west of SR 520 with the left hand lane crossed over to one of the normal eastbound lanes where it will join the SR 520 traffic that is entering the contraflow operation.

Florida Highway Patrol is currently addressing strategies to strongly encourage evacuees traveling westbound on SR 520 (from Merritt Island, Cocoa, and Rockledge) who intend to go westbound, to stay on SR 520 until they enter the Beeline. The modeling accomplished for the ECFRPC recognized that many of these evacuees would try to go north on I-95 then west on SR 528. The aggressive use of variable message signs (VMS) coupled with the implementation of east/west arterial and I-95 traffic management in Brevard County will be critical to successful evacuations. This strategy would put an additional 7,000 to 8,000 evacuating vehicles on SR 520 and would create better balance on the beginning of the operation. It would also help with the severe bottleneck expected on I-95 northbound just below SR 528.

The operation is now planned to end at SR 417 with the two normal westbound SR 528 lanes taken to the northbound SR 417 ramp and the contraflow SR 528 lanes taken to the normal SR 528 westbound lanes. This should work although clear public information needs to be available so that evacuees directed to SR 417 are not confused or lost.

REGIONAL BOTTLENECK IMPACTS

The SR 528 (Beeline) contraflow operation does not solve the worst bottlenecks in the region which control overall clearance time, but does help with a couple of the major secondary bottlenecks listed in the ECFRPC reports. Several east-west arterials, as well as I-95 northbound in Brevard County, are slightly higher on the list of critical bottlenecks. The SR 520 and SR 50 intersection/bottleneck

could be greatly relieved by this operation. Officials will need to look at how to handle the I-95 bottleneck between SR520 and SR 528 to get maximum benefit out of the contraflow operation on the Beeline.

VEHICULAR THROUGHPUT ANALYSIS

PBS&J modeled the route to determine the number of additional vehicles and people that can get through the one-way segment. This was accomplished by calculating clearance times required to process the worst case evacuation travel demand on SR 528 westbound for Category 4-5 hurricane scenario with and without the one-way operation. In addition, worst individual household commute times through the route were estimated with and without the one-way operation. For scenarios where the one-way operation is in place, it was assumed that the reverse laning would be operational for no more than 12 hours. Scenarios were also differentiated for light and heavy background traffic conditions. In an urban area such as Brevard County, the level of non evacuating traffic also present on the road at the start of an evacuation can be quite variable depending on time of day and depending on whether people have to commute from work to home to begin their evacuation.

As can be seen in the attached tables (regarding clearance times and worst household commute times), the one-way operation on SR 528 westbound could save up to six hours of corridor evacuation clearance time and up to six hours of corridor individual household commute time. Translating the increased vehicular movement (an additional 2,000 vehicles per hour) to people, an additional 5,000 people per hour are able to evacuate through the Beeline due to the one-way operation. Looking over the length of an entire evacuation for a worst case Category 4-5 hurricane, this means some people will be able to make their evacuation movement that otherwise might not have been able to.

It should be noted that if this reserve lane concept is used for other types of events (e.g. space shuttle launches), traffic volumes and time frames could be quite different than what has been reported within this report for hurricane situations.

CORRIDOR EVACUATION CLEARANCE TIMES (IN HOURS)

State Road 528 (Beeline) from SR 520 to SR 417

Analysis of Florida's One Way Operations For Hurricane Evacuation

	<u>Normal Lane Usage</u>		<u>W/One Way Operation</u>	
	<u>Light Background Traffic</u>	<u>Heavy Background Traffic</u>	<u>Light Background Traffic</u>	<u>Heavy Background Traffic</u>
<u>Category 3-5 Hurricane</u>				
Rapid Response/Loading	17.2 hours	18.1 hours	10.4 hours	11.1 hours
Medium Response/Loading	17.1 hours	18.6 hours	11.2 hours	12.5 hours
Long Response/Loading	17.3 hours	19.4 hours	11.4 hours	13.0 hours

Please Note: Times were developed using evacuation travel demand data developed in the recent 1999 Hurricane Evacuation Study published by the ECFRPC. Since one-way operations are not anticipated for a Category 1-2 hurricane response, times are shown only for the Category 3-5 hurricane response scenarios. Rapid response/loading means evacuees try to enter the evacuation road network over a 5 to 6 hour period of time (as occurred with Floyd). Medium response/loading means evacuees try to enter over an 8 to 9 hour period and Long response/loading means evacuees try to enter over an 11 to 12 hour period.

CORRIDOR WORST HOUSEHOLD COMMUTE TIMES (IN HOURS)

State Road 528 (Beeline) from SR 520 to SR 417

Analysis of Florida's One Way Operations For Hurricane Evacuation

	<u>Normal Lane Usage</u>		<u>W/One Way Operation</u>	
	<u>Light Background Traffic</u>	<u>Heavy Background Traffic</u>	<u>Light Background Traffic</u>	<u>Heavy Background Traffic</u>
<u>Category 3-5 Hurricane</u>				
Rapid Response/Loading	12.4 Hours	13.4 Hours	9.0 Hours	9.8 Hours
Medium Response/Loading	9.7 Hours	11.2 Hours	3.8 Hours	5.0 Hours
Long Response/Loading	7.1 Hours	9.2 Hours	1.2 Hours	2.8 Hours

Please Note: Times were developed using evacuation travel demand data developed in the recent 1999 Hurricane Evacuation Study published by the ECFRPC, since one way operations are not anticipated for a Category 1-2 hurricane response, times are shown only for the Category 3-5 hurricane response scenarios. Rapid response/loading means evacuees try to enter the evacuation road network over a 5 to 6 hour period of time (as occurred with Floyd). Medium response/loading means evacuees try to enter over an 8 to 9 hour period and Long response/loading means evacuees try to enter over an 11 to 12 hour period.

EVACUEE NOTIFICATION/EVACUATION SHUT-DOWN TIME FRAMES

As Orlando and the east central Florida area are an origin for significant numbers of evacuees and a potential destination for significant numbers of downstate Florida evacuees, it will be important to implement evacuation shut down procedures so that evacuees are not stranded on I-95 and I-4 as a storm arrives. This could be a particularly dangerous situation if sustained tropical storm winds or hurricane winds begin to affect the roadway and evacuees are still on the facility. Late in an evacuation, it will be important to make a coordinated decision about when to tell evacuees to stop entering I-95, I-4 and the Beeline.

Since the region and state's population will respond differently for various storm events, the time at which evacuees should be advised to stop entering I-95, I-4 and the Beeline should be based on actual traffic conditions and not modeled predictions such as clearance times calculated in the regional and statewide studies (which indicate when an evacuation should begin). There are FDOT permanent traffic count stations located along the facilities, which should be used for travel speed monitoring (sites 9906 and 0292). Traffic conditions can be further monitored through Civil Air Patrol support and/or highway patrolmen stationed on the ground at strategic locations. Traffic can also be monitored using CCTV cameras within the Volusia County and Metro-Orlando area. Hourly snapshots of traffic volumes and average travel speeds at these locations, coupled with storm information regarding the radius of tropical storm winds and forward speed, will be critical to making prudent shutdown decisions. As average travel speeds are monitored hour to hour and the information fed back to the state and county Emergency Management Operation Centers (EOCs), data must be interpreted and the public notified of evacuation shut down.

The best indicator of evacuation traffic congestion and progression is average travel speed. Identifying the most congested sites in the appropriate direction, PBS&J would propose that the state and counties notify the public to stop entering I-95, I-4 and the Beeline in the hourly time frames shown. This should greatly

help prevent people from being stuck on the roadway system as hazardous conditions arrive.

EVACUATION CLOSURE/EVACUEE NOTIFICATION TIME FRAMES

From the East Central Florida Hurricane Evacuation Study - 1999

(Expressed in Hours Before Expected Sustained Tropical Storm Winds to Discourage New Evacuees From Entering Regional Interstate Facilities)

Average Travel Speed of Evacuation Traffic at Congestion Monitoring Sites	I-4 Westbound (site 9906) near Deltona	I-95 Northbound (site 0292) in Flagler County
5 mph	6 Hours	12 Hours
15 mph	2 Hours	4 Hours
25 mph	13 Hours	22 Hours
35 mph	1 Hour	2 Hours
45 mph	1 Hour	12 Hours
55 mph	1 Hour	1 Hour
65 mph	1 Hour	1 Hour

Please Note: These notification time frames should not be confused with the time required to shut down the one-way operation. Trial exercises during November 2000 will show how long it will take the FHP and FDOT to shut down the operation.

Please Note: Times were developed using evacuation travel demand data developed in the recent 1999 Hurricane Evacuation Study published by the ECFRPC Since one way operations are not anticipated for a Category 1-2 hurricane response, times are shown only for the Category 3-5 hurricane response

scenarios. Rapid response/loading means evacuees try to enter the evacuation road network over a 5 to 6 hour period of time (as occurred with Floyd). Medium response/loading means evacuees try to enter over an 8 to 9 hour period and Long response/loading means evacuees try to enter over an 11 to 12 hour period.

Analysis of Florida's One-Way Operations for Hurricane Evacuation

**Florida Turnpike from SR 70
to Milepost 253 North of
Osceola Parkway**

Prepared By



1901 Commonwealth Lane
Tallahassee, Florida 32303

Prepared For



Florida Department of Transportation
605 Suwannee Street
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February 2001
with Winter 2002 Introductory Update
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TECHNICAL MEMORANDUM

Analysis of Florida's One-Way Operations For Hurricane Evacuation

Florida Turnpike from SR70 to Milepost 253 north of Osceola Parkway

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ANALYSIS OF FLORIDA'S ONE-WAY OPERATIONS FOR HURRICANE EVACUATION

Florida Turnpike from SR70 to Milepost 253 north of Osceola Parkway

INTRODUCTION

The largest evacuation in Florida's history occurred as the result of Hurricane Floyd in September 1999. Although all of Florida's evacuees were able to evacuate without harm, many spent long hours on congested highways with inadequate guidance on where to go to seek shelter. Long evacuation travel times raised questions as to the need and feasibility of reverse laning limited access facilities to reduce these times. To address these issues, Governor Jeb Bush appointed a Governor's Hurricane Evacuation Task Force, which was chaired by Walter Revell of H. J. Ross Associates, Inc.

The Task Force assigned a traffic management team the responsibility of conducting meetings around the state and identifying routes that might warrant one-way evacuation operations during a major hurricane threat. Seven routes were identified as follows:

- I-10 westbound – Jacksonville to Tallahassee
- I-10 eastbound – Pensacola to Tallahassee
- I-4 eastbound – Tampa to Orange County line
- I-75 northbound – Charlotte County to I-275
- Florida's Turnpike northbound – Ft. Pierce to Orlando
- State Road 528 westbound – SR 520 to SR 417
- I-75 Alligator Alley east and westbound – coast to coast

I-75 from I-275 to Wildwood was added as a result of the recently completed Tampa Bay Regional Hurricane Evacuation Study. I-10 eastbound from Pensacola to Tallahassee has been dropped due to need for bi-directional evacuation movements on I-10 in the Panhandle.

Winter 2002 Status

Throughout the process of analyzing each contraflow route in 2000-2001, FDOT and its consultant have learned that the review of contraflow plans must be an iterative and continuing process that recognizes changing geometrics, law enforcement priorities, resource availability, and evolving evacuation travel behavioral trends. Reports produced for each analyzed contraflow route have been developed at a planning level of analysis, which has helped to identify the benefits/disbenefits and general operational feasibility of each section. It has been suggested by some of the FDOT district staff that a more detailed engineering and design level of analysis be performed on each route as monies and schedule permit. In that regard, it is strongly recommended that a detailed review cycle be established where two contraflow routes per year are reviewed in detail by agency participants. The review would cover detailed operational features and a consideration of environmental/infrastructure changes that may have affected the feasibility of the operation or the timeframes for startup and shutdown.

The tragic events of September 11, 2001 have shifted resources and preparedness focus to preparing for possible terrorist strikes. Future analyses regarding the contraflow sections should address other emergency situations, which may necessitate contraflow implementation besides that of a hurricane threat.

This initial analysis models and examines the Florida Turnpike segment from SR70 near Ft. Pierce to milepost 253 north of Osceola Parkway. To accomplish this analysis, PBS&J has been retained by FDOT (through FDOT's Florida Intrastate Highway System contract with RS&H) to assist FDOT, DCA and FDLE in analyzing the route operation. Four "slices" of analysis are provided and described below.

ENTER/EXIT ANALYSIS

Using the State of Florida's Contraflow Implementation Plan for the Florida Turnpike (Summer 2000 draft), PBS&J examined how traffic will enter and exit the planned one-way operation. To understand what percent of evacuation traffic is entering the operations from each county south of and along the corridor, PBS&J reviewed detailed evacuation traffic modeling that the firm has compiled during the Florida Statewide Recon Study and Phase 3 Transportation Analysis. In addition, a Palm Beach County Supplemental Analysis coupled with recent post Floyd behavioral and traffic studies also helped PBS&J ascertain traffic departure volumes at the terminus of the operation.

In the absolute worst case Category 4-5 hurricane scenario, approximately 171,000 vehicles will attempt to use the Florida Turnpike northbound through the beginning section of the operation. Origins of that traffic will be as follows:

Worst Case Category 4-5 Hurricane Entering Vehicles

Feeder Route/County	Total Evacuation Traffic Volume Attempting to Enter Turnpike One Way Operation	Percent of Total
South Florida		
Monroe	10,000 vehicles	6%
Dade	72,000 vehicles	42%
Broward	28,000 vehicles	16%
Treasure Coast		
Palm Beach	22,000 vehicles	13%
Martin	11,000 vehicles	7%
SR70/St. Lucie	7,000 vehicles	4%
SR60/Indian River	6,000 vehicles	3%
I-95 attracted traffic at SR70		
	15,000 vehicles	9%
Totals	171,000 vehicles	100%

If just south Florida is evacuating and not Treasure Coast, the number of entering vehicles drops to 110,000 evacuating vehicles. However, a major category 4 or 5 hurricane will almost always cause more than one region of the state to respond.

The start up of the contraflow section at SR70 appears to be workable with Turnpike traffic coming northbound south of SR70 split with one lane taken to the contraflow side and the other kept on the normal northbound side of the Turnpike. St. Lucie County evacuees and any I-95 traffic attracted to the contraflow operation will need to be integrated into the operation.

Compared to the volumes already on the Turnpike, the vehicles are more modest in number and should be able to be accommodated with the current design.

The current ending of the contraflow operation is less than optimal with four lanes of traffic taken down to two lanes at milepost 253. The Turnpike district recognizes the potential bottleneck and is working on an addendum to the plan to extend the contraflow to the Leesburg south/US27 (MP285) interchange as the termination point of the contraflow. The extension of the contraflow would only be implemented if there were a need to alleviate traffic tie-ups at the northern crossover. The Turnpike district is discussing their efforts with the local counties so that contraflow plans are in harmony with local sheltering plans. The tremendous evacuee demand for private and public sheltering will not be easy to service even under the best of circumstances. Hotel/motel availability information will be critical to the public as they make directional travel decisions at the ending point. As hotels fill up late in the evacuation, evacuees exiting the Turnpike will need public shelter information.

REGIONAL BOTTLENECK IMPACTS

Approximately 65 percent of the vehicles using the contraflow operation will come from Monroe, Dade and Broward Counties. These vehicles will encounter a serious bottleneck near Glades Road in Palm Beach County where the Turnpike transitions from three northbound lanes to two northbound lanes. This transition spot is the worst bottleneck for south Florida evacuations and the current planned operation does nothing to solve this bottleneck. When Palm Beach and Martin County traffic are added to the two northbound lane section of the Turnpike, approximately 85 percent of the total potential entering volume must traverse this area before it ever arrives at the contraflow section.

The Turnpike district of FDOT recognizes this dilemma and is working feverishly to widen the Turnpike in Palm Beach County. Presently, the Turnpike is being widened between Glades Road and Atlantic Avenue at Lantana. A PD&E study has been initiated for the next section which would widen the Turnpike from Atlantic Avenue to Lake Worth. Concept reports are being accomplished to continue the widening to the Martin County line. A final Turnpike

improvement, which is under a design build contract, is the Immanuel Bridge in Martin County. Widening improvements will make it much safer for evacuation either with or without a contra-flow operation.

Ideally, as the Turnpike widening moves north, the beginning of the contraflow section needs to move south so that the South Florida evacuation traffic can be moved northward through a minimum of three northbound lanes.

VEHICULAR THROUGHPUT ANALYSIS

PBS&J modeled the route to determine the number of additional vehicles and people that can get through the one-way segment assuming there is enough time for the vehicles to arrive at the operation. This was accomplished by calculating clearance times required to process the worst-case evacuation travel demand on the Turnpike for a Category 4-5 hurricane scenario with and without the one-way operation. In addition, worst individual household commute times through the route were estimated with and without the one-way operation. For scenarios where the one-way operation is in place, it was assumed that the reverse laning would be operational for no more than 12 to 24 hours. Scenarios were also differentiated for South Florida only and South Florida and Treasure coast concurrent evacuations.

As can be seen in the attached tables (regarding clearance times and worst household commute times), the one way operation on the Turnpike could save 15 to 20 hours of corridor evacuation clearance time and 20 to 25 hours of corridor individual household commute time. Translating the increased vehicular movement (an additional 2,000 vehicles per hour) to people, an additional 5,000 people per hour are able to evacuate through the Turnpike due to the one-way operation. Looking over the length of an entire evacuation for a worst case Category 4-5 hurricane, this means some people will be able to make their evacuation movement that otherwise might not have been able to. Since the operation does not solve the Turnpike bottleneck in Palm Beach County, the greatest benefit will be for St. Lucie and Indian River evacuees who may not have been able to even enter the Turnpike without the contraflow operation.

TURNPIKE CORRIDOR EVACUATION CLEARANCE TIMES (IN HOURS)

**Florida Turnpike from SR70 to MP253 north of Osceola Pkwy
Analysis of Florida’s One Way Operations for Hurricane Evacuation**

Category 4-5 Hurricane	Normal Lane Usage		W/ One Way Operations	
	S. Florida	S. Florida and	S. Florida	S. Florida and
	Evac Only	Treasure Coast	Evac Only	Treasure Coast
Rapid Response/Loading	43 ½ hours	66 ¼ hours	26 ½ hours	40 hours
Medium Response/Loading	43 ½ hours	66 hours	28 ½ hours	42 ½ hours
Long Response/Loading	44 ½ hours	67 hours	29 hours	43 ½ hours

Please note: Times were developed using evacuation travel demand data compiled in the Recon Study and Phase 3 Transportation Analysis – Florida Statewide study report which was based upon hurricane evacuation study data available for southeast and Treasure Coast regions of Florida.

CORRIDOR WORST HOUSEHOLD COMMUTE TIMES (IN HOURS)

**Florida Turnpike from SR70 to MP253 north of Osceola Pkwy
Analysis of Florida’s One Way Operations for Hurricane Evacuation**

Category 4-5 Hurricane	Normal Lane Usage		W/ One Way Operations	
	S. Florida	S. Florida and	S. Florida	S. Florida and
	Evac Only	Treasure Coast	Evac Only	Treasure Coast
Rapid Response/Loading	37 hours	59 hours	19 hours	35 hours
Medium Response/Loading	34 hours	56 hours	17 hours	33 hours
Long Response/Loading	32 hours	54 hours	16 hours	31 hours

Please note: Times were developed using evacuation travel demand data compiled in the Recon Study and Phase 3 Transportation Analysis – Florida Statewide study report which was based upon hurricane evacuation study data available for southeast and Treasure Coast regions of Florida.

EVACUEE NOTIFICATION/EVACUATION SHUT-DOWN TIME FRAMES

As Orlando is a potential destination for significant numbers of downstate Florida evacuees, it will be important to implement evacuation shut down procedures so that evacuees are not stranded on the Turnpike and I-95 as a storm arrives. This could be a particularly dangerous situation if sustained tropical storm winds or hurricane winds begin to affect the roadway and evacuees are still on the facility. Late in an evacuation, it will be important to make a coordinated decision about when to tell evacuees to stop entering the Turnpike and I-95.

Since the region and state's population will respond differently for various storm events, the time at which evacuees should be advised to stop entering the Turnpike and I-95 should be based on actual traffic conditions and not modeled predictions such as clearance times calculated in the regional and statewide studies (which indicate when an evacuation should begin). There are FDOT permanent traffic count stations located along the facilities, which should be used for travel speed monitoring (sites 970410, 970413, 930198, 979931 and 940260). Traffic conditions can be further monitored through Civil Air Patrol support and/or highway patrolmen stationed on the ground at strategic locations. Traffic can also be monitored using CCTV cameras within Palm Beach and Metro-Orlando areas. Hourly snapshots of traffic volumes and average travel speeds at these locations, coupled with storm information regarding the radius of tropical storm winds and forward speed, will be critical to making prudent shutdown decisions. As average travel speeds are monitored hour to hour and the information fed back to the state and county Emergency Management Operation Centers (EOCs), data must be interpreted and public notified of evacuation shut down.

The best indicator of evacuation traffic congestion and progression is average travel speed. Identifying the most congested sites in the appropriate direction, PBS&J would propose that the state and counties notify the public to stop entering the Turnpike and I-95 in the hourly time frames shown. This should greatly help prevent people from being stuck on the roadway system as hazardous conditions arrive.

EVACUATION CLOSURE/EVACUEE NOTIFICATION TIMEFRAMES
From Palm Beach County Supplemental Emergency Transportation Planning Analysis –
1996

**(Expressed in Hours Before Expected Sustained Tropical Storm Winds to
Discourage New Evacuees From Entering the Florida Turnpike and I-95)**

Average Travel of Evacuation Traffic at Most Congested Sites	Florida Turnpike Sites				I-95 Sites	
	Broward	Palm Beach	Ft. Pierce	Wildwood	Palm Beach	St. Pierce
5 mph	20 hrs	17 hours	10 hours	1 hour	17 hours	10 hours
15 mph	7	5 ½	3 ½	1	5 ½	3 ½
25 mph	4	3 ½	2		3 ½	2
35 mph	3	2 ½	1 ½		2 ½	1 ½
45 mph	2 ¼	2	1 ¼		2	1 ¼
55 mph	2	1 ½	1		1 ½	1
65 mph	1 ½	1 ¼	1		1 ¼	1

Please note: These notification timeframes should not be confused with the time required to shut down the one-way operation. Trial exercises in Spring 2001 will show how long it will take the FHP and FDOT to shut down the operation.

Analysis of Florida's One-Way Operations for Hurricane Evacuation

**Interstate 75 / Alligator Alley
from Alico Road to US 27**

Prepared By



1901 Commonwealth Lane
Tallahassee, Florida 32303

Prepared For



Florida Department of Transportation
605 Suwannee Street
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TECHNICAL MEMORANDUM

Analysis of Florida's One-Way Operations For Hurricane Evacuation

Interstate 75/Alligator Alley from Alico Road to U.S. 27

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ANALYSIS OF FLORIDA'S ONE-WAY OPERATIONS FOR HURRICANE EVACUATION

Interstate 75/Alligator Alley from Alico Road to U.S. 27

INTRODUCTION

The largest evacuation in Florida's history occurred as the result of Hurricane Floyd in September 1999. Although all of Florida's evacuees were able to evacuate without harm, many spent long hours on congested highways with inadequate guidance on where to go to seek shelter. Long evacuation travel times raised questions as to the need and feasibility of reverse-laning limited access facilities to reduce these times. To address these issues, Governor Jeb Bush appointed a Governor's Hurricane Evacuation Task Force, which was chaired by Walter Revell of H. J. Ross Associates, Inc.

The Task Force assigned a traffic management team the responsibility of conducting meetings around the state and identifying routes that might warrant one-way evacuation operations during a major hurricane threat. Seven routes were identified as follows:

I-10 Westbound – Jacksonville to Tallahassee

I-10 Eastbound – Pensacola to Tallahassee

I-4 Eastbound – Tampa to Orange County Line

I-75 Northbound – Charlotte County to I-275

Florida's Turnpike Northbound – Fort Pierce to Orlando

State Road 528 Westbound – State Road 520 to State Road 417

I-75 Alligator Alley East and West bound – Coast to Coast

I-75 from I-275 to Wildwood was added as a result of the recently completed Tampa Bay Regional Hurricane Evacuation Study. I-10 eastbound from Pensacola to Tallahassee has been dropped due to need for bi-directional evacuation movements on I-10 in the Panhandle.

Winter 2002 Status

Throughout the process of analyzing each contraflow route in 2000-2001, FDOT and its consultant have learned that the review of contraflow plans must be an iterative and continuing process that recognizes changing geometrics, law enforcement priorities, resource availability, and evolving evacuation travel behavioral trends. Reports produced for each analyzed contraflow route have been developed at a planning level of analysis, which has helped to identify the benefits/disbenefits and general operational feasibility of each section. It has been suggested by some of the FDOT district staff that a more detailed engineering and design level of analysis be performed on each route as monies and schedule permit. In that regard, it is strongly recommended that a detailed review cycle be established where two contraflow routes per year are reviewed in detail by agency participants. The review would cover detailed operational features and a consideration of environmental/infrastructure changes that may have affected the feasibility of the operation or the timeframes for startup and shutdown.

The tragic events of September 11, 2001 have shifted resources and preparedness focus to preparing for possible terrorist strikes. Future analyses regarding the contraflow sections should address other emergency situations, which may necessitate contraflow implementation besides that of a hurricane threat.

This analysis models and examines the I-75/Alligator Alley segment from Alico Road near Ft. Myers to US 27 in Broward County. To accomplish this analysis, PBS&J has been retained by FDOT (through FDOT's Florida Intrastate Highway System contract with RS&H) to assist FDOT, DCA and FDLE in analyzing the route operation.

It is important to note that in August 1998 the Florida Department of Community Affairs, Division of Emergency Management contracted with PBS&J, Inc. to assess the general feasibility of various evacuation and transportation management strategies regarding Alligator Alley. The analysis Scope of Work focused on southeast Florida evacuations with a predominantly westbound evacuation movement through Alligator Alley and southwest Florida evacuations with a predominantly eastbound evacuation movement. A normal directional lane usage, a three-lane operation, and a one-way operation were addressed. The following tasks were accomplished in the analysis:

- Identified the overall need for the evacuation strategies regarding Alligator Alley.
- Assessed the positive and negative impacts to hurricane evacuation clearance times.
- Assessed the positive and negative impacts to traffic capacity.
- Identified major operational problems that might be encountered with initiating, managing and terminating each strategy.
- Developed evacuation shut down time requirements.

The current analysis draws heavily from the Technical Memorandum that was produced for that study. The current effort produced four slices of analysis, which are provided and described below.

ENTER/EXIT ANALYSIS

Using the State of Florida's northbound and southbound Contra-flow Implementation Plans for I-75/Alligator Alley (Summer 2000 draft), PBS&J examined how traffic will enter and exit the planned

one-way operation. To understand what percent of evacuation traffic is entering the operations from each county, PBS&J reviewed detailed evacuation traffic modeling that the firm compiled during the Florida Statewide Recon Study and Phase 3 Transportation Analysis and 1998 Alligator Alley effort. Those counties, which were considered potential counties contributing evacuation traffic to Alligator Alley, are Lee and Collier Counties in southwest Florida and Monroe, Dade and Broward Counties in southeast Florida.

Table 1 shows the category 4-5 hurricane total out-of-county evacuating vehicles for Lee, Collier, Monroe, Dade and Broward Counties for each of five possible storm tracks. The numbers were developed in regional studies conducted by The Southwest Florida Regional Planning Council and by PBS&J for various public clients. It is important to note that the numbers are maximum unconstrained out-of-county traffic figures regardless of exit routes used by each county. Since some portion of these out-of-county vehicles might be diverted to Alligator Alley through aggressive traffic management, these are important numbers to begin with.

Table 1
CATEGORY 4-5 HURRICANE
OUT-OF-COUNTY EVACUATING VEHICLES BY RELEVANT TRACK
Maximum Unconstrained Out-of-County Evacuating Traffic Regardless of Exit Route for:

South Florida County	SE Florida Landfall SW Florida Exit	SE Florida Landfall Tampa Bay Exit	East Coast Parallel	SW Florida Landfall E. Central Coast Florida Exit	West Coast Parallel
Southwest Florida Lee Collier	84,000 Vehicles 46,600 Vehicles	21,700 Vehicles 18,900 Vehicles	- 18,900 Vehicles	152,000 Vehicles 75,500 Vehicles	84,000 Vehicles 75,500 Vehicles
Southeast Florida Monroe Dade Broward	31,000 Vehicles 207,000 Vehicles 80,000 Vehicles	31,000 Vehicles 207,000 Vehicles 80,000 Vehicles	31,000 Vehicles 207,000 Vehicles 80,000 Vehicles	- - -	31,000 Vehicles - -

Source: Recon Study and Phase 3 Transportation Analysis, Florida Statewide Hurricane Evacuation/Shelter Plan, 1996, Regional HES Studies

Previous evacuations and hurricane study work suggest that without active traffic management and aggressive public information, Alligator Alley will be underutilized as an evacuation route. In developing percentages of exiting traffic by county that might be diverted to Alligator Alley, PBS&J had to “guesstimate” the maximum percentage for Lee, Collier, Monroe, Dade and Broward counties for possible storm tracks. Two levels of diversion were assumed for each county as follows:

	Limited Diversion	Maximum Diversion
Lee County	20%	40%
Collier County	35%	70%
Monroe County	15%	30%
Dade County	15%	25%
Broward County	15%	25%

Maximum diversion assumes the most aggressive level of traffic management where, perhaps halfway through an evacuation, traffic is forced to use Alligator Alley. Limited diversion would assume the public is strongly advised to consider Alligator Alley as an alternative escape route.

Using the diversion percentages and applying them to out-of-county vehicles shown in Table 1, numbers of evacuating vehicles on the Alligator Alley were generated for contraflow operations in each direction. Table 2 provides the northbound/westbound vehicles for a major storm affecting southeast Florida. Approximately 10 percent of the traffic would come from Monroe County, 25 percent from Broward County, and the remaining 65 percent from Dade County.

Table 2
Worst Case Category 4-5 Hurricane Northbound/Westbound
I-75/Alligator Alley Evacuation Traffic

<u>Feeder County</u>	<u>With No Diversion</u>	<u>Limited Diversion</u>	<u>Maximum Diversion</u>
Monroe	1,550 vehicles	4,650 vehicles	9,300 vehicles
Dade	6,350 vehicles	31,750 vehicles	52,450 vehicles
Broward	<u>4,000</u> vehicles	<u>12,000</u> vehicles	<u>20,000</u> vehicles
Total	11,900 vehicles	48,400 vehicles	81,750 vehicles

Table 3 provides the potential southbound/eastbound vehicles for a major storm threatening southwest Florida. Approximately 45 percent of the traffic would come from Collier County and 55 percent from Lee County.

Table 3
Worst Case Category 4-5 Hurricane Southbound/Eastbound
I-75/Alligator Alley Evacuation Traffic

<u>Feeder County</u>	<u>With No Diversion</u>	<u>Limited Diversion</u>	<u>Maximum Diversion</u>
Lee	Negligible	30,400 vehicles	60,800 vehicles
Collier	Negligible	<u>26,400</u> vehicles	<u>52,800</u> vehicles
Total	Negligible	56,800 vehicles	113,600 vehicles

Given these traffic volumes and the schematics developed by FDOT for each directional contraflow operation, PBS&J reviewed enter and exit characteristics of each operation. The

southbound/eastbound operation begins at CR 951 in Collier County and ends at US 27 in Broward County. I-75 southbound traffic from Lee County will be maintained in the normal southbound roadway. Collier County evacuees can use the normal southbound lanes or the contraflow lanes depending on actual congestion and conditions. The ending at US 27 should work as I-75 picks up an additional eastbound lane at US 27.

The northbound/westbound operation is more problematic. It is planned to begin at US 27 in Broward County and end at Alico Road in Lee County. It is not clear from the current drawings how Monroe, Dade and Broward Counties will enter the operation officials will want to achieve a balance of traffic on each side of the road. The ending at Alico Road takes four-lanes of traffic down to two lanes of traffic, which will create a major bottleneck. (Fortunately, this analysis justifies a southbound/eastbound contraflow operation, but recommends a normal operation or normal operation with shoulder usage in the northbound/westbound direction.)

REGIONAL BOTTLENECK IMPACTS

The proactive use of I-75/Alligator Alley as a major evacuation route has many benefits in providing relief to major regional and statewide evacuation bottlenecks. The primary benefit of the northbound/westbound operation is relieving the incredible evacuation traffic numbers and bottlenecks on I-95 and the Florida Turnpike. An even greater benefit is derived from the southbound/eastbound operation, which takes pressure off the worst potential hurricane evacuation bottleneck in the whole state (I-75/I-275 interchange just north of Tampa).

While a limited diversion of northbound I-95 and Florida Turnpike traffic to Alligator Alley will help regional bottlenecks, PBS&J would not recommend an aggressive or maximum diversion, as west coast bottlenecks would worsen to the point of negating east coast benefits. Also, limited public shelter spaces in southwest Florida with an exiting category 4-5 hurricane would make it difficult to deal with a lot of southeast Florida evacuees.

What makes the enhanced evacuation capacity option so appealing is the diversion of evacuation traffic to Alligator Alley, which would otherwise be grossly underutilized. The diversion as previously stated takes traffic away from grossly over-utilized routes. For the upcoming 2001 hurricane season, contraflow plans may need to stay in place. However, a more prudent, less resource intensive option, would be developing the outside shoulder as a third evacuation lane in each direction. This would involve some minor widening and altering of rumble strips. The use of the normal direction outside shoulder will accommodate the identified traffic and will be easier to manage. If the Turnpike or I-75/I-4 contraflow operation is in progress, state resources will be at a premium. Alligator Alley, with a contra flow operation, may overwhelm already committed state resources.

VEHICULAR THROUGHPUT ANALYSIS

Table 4 shows the clearance time benefits statewide of using Alligator Alley as a major evacuation route for various storm tracks. Seven to 12 hours of time is saved due to an enhanced use in the northbound/westbound direction. For a southbound/eastbound enhanced use, 29 to 38 hours of clearance time is saved. With an outside shoulder being used as an evacuation lane, vehicles throughput is increased from 3,000 to 4,200 vehicles per hour. With a contra flow operation, vehicle throughput is increased from 3,000 to 5,000 vehicles per hour. Contraflow should not be used unless southwest Florida is taken by surprise by a rapidly forming/rapidly moving, intense hurricane system in the Gulf of Mexico.

Table 4
IMPACT TO STATEWIDE HURRICANE EVACUATION
CLEARANCE TIMES

<u>Statewide Category 4/5 Hurricane Storm Track</u>	<u>Potential Savings in Hours of Evacuation Clearance Time</u>	<u>Recommended Level of Diversion/Use of Alligator Alley</u>
SE Florida Landfall SW Florida Exit	7 Hour Reduction	Limited diversion/normal lane use or shoulder addition
SE Florida Landfall Tampa Bay Exit	7 Hour Reduction	Limited diversion/normal lane use or shoulder addition
East Coast Parallel	12 Hour Reduction	Maximum diversion/normal lane use or shoulder addition
SW Florida Landfall E. Central Florida Exit	38 Hour Reduction	Maximum diversion/use eastbound shoulder as third eastbound lane or contraflow
West Coast Parallel	29 Hour Reduction	Maximum diversion/normal lane use or shoulder addition

EVACUEE NOTIFICATION/EVACUATION SHUT-DOWN TRAFFIC

As Alligator Alley becomes accepted by the public as a legitimate evacuation route, it will be important to implement evacuation shut-down procedures so that evacuees are not stranded on a 60-mile long section of low-lying roadway with few facilities and virtually no sheltering capability. This could be a particularly dangerous situation if sustained tropical storm winds or hurricane winds begin

to affect the roadway and evacuees are still on the facility. Late in an evacuation, it will be important to make a coordinated decision about when to tell Collier, Lee, Monroe, Dade and Broward evacuees to stop entering Alligator Alley.

Since south Florida's population will respond differently for various storm events, the time at which evacuees should be advised to stop entering Alligator Alley should be based on actual traffic conditions and not modeled predictions such as clearance times calculated in the regional and statewide studies (which indicate when an evacuation should begin). Unfortunately, there are not FDOT permanent traffic count stations located along the facility which could be used for travel speed monitoring. This is because the communications infrastructure is not out there along the remote sections of Alligator Alley to support the newest count station technology. Therefore, traffic conditions will need to be monitored through Civil Air Patrol support and/or highway patrolmen stationed on the ground at strategic locations.

At a minimum, PBS&J recommends that Alligator Alley at State Road 29 and in the vicinity of the Indian reservations be monitored during a hurricane evacuation. Hourly snapshots of traffic volumes and average travel speeds at these locations coupled with storm information regarding radius of tropical storm winds and forward speed will be critical to making prudent shut-down decisions. As average travel speeds are monitored hour-to-hour and the information is fed back to the state and county EOCs, data must be interpreted and the public notified of evacuation shutdown.

The best indicator of evacuation traffic congestion and progression is average travel speed. Identifying the most congested sites in the appropriate direction and using Table 5, PBS&J would propose that the state and relevant counties notify the public to stop entering Alligator Alley in the hourly timeframes shown. This should greatly help prevent people from being stuck on the roadway system as hazardous conditions arrive.

Table 5
EVACUATION CLOSURE/EVACUEE NOTIFICATION TIMEFRAMES
 (Expressed in Hours Before Expected Sustained Tropical Storm Winds
 Discourage New Evacuees from Entering Alligator Alley)

Average Travel Speed of Evacuation Traffic at Congestion Monitoring Sites	Congestion Monitoring Sites			
	Alligator Alley at SR 29		Alligator Alley at Indian Reservations	
	Eastbound	Westbound	Eastbound	Westbound
5 mph	12 Hours	4 ½ Hours	7 Hours	11 Hours
15 mph	4 Hours	1 ½ Hours	2 ½ Hours	3 ½ hours
25 mph	2 ½ Hours	1 Hour	1 ½ Hours	2 Hours
35 mph	1 ¾ Hours	1 Hour	1 Hour	1 ½ Hours
45 mph	1 ½ Hours	1 Hour	1 Hour	1 ¼ hours
55 mph	1 Hour	1 Hour	1 Hour	1 Hour
65 mph	1 Hour	1 Hour	1 Hour	1 Hour

Analysis of Florida's One-Way Operations for Hurricane Evacuation

Interstate 75 from Charlotte County
to Interstate 4, Interstate 4,
and Interstate 75 from
Interstate 275 to Wildwood

Prepared By



1901 Commonwealth Lane
Tallahassee, Florida 32303

Prepared For



Florida Department of Transportation
605 Suwannee Street
Tallahassee, Florida 32399-0450

May 2001

with Winter 2002 Introductory Update

090853.21-0102

TECHNICAL MEMORANDUM

Analysis of Florida's One-Way Operations For Hurricane Evacuation

**Interstate 75 from Charlotte County to Interstate 4,
Interstate 4, and Interstate 75 from Interstate 275 to Wildwood**

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ANALYSIS OF FLORIDA'S ONE-WAY OPERATIONS FOR HURRICANE EVACUATION

Interstate 75 from Charlotte County to Interstate 4, Interstate 4, and Interstate 75 from Interstate 275 to Wildwood

INTRODUCTION

The largest evacuation in Florida's history occurred as the result of Hurricane Floyd in September 1999. Although all of Florida's evacuees were able to evacuate without harm, many spent long hours on congested highways with inadequate guidance on where to go to seek shelter. Long evacuation travel times raised questions as to the need and feasibility of reverse laning limited access facilities to reduce these times. To address these issues, Governor Jeb Bush appointed a Governors Hurricane Evacuation Task Force, which was chaired by Walter Revell of H. J. Ross Associates, Inc.

The Task Force assigned a traffic management team the responsibility of conducting meetings around the state and identifying routes that might warrant one-way evacuation operations during a major hurricane threat. Seven routes were identified as follows:

- I-10 Westbound - Jacksonville to Tallahassee
- I-10 Eastbound - Pensacola to Tallahassee
- I-4 Eastbound - Tampa to Orange County line
- I-75 Northbound - Charlotte County to I-275
- Florida's Turnpike Northbound - Ft. Pierce to Orlando
- State Road 528 Westbound - State Road 520 to State Road 417
- I-75 Alligator Alley East and Westbound - Coast to Coast

I-75 from I-275 to Wildwood was added as a result of the recently completed Tampa Bay Regional Hurricane Evacuation Study. I-10 eastbound from Pensacola to Tallahassee has been dropped due to need for bi-directional evacuation movements on I-10 in the Panhandle.

Winter 2002 Status

Throughout the process of analyzing each contraflow route in 2000-2001, FDOT and its consultant have learned that the review of contraflow plans must be an iterative and continuing process that recognizes changing geometrics, law enforcement priorities, resource availability, and evolving evacuation travel behavioral trends. Reports produced for each analyzed contraflow route have been developed at a planning level of analysis, which has helped to identify the benefits/disbenefits and general operational feasibility of each section. It has been suggested by some of the FDOT district staff that a more detailed engineering and design level of analysis be performed on each route as monies and schedule permit. In that regard, it is strongly recommended that a detailed review cycle be established where two contraflow routes per year are reviewed in detail by agency participants. The review would cover detailed operational features and a consideration of environmental/infrastructure changes that may have affected the feasibility of the operation or the timeframes for startup and shutdown.

The tragic events of September 11, 2001 have shifted resources and preparedness focus to preparing for possible terrorist strikes. Future analyses regarding the contraflow sections should address other emergency situations, which may necessitate contraflow implementation besides that of a hurricane threat.

This analysis examines three of the eight areas. The Southwest Florida area along with Tampa Bay comprises the most difficult hurricane evacuation area in the entire United States. A major hurricane threatening this area would precipitate an evacuation that would greatly burden Interstate 75 and Interstate 4. This analysis examines the role that various contra flow and shoulder plans might play separately and in conjunction with one another. Although a separate report has addressed Alligator Alley, it is also included as an analysis feature of this report.

To accomplish this analysis, PBS&J has been retained by the FDOT (through FDOT's Florida Intrastate highway System contract with RS&H) to assist FDOT, DCA, and FDLE in analyzing the route operation. Four "slices" of analysis are provided and described below.

ENTER/EXIT ANALYSIS

Using the State of Florida's recently updated ContraFlow Implementation Plan for Interstate 4, and the state's Interstate 75 Northbound shoulder use plans for Sarasota and Hillsborough Counties, PBS&J examined how traffic will enter and exit the planned operations. It should be noted that no contra flow plan exists for the Interstate 75 from Interstate 275 to Wildwood section as of yet. FDOT and FHP officials will make a decision to move forward with these detailed plans after reviewing findings of this analysis

To understand what percent of evacuation traffic is entering the operations from each county south of and along the corridor, PBS&J reviewed detailed evacuation traffic modeling that the firm compiled during the Florida Statewide Recon Study and Phase 3 Transportation Analysis and the recently completed Tampa Bay Hurricane Evacuation Study.

The following table shows the county-by-county worst-case category 4-5 hurricane contribution of out of county evacuation vehicles to the regional road system. **The vehicle numbers are unconstrained maximums, as most storm scenarios will not permit enough time for this level of out-of-county evacuation to be accommodated.**

Worse Case Category 4-5 Hurricane/ High Tourist Occupancy Unconstrained Out Of County Evacuating Vehicles By Area		
County	Evacuating Vehicles Attempting to Exit the County	Percent of Total
Southwest Florida		
Collier	75,500 vehicles	10%
Lee	152,000 vehicles	21%
Charlotte	65,200 vehicles	9%
Sarasota	86,100 vehicles	12%
Subtotal	378,800 vehicles	52%
Tampa Bay		
Manatee	39,500 vehicles	5%
Hillsborough	82,700 vehicles	11%
Pinellas	149,900 vehicles	20%
Pasco	89,300 vehicles	12%
Subtotal	361,400 vehicles	48%
Total	740,200 vehicles	100%

Interestingly, Southwest Florida and Tampa Bay would contribute roughly equal amounts of out-of-county vehicles. Although Tampa Bay has more total population than Southwest Florida, Southwest Florida is more surge vulnerable thus generating a similar potential volume of out of county traffic

What is critical to understand and try to forecast is what portion of each county's traffic will be on roadway segments leading out of the respective regions for various traffic control/contraflow alternatives. In that regard, PBS&J set up a series of spreadsheets, assigning various percentages of each county's traffic to the available routes. For each traffic control/contraflow alternative, percentages of out of county traffic were assigned to:

- | | |
|---------------------|------------------------|
| Alligator Alley | SR-72 |
| I-75 south of I-4 | SR-64 |
| I-4 | SR-60 |
| I-75 north of I-275 | US-301 |
| SR-80 | US-41/Suncoast Parkway |
| US-17 | US-19 |

This was accomplished for each of the following traffic control/contraflow alternatives:

Normal lane usage	Alligator Alley contraflow only with maximum Lee/Collier diversion
I-75 north of I-275 contraflow only	
I-4 contraflow only	I-75 north of I-275 contraflow with Alligator Alley contraflow
I-75 northbound shoulder to I-4 only	
Alligator Alley contraflow only with limited Lee/Collier diversion	I-4 contraflow with Alligator Alley contraflow

The following tables show the assigned maximum unconstrained vehicle volumes by each of the key analysis segments for a Southwest Florida-only evacuation, a Tampa Bay only-evacuation, and a combined Southwest Florida/Tampa Bay evacuation.

MAXIMUM UNCONSTRAINED EVACUATION VEHICLES BY ROUTE SOUTHWEST FLORIDA ONLY EVACUATION				
	Evacuation Vehicles by Route			
Traffic Control/ Contraflow Alternative	Alligator Alley	I-75 south of I-4	I-4	I-75 north of I-275
Normal Lane Usage	6,815 vehicles	341,770 vehicles	155,400 vehicles	186,360 vehicles
I-75 north of I-275 contraflow only	6,815	341,770	155,400	186,360
I-4 contraflow only	6,815	341,770	167,640	174,130
I-75 northbound shoulder only	6,815	341,770	155,400	186,360
Alligator Alley contraflow only with limited Lee/Collier diversion	56,825	291,760	128,880	162,875
Alligator Alley contraflow only with maximum Lee/Collier diversion	113,660	234,903	106,920	128,015
I-75 north of I-275 contraflow with Alligator Alley contraflow	113,660	234,930	106,920	128,015
I-4 contraflow with Alligator Alley contraflow	113,660	234,930	109,290	125,640

MAXIMUM UNCONSTRAINED EVACUATION VEHICLES BY ROUTE TAMPA BAY ONLY EVACUATION				
	Evacuation Vehicles by Route			
Traffic Control/ Contraflow Alternative	Alligator Alley	I-75 south of I-4	I-4	I-75 north of I-275
Normal Lane Usage	0	41,845	101,860	178,540
I-75 north of I-275 contraflow only	0	41,845	97,210	183,190
I-4 contraflow only	0	41,845	108,840	171,560
I-75 northbound shoulder only	0	41,845	101,860	178,540
Alligator Alley contraflow only with limited Lee/Collier diversion	N/A	N/A	N/A	N/A
Alligator Alley contraflow only with maximum Lee/Collier diversion	N/A	N/A	N/A	N/A
I-75 north of I-275 contraflow with Alligator Alley contraflow	N/A	N/A	N/A	N/A
I-4 contraflow with Alligator Alley contraflow	N/A	N/A	N/A	N/A

MAXIMUM UNCONSTRAINED EVACUATION VEHICLES BY ROUTE SOUTHWEST FLORIDA AND TAMPA BAY EVACUATING				
	Evacuation Vehicles by Route			
Traffic Control/ Contraflow Alternative	Alligator Alley	I-75 south of I-4	I-4	I-75 north of I-275
Normal Lane Usage	6,815	383,610	257,270	364,900
I-75 north of I-275 contraflow only	6,815	383,610	252,620	369,550
I-4 contraflow only	6,815	383,610	276,480	345,690
I-75 northbound shoulder only	6,815	383,610	257,270	364,900
Alligator Alley contraflow only with limited Lee/Collier diversion	56,825	333,600	230,745	341,415
Alligator Alley contraflow only with maximum Lee/Collier diversion	113,660	276,780	208,780	306,550
I-75 north of I-275 contraflow with Alligator Alley contraflow	113,660	276,780	204,130	311,205
I-4 contraflow with Alligator Alley contraflow	113,660	276,680	218,130	297,200

In addition to reviewing potential traffic volumes using each operation, plans were reviewed for starting and ending the shoulder and contraflow operations. Both the I-75 shoulder and I-4 contraflow plan seem to be well thought out. The I-75 shoulder plan has already been tested and appears quite doable. The I-4 plan although well designed, would require control of some 30 interchanges and would be very resource intensive. As in previous contraflow analyses, the need for clear communication to the public at the beginning and endings of each operation cannot be overstated.

REGIONAL BOTTLENECK IMPACTS

The I-75 contraflow from I-275 to Wildwood would help “solve” the worst potential evacuation bottleneck in Florida for an evacuation involving Tampa Bay and southwest Florida. The I-4 contraflow plans biggest contribution is in “solving” the horrendous potential bottleneck at the I-4/I-275 interchange in downtown Tampa. The I-75 shoulder plan, although useful to a southwest Florida only evacuation, actually could bring evacuees more quickly into an already over-congested I-4 area if Tampa Bay is also evacuating. The greatest relief to regional bottlenecks would be a combination of an I-75 from I-275 to Wildwood contraflow, an Alligator Alley contraflow and a short I-4 contraflow operation from the I-275 interchange to I-75 east of Tampa. However, even with these enhancements, congestion will be severe and there may not be enough time to accommodate every person who wants to leave the region in a worst-case situation. Also, the state may not have the resources to handle an effort of this magnitude.

VEHICULAR THROUGHPUT ANALYSIS

PBS&J modeled the routes to determine the number of additional vehicles and people that can get through the contraflow segments assuming there is enough time for the vehicles to arrive at the operation. This was accomplished by calculating hours of travel demand/clearance times required to process the worst case evacuation travel demand on each segment for a category 4-5 hurricane scenario with and without the contraflow alternatives. Scenarios were differentiated for Southwest Florida only, Tampa Bay only, and southwest Florida and Tampa Bay concurrent evacuations.

Calculations assumed that the I-75 shoulder plan would increase vehicle throughput from 6,000 vehicles per hour to 7,000 vehicles per hour. The I-75 north of I-295 and I-4 contraflow operations will increase vehicle throughput from 3,000 vehicles per hour to 5,000 vehicles per hour. I-4 will actually carry even more vehicles on those sections that have recently been six laned. This type of analysis must look at the most constrictive sections, which, in the case of I-4, are the four-lane segments near Lakeland. The widening improvements to I-4 are progressing well and will greatly reduce the need for contraflowing I-4 during hurricane evacuations.

The following tables provide the maximum unconstrained hours of travel demand by route for each traffic control/contraflow alternative. Separate tables are provided for the southwest Florida, Tampa Bay and concurrent regional evacuations.

MAXIMUM UNCONSTRAINED HOURS OF TRAVEL DEMAND BY ROUTE SOUTHWEST FLORIDA ONLY EVACUATION				
	Hours of Evacuation Travel Demand by Route			
Traffic Control/ Contraflow Alternative	Alligator Alley	I-75 south of I-4	I-4	I-75 north of I-275
Normal Lane Usage	2 hours	57 hours	52 hours	62 hours
I-75 north of I-275 contraflow only	2	57	52	37
I-4 contraflow only	2	57	34	58
I-75 northbound shoulder only	12	49	52	62
Alligator Alley contraflow only with limited Lee/Collier diversion	11	49	43	54
Alligator Alley contraflow only with maximum Lee/Collier diversion	23	39	36	43
I-75 north of I-275 contraflow with Alligator Alley contraflow	23	39	36	26
I-4 contraflow with Alligator Alley contraflow	23	39	22	42

MAXIMUM UNCONSTRAINED HOURS OF TRAVEL DEMAND BY ROUTE TAMPA BAY ONLY EVACUATION				
	Hours of Evacuation Travel Demand by Route			
Traffic Control/ Contraflow Alternative	Alligator Alley	I-75 south of I-4	I-4	I-75 north of I-275
Normal Lane Usage	0	7	34	60
I-75 north of I-275 contraflow only	0	7	32	37
I-4 contraflow only	0	7	22	57
I-75 northbound shoulder only	0	6	34	60
Alligator Alley contraflow only with limited Lee/Collier diversion	N/A	N/A	N/A	N/A
Alligator Alley contraflow only with maximum Lee/Collier diversion	N/A	N/A	N/A	N/A
I-75 north of I-275 contraflow with Alligator Alley contraflow	N/A	N/A	N/A	N/A
I-4 contraflow with Alligator Alley contraflow	N/A	N/A	N/A	N/A

MAXIMUM UNCONSTRAINED HOURS OF TRAVEL DEMAND BY ROUTE SOUTHWEST FLORIDA AND TAMPA BAY EVACUATING				
	Hours of Evacuation Travel Demand by Route			
Traffic Control/ Contraflow Alternative	Alligator Alley	I-75 south of I-4	I-4	I-75 north of I-275
Normal Lane Usage	2	64	86	122
I-75 north of I-275 contraflow only	2	64	84	74
I-4 contraflow only	2	64	55	115
I-75 northbound shoulder only	2	55	86	122
Alligator Alley contraflow only with limited Lee/Collier diversion	11	56	77	114
Alligator Alley contraflow only with maximum Lee/Collier diversion	23	46	70	102
I-75 north of I-275 contraflow with Alligator Alley contraflow	23	46	68	62
I-4 contraflow with Alligator Alley contraflow	23	46	44	99

Since most of the times would require evacuations to begin before the National Hurricane Center could tell the region it is under threat, the times only serve as a relative measure of one scenario versus another. In that light, tables are also provided indicating the percentage savings in times by route segment for each contraflow alternative. In light of the calculations, the prioritization of measures from highest to lowest should be as follows:

- 1) I-75 from I-275 to Wildwood contraflow
- 2) Alligator Alley contraflow with maximum diversion of Lee and Collier Counties
- 3) I-4 partial contraflow from I-275 to I-75
- 4) I-4 full contraflow (not needed after multilane construction is complete)
- 5) I-75 shoulder plan

PERCENT SAVINGS IN CLEARANCE TIME BY ROUTE SEGMENT BY TRAFFIC CONTROL/CONTRAFLOW ALTERNATIVE SOUTHWEST FLORIDA ONLY EVACUATION				
	Hours of Evacuation Travel Demand by Route			
Traffic Control/ Contraflow Alternative	Alligator Alley	I-75 south of I-4	I-4	I-75 north of I-275
Normal Lane Usage	Baseline	Baseline	Baseline	Baseline
I-75 north of I-275 contraflow only	0%	0%	0%	40%
I-4 contraflow only	0%	0%	35%	6%
I-75 northbound shoulder only	0%	14%	0%	0%
Alligator Alley contraflow only with limited Lee/Collier diversion	—	14%	17%	13%
Alligator Alley contraflow only with maximum Lee/Collier diversion	—	32%	31%	31%
I-75 north of I-275 contraflow with Alligator Alley contraflow	—	32%	31%	58%
I-4 contraflow with Alligator Alley contraflow	—	32%	58%	32%

**PERCENT SAVINGS IN CLEARANCE TIME BY ROUTE SEGMENT BY TRAFFIC CONTROL/CONTRAFLOW ALTERNATIVE
TAMPA BAY ONLY EVACUATION**

Traffic Control/ Contraflow Alternative	Hours of Evacuation Travel Demand by Route			
	Alligator Alley	I-75 south of I-4	I-4	I-75 north of I-275
Normal Lane Usage	Baseline	Baseline	Baseline	Baseline
I-75 north of I-275 contraflow only	0%	0%	6%	38%
I-4 contraflow only	0%	0%	35%	5%
I-75 northbound shoulder only	0%	14%	0%	0%
Alligator Alley contraflow only with limited Lee/Collier diversion	—	—	—	—
Alligator Alley contraflow only with maximum Lee/Collier diversion	—	—	—	—
I-75 north of I-275 contraflow with Alligator Alley contraflow	—	—	—	—
I-4 contraflow with Alligator Alley contraflow	—	—	—	—

PERCENT SAVINGS IN CLEARANCE TIME BY ROUTE SEGMENT BY TRAFFIC CONTROL/CONTRAFLOW ALTERNATIVE SOUTHWEST FLORIDA AND TAMPA BAY EVACUATION				
	Hours of Evacuation Travel Demand by Route			
Traffic Control/ Contraflow Alternative	Alligator Alley	I-75 south of I-4	I-4	I-75 north of I-275
Normal Lane Usage	Baseline	Baseline	Baseline	Baseline
I-75 north of I-275 contraflow only	0%	0%	2%	39%
I-4 contraflow only	0%	0%	36%	6%
I-75 northbound shoulder only	0%	14%	0%	0%
Alligator Alley contraflow only with limited Lee/Collier diversion	—	12%	10%	7%
Alligator Alley contraflow only with maximum Lee/Collier diversion	—	28%	19%	16%
I-75 north of I-275 contraflow with Alligator Alley contraflow	—	28%	21%	49%
I-4 contraflow with Alligator Alley contraflow	—	28%	49%	19%

EVACUEE NOTIFICATION/EVACUATION SHUT-DOWN TIMEFRAMES

As Tampa Bay is an origin for significant numbers of evacuee and a potential destination for significant numbers of Southwest Florida evacuees, it will be important to implement evacuation shut down procedures so that evacuees aren't stranded on I-75 and I-4 as a storm arrives. This could be a particularly dangerous situation if sustained tropical storm winds or hurricane winds begin to affect the roadway and evacuees are still on the facility. Late in an evacuation, it will be important to make a coordinated decision about when to tell evacuees to stop entering I-75, I-4 and I-275.

Since the region and state's population will respond differently for various storm events, the time at which evacuees should be advised to stop entering I-75, I-4 and I-275 should be based on actual traffic conditions and not modeled predictions such as clearance time calculated in the regional and statewide studies (which indicate when an evacuation should begin). There are FDOT permanent traffic count stations located along the facilities which should be used for travel speed monitoring (sites 140190, 100106 and 100110). Traffic conditions can be further monitored through Civil Air Patrol support and/or highway patrolmen stationed on the ground at strategic locations. Traffic can also be monitored using CCTV cameras that are available within the area. Hourly snapshots of traffic volumes and average travel speeds at these locations, coupled with storm information regarding the radius of tropical storm winds and forward speed, will be critical to making prudent shut-down decisions. As average travel speeds are monitored hour to hour and the information fed back to the state and county Emergency Management Operation Centers (EOCs), data must be interpreted and the public notified of evacuation shut down.

The best indicator of evacuation traffic congestion and progression is average travel speed. Identifying the most congested sites in the appropriate direction and using the following table, PBS&J would propose that the state and counties notify public to stop entering I-75, I-4, and I-275 in the hourly time frames shown. This should greatly help prevent people from being stuck on the roadway system as hazardous conditions arrive.

**EVACUATION CLOSURE/EVACUEE NOTIFICATION TIMEFRAMES
TAMPA BAY FLORIDA HURRICANE EVACUATION STUDY UPDATE-
1999**

(Expressed in hours before expected Sustained Tropical Storm Winds to Discourage New Evacuees From Entering Regional Interstate Facilities)

Average Travel Speed of Evacuation Traffic at Congestion Monitoring Sites	Shut Down Timeframes
5 mph	8 hours
15 mph	3 hours
25 mph	2 hours
35 mph	1 ½ hours
45 mph	1 hour
55 mph	1 hour
65 mph	1 hour

Assumed monitoring sites:

FDOT Station 140190 (I-75 at SR54 in Pasco County)

FDOT Station 100110 (I-275 west of I-4 interchange)

FDOT Station 100106 (I-4 east of I-275)