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Traffic Calming for Pedestrians

at Miami Dade College Wolfson Campus

Technical Memorandum 3: Final Report

September 2004

Prepared for:
Miami-Dade MPO

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Miami Dade College

MIAMI-DADE MPO

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INTRODUCTION

The Wolfson Campus of Miami Dade College (MDC), located in the northern portion of the Central Business District (CBD) of Downtown Miami, currently has an enrollment in excess of 20,000 students. Due to the Downtown location and multiple city block layout of the campus within the City's grid street network, a substantial number of students, faculty, and staff are required to cross streets to access the various educational buildings and facilities, and parking facilities and transit stations located at the campus. The purpose of this study is to develop recommendations for traffic calming measures specifically aimed at reducing the negative effects of motor vehicle use on pedestrians in and around the Wolfson campus. These recommendations will be made in an effort to improve pedestrian connections and safety at key locations at the campus. In light of anticipated growth in enrollment at the Wolfson Campus, and of the new boom in residential construction as well as the usual development of commercial buildings in Downtown, promoting safety by developing implementable recommendations for traffic calming for pedestrians at the Campus assumes even greater importance.

To assist in the development and review of recommendations, a Study Advisory Committee was established, which included representatives from the Miami-Dade Metropolitan Planning Organization (MPO), Miami Dade College, Miami-Dade County Public Works Department, Miami-Dade Seaport Department, and Miami-Dade Transit. Based on input from the Committee at the project kickoff meeting, a project study area was established, along with a list of high priority focus areas. Figure 1 shows the Wolfson Campus layout, the project study area, and the project's specific focus areas.

This Final Report includes the following:

- A summary of issues affecting pedestrians at the Wolfson Campus, as compiled during the project kickoff meeting with the Study Advisory Committee
- A review of relevant studies from the Downtown Miami area, particularly traffic calming or pedestrian elements
- A review of traffic calming and/or pedestrian approaches proposed at other colleges and universities located in densely developed downtown urban environments
- A summary of the most common pedestrian issues found and problems identified in the research of Downtown Miami and other colleges and universities, along with the most common recommendations, even if not implemented
- A summary of available and relevant pedestrian and traffic calming treatments for at-grade pedestrian crossings
- A review of data collected and compiled for this study, including pedestrian and vehicle counts, pedestrian crash data, and on-site observations of pedestrian and vehicle patterns, including safety issues
- A discussion of the development and assessment of alternatives at the focus areas around the campus
- Presentation of a tiered recommendation plan, along with planning level cost estimate ranges for each improvement

MDC WOLFSON CAMPUS
Study Area & Focus Areas

LEGEND:

- Study Area
- Non-Study Area
- Focus Area
- 1000 MDC Wolfson Building Number

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Figure 1

9/20/04

ISSUES

At the project kickoff meeting with the Study Advisory Committee in February 2004, a number of issues were discussed that impact the Wolfson Campus and its pedestrian activity. This section provides a summary of these issues, grouped by category.

POTENTIAL ONE-WAY TO TWO-WAY STREET CONVERSIONS

The Miami Downtown Transportation Master Plan (MDTMP) recommends conversion of numerous streets in the Downtown area from one-way to two-way, including NE 1st and 2nd Avenues and NE 2nd and 3rd Streets. While two-way traffic requires pedestrians to pay more attention to traffic by needing to be aware of two oppositely moving traffic streams of vehicles, which intrinsically heightens safety concerns, two-way traffic tends to travel more slowly and subsequently is more safe.

FREIGHT MOVEMENT AND TRUCK TRAFFIC CONCERNS

- A 1996 Freight Movement Study showed that 64% of the truck traffic traveling to the Port of Miami uses NE 2nd Avenue to NE 5th Street (55% from I-395 and 9% from NE 2nd Avenue, north of I-395). Similarly, 54% of trucks leaving the Port used NE 6th Street to NE 1st Avenue. Less traffic used NE 5th and 6th Streets from I-95 (6% on each street) to travel to and from the Port. Due to the truck patterns, there are a high number of trucks on NE 5th and 6th Streets directly adjacent to the Wolfson Campus, particularly at the intersection of NE 5th Street and NE 2nd Avenue.
- The MPO Board recently decided to eliminate building a slip ramp from NW 6th Street to I-95 North that would allow direct access to SR 836 westbound – this improvement had been planned after having been recommended in the 1996 Freight Movement Study. As such, the majority of truck traffic traveling to and from the Port will continue to use the NE 1st and 2nd Avenue one-way pair to and from I-395.
- Although the DMTMP does not recommend NE 5th and 6th Streets for conversion to two-way streets, without the planned slip ramp from NW 6th Street to I-95, a two-way conversion may become more feasible. Traffic calming and pedestrian improvements recommended in this study will consider the possibility of these streets being converted to two-way streets.

NE 5TH STREET ISSUES

- NE 5th Street has three eastbound lanes. However, barriers adjacent to the Federal Court House at the NE 1st Avenue intersection currently block off the southern-most lane. The Port opposes this lane closure, as well as any other modifications on NE 5th Street that would reduce vehicle capacity.
- Traffic waiting to enter the Wolfson parking garage across from the Fire Station queues onto NE 5th Street during peak times, blocking the northern most lane.
- The County is installing a midblock pedestrian crossing between the Wolfson Parking Garage and the Fire Station on NE 5th Street (Focus Area A). For this crosswalk, the City

is responsible for providing curb ramps, and the County is responsible for crosswalk markings and pedestrian crossing warning signs. The MDC Wolfson Campus would be responsible for any costs associated with upgrading this midblock crossing to a signalized crossing. The crosswalk plan is presented in Appendix A.

- The County has also completed a study for the intersection of NE 5th Street and NE 2nd Avenue (Focus Area B), which recommended construction of a channelized southbound left turn lane, primarily to accommodate the numerous large trucks that make that left turning movement. Signage is planned at the intersection that will read "Turning Vehicles Yield to Peds". A similar channelization treatment is planned at the NE 6th Street/NE 1st Avenue intersection for right turning vehicles. These improvements are part of an existing project in the MPO's Transportation Improvement Program to make improvements along NE 1st and NE 2nd Avenues between NE 5th and NE 11th Streets, including intersection geometry improvements.

NE 2ND AVENUE/NE 4TH STREET INTERSECTION ISSUES

- There is currently a problem with vehicle-pedestrian conflicts at the NE 2nd Avenue/NE 4th Street intersection (Focus Area C) – when 4th Street gets a green signal indication (concurrently with the pedestrian walk signal), traffic turning left onto 2nd Avenue conflicts with the pedestrian traffic crossing 2nd Avenue on the south side of 4th Street. The traffic signal at this location can only display a concurrent pedestrian phase. Different signal hardware would be needed to display an exclusive pedestrian phase or leading pedestrian interval. Exclusive pedestrian phases are currently used at 6 intersections in the City of Miami (such as at the Flagler Street/Miami Avenue intersection).
- The Wolfson Campus has engaged in discussions with the City of Miami regarding at least a partial closing of NE 4th Street between NE 2nd Avenue and Biscayne Boulevard and incorporating this corridor into the Wolfson Campus' Pedestrian Promenade project. McDonald's (which is located on the southeast corner of the 4th Street/2nd Avenue intersection) has expressed their approval of this project. A partial closure would allow access to the eastern end of NE 4th Street from Biscayne Boulevard to provide access to the existing Holiday Inn parking lot on 4th Street.

NE 3RD STREET & NE 1ST AVENUE PEDESTRIAN ISSUES

- There are two high schools located on the Wolfson Campus. The New World School of the Arts has classes in two buildings (Buildings 4 and 5), which are located on opposite sides of the campus, requiring students to walk across the campus and across several intersections or streets.
- Numerous pedestrians cross midblock on NE 3rd Street between Building 1 and the Wolfson surface parking lot (Focus Area D), and also on NE 1st Avenue, south of NE 3rd Street and adjacent to the same parking lot (Focus Area E). This route across the surface parking lot represents the shortest path between Buildings 1 and 5, and is the route used by many of the high school students that must walk between buildings on campus.
- Miami-Dade County is installing a midblock crosswalk on NE 3rd Street, adjacent to the Wolfson parking lot driveway – the plan is presented in Appendix A.

LITERATURE REVIEW

A literature review was undertaken to research specific pedestrian and traffic calming measures that have been included and recommended in Downtown Miami, as well as other downtown environments, particularly those that contain institutes of higher learning.

DOWNTOWN MIAMI STUDIES

This section addresses the pedestrian and traffic calming elements within studies that focus on Downtown Miami.

Miami Downtown Transportation Master Plan

The Miami Downtown Transportation Master Plan (MDTMP) was developed to provide and organized approach and to set a framework for transportation system improvements in the Downtown area through 2020. The goal of the MDTMP is "to create a unique, progressive, and vibrant Downtown Miami through a balanced transportation system, preservation of neighborhoods, protection of the environment, and improvement of the community's quality of life." The MDTMP focuses on multiple modes of transportation to help resolve mobility issues for Downtown Miami and better connect neighborhoods to this area.

Among those improvements recommended for the area around the Wolfson Campus are:

- Development of pedestrian corridors on all the streets surrounding the Wolfson Campus, including NE 1st and 2nd Avenues, and NE 3rd, 4th, and 5th Streets
- Conversion of existing one-way streets to two-way streets, including NE 1st and 2nd Avenues and NE 2nd and 3rd Streets directly adjacent to the Wolfson Campus
- Provision of a transit greenway on NE 4th Street between Biscayne Boulevard and NE 1st Avenue

Additionally, although they will not directly affect traffic patterns near the Wolfson Campus, NE 9th, 10th, and 11th Streets are currently programmed by the City of Miami to be converted from one-way to two-way between Biscayne Boulevard and NE 2nd Avenue.

Metromover – Bayside Pedestrian Promenade Concept Master Plan

The purpose of the Metromover-Bayside Pedestrian Promenade project is to implement the most cost effective pedestrian improvements to NE 4th Street from Biscayne Boulevard west to NE 2nd Avenue, which will assist not only in the pedestrianization of the street, but also in linking public transit with nearby activity generators (such as Bayside Marketplace). This project proposes the closure or partial closure of NE 4th Street to vehicle traffic, and the extension of the existing pedestrian mall which runs through the Wolfson Campus.

Potential street closure/pedestrian promenade on 4th Street, east of 2nd Ave.

The study notes that aside from providing local access to abutting properties, the section of NE 4th Street between Biscayne Boulevard and NE 2nd Avenue has little significance in the overall vehicular traffic circulation patterns of the study area. The study concluded that because there is excess capacity on NE 3rd and 5th Streets, traffic using NE 4th Street can be rerouted to these other roadways without causing any adverse impacts.

On-street parking on NE 4th Street (a total of 17 spaces) does not appear to play a role in the area's parking inventory, as it represents only 1% of the parking supply adjacent to the study area. It is also noted that on-street parking is typically considered a luxury which provides convenient short-term, high turnover parking in support of abutting commercial development. The only commercial parcel along this corridor is the McDonald's located on the southeast corner of 4th Street and 2nd Avenue, which has voiced its approval of the street closure.

Existing 4th Street pedestrian promenade through Wolfson Campus

The study's preferred alternative is to reroute vehicular traffic from NE 4th Street, converting it completely into a pedestrian promenade. However, given the present property ownership patterns along the south side of the street, closing the street entirely may only be possible west of the Holiday Inn parking lot. The removal of on-street parking spaces would allow for the widening of pedestrian circulation paths along the street enhancing access to the Metromover station, Bayside Marketplace, and the Wolfson Campus. The recommended design provides a continuous paving surface and pattern so as to visually and physically integrate, within the constraints of limited vehicular access, the streetscape activities and pedestrian flows within the existing right-of-way.

An application for Transportation Enhancement funding for the Metromover-Bayside Pedestrian Promenade was submitted by Miami Dade College in the 1990's. The total project cost of $1.4 million was anticipated to be funded with 80% federal funds, 10% state funds, and 10% local funds. According to the Miami-Dade MPO, this Enhancement application was approved, and the project only needs to be coordinated with and approved by the City. The College intends to coordinate with the MPO and the Bicycle-Pedestrian Program within the MPO in pursuit of the funds.

City of Miami Streetcar

A Streetcar Feasibility Study is currently underway in the City of Miami to evaluate the reintroduction of streetcar service in several neighborhoods and corridors of the City, utilizing and implementing its modern technology counterpart. By so doing, it seeks to provide its citizens, businesses, and visitors with a safe, comfortable, and inexpensive urban mode of transit. The intent of a new streetcar service would be to provide improved transit connections between Downtown Miami and redeveloping areas of Midtown, the Miami Design District, Little Haiti, Wynwood/Edgewater, and the Upper East Side. This modern streetcar's route would be designed to link with existing transportation systems as well as with other planned systems such as the Bay Link system, which is proposed to connect Downtown Miami with South Beach.

This project's impact on the Wolfson Campus will depend on the alignment of the system. At this point in the study, the preferred Miami Sstreetcar alignment, which is advancing for further feasibility analysis, travels directly adjacent to the Wolfson Campus on NE 1st Avenue.

STUDIES OF OTHER URBAN AND COLLEGE ENVIRONMENTS

This section of the report focuses on studies found that address pedestrian and traffic calming elements at colleges, universities, and downtown areas. More emphasis was placed on college environments in densely developed downtown areas, but studies that were so specific were difficult to find. As such, other studies were included which focused on colleges and universities not necessarily located in a major downtown area, as well as studies of urban and downtown areas which were not necessarily focused on a college or university. A summary of the studies reviewed, including issues, recommendations, and results (if available) is presented in Table 1. A matrix of the proposed and/or recommended treatments is included in Table 2.

The most common issue among the various studies reviewed is that of pedestrian safety. This echoes the concerns voiced by the Wolfson administration and its officials when they applied for the study within the MPO.

Pedestrians are often required to cross a busy street to travel between different areas of a college campus, or to access supporting land use such as residence halls or recreational areas. Another prevalent issue is non-compliance by pedestrians with existing crosswalks or pedestrian signal phases. This issue is the result of pedestrians often desiring to travel between two places as quickly and directly as possible, which leads them to cross streets in a location that is most convenient for them, and to ignore pedestrian signal indications or phases if they think they can safely negotiate the available gaps in traffic.

As shown in Table 2, the most commonly proposed treatments to address these issues are enhancements to crosswalks, new or improved signals, enhanced signage, curb extensions, and pedestrian refuge islands. Many other innovative treatments were proposed or recommended less frequently. Of note is that all three college campuses reviewed that were considering pedestrian overpasses ended up rejecting them as an option, either because an overpass would not be cost effective or that it would be under used because of the number of distinct origins and destinations on each side of the proposed location. Studies have shown that pedestrians will not use overpasses if a more direct route is available. With multiple origins and/or destinations on each side of a roadway, pedestrians often would be required to walk out of their way to use an overpass. Since it has been noted that pedestrians often opt for the shortest route between their origin and destination, the colleges that evaluated pedestrian overpasses all concluded that given the proposed locations, not enough pedestrians would use them to warrant their high cost.

Table 1
Summary of Literature Review

STUDY/PROJECT	ISSUES	RECOMMENDATIONS	RESULTS
UNIVERSITY OF GEORGIA - ATHENS, GEORGIA			
Campus Pedestrian Improvements	High pedestrian traffic on campus; Issue of pedestrian safety	Raised intersection with advanced warning flasher and increased turning radii at Coliseum parking lot Raised crosswalks and narrowed roadway at crosswalks between commuter parking lot and bus stop; sidewalks constructed to guide peds to crosswalks Exclusive pedestrian phases on traffic signals at 3 locations Installation of "No Turn on Red" and "Watch for Turning Vehicle" signs at intersections on and adjacent to campus Railing and landscaping along Baxter Street, which links residence halls to main campus, to prohibit pedestrian crossing except at intersections	Recommended improvements implemented; No results documented
UNIVERSITY OF LAS VEGAS - LAS VEGAS, NEVADA			
Maryland Parkway Mid-block Crossing - Initial Improvements	Maryland Parkway is a seven-lane roadway this is a heavily traveled crossing between campus and strip malls to the east Considered a dangerous pedestrian crossing	Two crosswalks consolidated into one U-turns prohibited Flashing pedestrian sign Median constructed with angled path to keep pedestrians facing oncoming traffic	Initial improvements implemented - but continued safety issues Only 20% of vehicles yielded to pedestrians in the crosswalk 14% of pedestrians still crossed street unsafely
Maryland Parkway Mid-block Crossing - Additional Study	Continued safety issues after initial improvements	Mid-block traffic signal Pedestrian bridge Greater level of enforcement to try and change driver behavior	Mid-block signal determined to be impractical by County Engineer because there are existing traffic signals a half block south and north of crossing Pedestrian bridge determined not to be cost-effective by County Engineer Greater degree of enforcement implemented but no results documented
UNIVERSITY OF WISCONSIN - MADISON, WISCONSIN			
West Campus Pedestrian and Bicycle Improvement Projects	Desire to enhance pedestrian and bicycle facilities; Improve overall safety on campus	Colored, stamped concrete pedestrian crosswalks at intersections Pedestrian refuge islands in selected median crosswalks Add stop bars and "STOP" lettering painted on asphalt at all STOP signs New painted pedestrian crosswalks Increase walk light times at selected signalized intersections Review policy of right-on-red turning movements with City Traffic Engineer	Improvements were committed to by the College but no results documented

Table 1, continued
Summary of Literature Review

STUDY/PROJECT	ISSUES	RECOMMENDATIONS	RESULTS
UNIVERSITY OF CALIFORNIA AT BERKELEY SOUTH CAMPUS - BERKELEY, CALIFORNIA			
Planning a Multi-Modal Circulation System for a University Campus	Conduct an operational analysis using a systems approach of alternatives designed to calm traffic flow in study corridor	Low cost circulation improvements Pedestrian crosswalk improvements New traffic signals Contra-flow bus signals Conversion of one-way streets to two-way streets with enhanced pedestrian crossings	No results documented
MARIST COLLEGE - POUGHKEEPSIE, NEW YORK			
Pedestrian Crossing Improvements	Heavily traveled pedestrian crossing of Route 9 which separates east and west side of campus - 4,000 daily pedestrian crossing at 4 crosswalks & 39,000 daily vehicles on Route 9 Based on a survey conducted by NYDOT, 70% of students cross Route 9 where it is most convenient and not at designated crossings	Traffic signal with pedestrian countdown heads at an existing mid-block crossing, synchronized with existing signals in corridor Upgrade existing crosswalk signal heads to countdown signal heads Upgrade lighting at all intersections Install a lined, diagonal crosswalk at a major intersection to be consistent with preferred pedestrian path Enhanced enforcement by town police and campus security	No results documented
ROLLINS COLLEGE - WINTER PARK, FLORIDA			
Rollins College Pedestrian Study	New parking garage being constructed across from Campus at a mid-block crossing of SR 426 that will significantly increase pedestrian traffic at this location; Significant number of students attend night class	Mid-block pedestrian signal Additional pedestrian warning signs and flashers Additional overhead lighting in the median Advance pedestrian warning signs for traffic approaching the mid-block pedestrian crossing Remove trees in median and replace with low level landscaping to increase visibility of pedestrians from oncoming vehicles Align walkway leading to/from campus with mid-block crossing	Mid-block pedestrian signal was warranted based on projected traffic and recommended subject to an operational analysis of corridor Subsequent operational analysis determined mid-block pedestrian signal would not be disruptive to platooned traffic flow along corridor FDOT installed mid-block pedestrian signal with warning signs and flashers
GEORGE WASHINGTON UNIVERSITY - DISTRICT OF COLUMBIA			
Pedestrian Crossing Study of H Street	H Street is an east-west road through campus - the block between 21st St. and 22nd St. separates student residence halls the student union and the academic center from the library, the quad and the auditorium Crossing study of H Street indicated 14,000 persons jaywalked across study block during the day District of Columbia is currently upgrading all pedestrian crossing signals to include countdown timers based on signal replacement schedule	Pedestrian overpass 3 raised crosswalks between major destinations - crosswalks will be angled so pedestrians can view oncoming traffic Use of landscape and environmental design to channel people to three new crosswalks Restriction on standing and parking, especially for larger trucks along street Evaluate advancing the replacement of signals near the university to include countdown timers	Pedestrian overpass was determined to not be a valid option in this location because there was no single origin/destination point The University and District of Columbia are pursuing other recommended improvements

Table 1, continued
Summary of Literature Review

STUDY/PROJECT	ISSUES	RECOMMENDATIONS	RESULTS
JOHNS HOPKINS UNIVERSITY - BALTIMORE, MARYLAND			
Redesign of Charles Street	Issue of pedestrian safety crossing Charles Street, a four-lane roadway which separates the campus from student residential areas City is currently working on a redesign of Charles Street with one aim to be slowing of traffic in the area - the University has provided a number of options which it hopes are included in the project	University has recommended the following as part of the City's Charles Street redesign project: More traffic signals (currently only 2 in an 8-block section) Pedestrian activated signals with a "scramble" pedestrian-only phase More visible, textured crosswalks Larger medians to act as pedestrian havens Pedestrian overpass over Charles Street	Final roadway typical and plan for Charles Street has not been decided upon yet Pedestrian overpass determined to be unlikely due to large number of origins/destinations - students unlikely to be channeled out of roadway
DREXEL UNIVERSITY - PHILADELPHIA, PENNSYLVANIA			
Traffic Safety Program	University and City Traffic Engineering Department conducted traffic safety survey of the Campus University issued Safety Bulletin University has implemented some existing measures to improve pedestrian safety	Additional signage recommended as a result of the survey Safety Bulletin urged pedestrians to only cross in designated crosswalks and urged students to only cross at corners of intersections - also included other pedestrian related safety tips	Additional signage was added to campus School has implemented design elements to channel people to crosswalks such as the plan of paths and other walkways and the use of landscaping
MICHIGAN TECHNOLOGICAL UNIVERSITY - HOUGHTON, MICHIGAN			
University Pedestrian Improvements	High occurrence of speeding on US 41 which extends through campus; Issue of pedestrians safety crossing US-41	Interactive radar speed signs to alert drivers to how fast they are going New crosswalk markings Larger speed-limit and pedestrian warning signs Increase enforcement of speeding	Recommended improvements implemented but no results documented
CARLETON UNIVERSITY - OTTAWA, CANADA			
University Drive Traffic Calming Improvements	Issue of high vehicle speeds on University Drive, a four-lane commuter roadway that extends through campus	Reconfigure and narrow four-lane road Striped pedestrian crossings STOP sign at pedestrian crossings On-street parking in the bays between crosswalks	Recommended improvements implemented but no results documented

Table 1, continued
Summary of Literature Review

STUDY/PROJECT	ISSUES	RECOMMENDATIONS	RESULTS
DADE COUNTY, FLORIDA			
Neighborhood Traffic Management	County inundated with requests from neighborhood residents for street closures County and MPO contracted for a study to research issues regarding street closures and develop traffic management procedures to address citizen requests for traffic flow modifications		Future street closures or traffic flow modification within the County and its municipalities will be limited to residential local streets and residential collector streets An 8-step incremental implementation process was developed to address citizen requests or proposals for street closure or traffic flow modification
CITY OF CAMBRIDGE, MASSACHUSETTS			
Overall City Traffic Calming Program	Dense urban environment High levels of transit service which encourage walking Home to 4 Universities and Colleges Pedestrian compliance low (2% - 64%) at traffic signals with exclusive pedestrian phases (although compliance increased with higher vehicle volumes)	Curb extensions Raised crosswalks Raised intersections Crossing islands Chicanes	85th percentile speed reduced by 14% to 30% using traffic calming measures Percent of drivers yielding to pedestrians at crossings significantly increased
Columbia Street Project	High pedestrian demand Crosswalk serves primary entrance to park, and intersection links neighborhood with an elementary school, branch library and a park Speeding and safety issues	Curb extensions Raised crosswalk Raised intersection Shifting on-street parking from side to side to create chicanes	Percent of drivers yielding to pedestrians increased from 13% to 53% at raised crosswalk (no indication as to whether marked crosswalks existed in "before" condition) Percent of drivers yielding to pedestrians increased from 18% to 54% at raised intersection
Berkshire & York Streets Projects	Speeding and running of STOP signs; Cut-through traffic during PM peak periods	Curb extensions on all 4 corners of intersections Raised crosswalk Raised intersections Reduce width of street to create a chicane Zebra crosswalk markings	85th percentile speed decreased from 30 mph to 21 mph at vertical calming devices and to 24 mph in between Before improvement 41% of vehicles traveling at or below 25 mph speed limit - after the study 95% of vehicles traveling at or below 25 mph.
Granite Street Project	Speeding issues	Curb extension on all 4 corners of intersections Raised crosswalk Raised intersection Truncated domes on edge of crosswalk Zebra crosswalk markings Unwarranted traffic signal removed at intersection	85th percentile speed decreased from 28 mph to 24 mph Before improvement 61% of vehicles traveling at or below 25 mph - after the study 86% of vehicles traveling at or below 25 mph.

Table 1, continued
Summary of Literature Review

STUDY/PROJECT	ISSUES	RECOMMENDATIONS	RESULTS
BROOKLYN, NEW YORK			
Downtown Brooklyn Traffic Calming Study	Dense urban area Extensive traffic calming study prepared by New York City DOT that identifies issues, develops recommendations, prepared area-wide strategies and a phased pilot program Pilot Study explored practical issues of implementation of typical traffic calming measures and attempted to gauge the impacts on safety, traffic operations and public perception	All pedestrian signal phase to remove conflict between pedestrians and vehicles	No impact to vehicle throughput due to low side street volumes Many pedestrians still did not obey "Don't Walk" Initially drivers began to lurch forward during the exclusive pedestrian phase, but this problem eventually no longer occurred (Potential solution - add MUTCD "Delayed Green" signage)
		Raised intersection (raised 2 inches with 8.33% grade on approaches)	Substantial reduction in median speed Pure asphalt intersection performed poorly - noisy at departure from intersection (noted that this could be remedied using concrete) Mailbox & face-to-face surveys of residents, merchants, and peds - Results: 77% said traffic turned more slowly and 91% said raised intersection slows traffic
		Leading pedestrian interval (LPI) - walk indications for NB & SB pedestrian movements displayed 5 seconds sooner than NB traffic at "T" intersection	Public response almost universally positive Survey results - 89% said LPI increased pedestrian safety and 96% said it increased pedestrian crossing possibilities Only 35% said LPI improved driver behavior LPI decreased traffic flow on side street and caused honking problem during AM peak period
		Neckdowns (curb extension) to provide pedestrians a safe, legal place to stand and shorten the crossing distance	Survey results - 94% said pedestrians felt safer and had better crossing opportunities and 100% said pedestrians were more visible No change in vehicle speeds Design of curb extensions needs to be compatible with street sweepers
			After 6 years of study and the initiation of the Pilot Study, the New York DOT eventually killed the traffic calming project

Table 1, continued
Summary of Literature Review

STUDY/PROJECT	ISSUES	RECOMMENDATIONS	RESULTS
CITY OF SACRAMENTO, CALIFORNIA			
Traffic Calming in Downtown Sacramento	City undertook major traffic calming plan that took 7 years, 5 published studies and 75 public meetings to be approved Plan encompassed 120 blocks in residential portion of downtown	Conversion of two heavily traveled one-way roadways to two-way operation Installation of 18 STOP signs Installation of 5 traffic signals Installation of 3 high-visibility crosswalks Installation of 16 corner bulb-outs at intersections 9 half street closures	No results documented
CITY OF SEATTLE, WASHINGTON			
Neighborhood Traffic Control Program - Mid-Block Speed Control	City has an active Neighborhood Traffic Control Program that attempts to address issues regarding cut-through and speed traffic City conducted case studies of experience with 2 types of mid-block speed control devices: chicanes and speed humps Chicanes consisted of a series of 2 or 3 curb bulb outs placed on opposite side of street to create a curved 1-lane segment Tested 2 types of speed humps - Seminole (6 ft. long ramps rising to 10 ft. long, 3 inch high center) and Watts (12 ft. long with 3 inch rise to center)		Chicane design in certain circumstances found to be problematic due to slope, curvature of road and the number of driveways Chicanes significantly reduce speeds of vehicles traveling through the device - 85th percentile speeds reduced by 8 to 12 mph. Chicanes shown to be effective at reducing traffic volumes on streets with nearby alternative routes - up to 48% decrease Both types of speed humps resulted in similar reductions in 85th percentile speeds between the humps of 2 to 7 mph Watts style speed humps slightly more effective at reducing speed on the hump Speed humps shown to be effective at reducing traffic volumes on streets with nearby alternative routes - up to 43% decrease Fire Department determined chicanes increased response time and could cause major delay if trucks experienced another vehicle negotiating chicane - larger trucks limited due to residents parking within the chicane Future chicanes constructed with 2 ft. wide mountable curb to allow emergency vehicles to drive over them and no parking allowed within chicane

Table 1, continued
Summary of Literature Review

STUDY/PROJECT	ISSUES	RECOMMENDATIONS	RESULTS
CITY OF BOSTON, MASSACHUSETTS			
Route 20 Transportation Planning Study (Boston University Area)	Boston University student activities generate high pedestrian volumes along study corridor, which is a high volume roadway Transit runs in median of roadway, forcing passengers to cross streets to board trains or exit from station platforms Observed issues of jaywalking, non-compliance with pedestrian crossing signal and drivers speeding and failing to yield to pedestrians in crosswalks	Widen transit reservation and platform to provide better refuge from traffic WB travel lanes reduced from 3 to 2 lanes to provide shorter crossing distances Curb extensions at intersections and platforms Improved pedestrian signal equipment & indications to be more responsive to pedestrian activation Improved signal phasing for better response to pedestrian calls	No results documented
FHWA CASE STUDIES			
Pedestrian Crosswalk Case Studies	Research examined effect of crosswalk markings on driver and pedestrian behavior at unsignalized intersections 11 intersections studied in 4 cities representing different geographical regions of the U.S.: Richmond, VA, Buffalo, NY, Stillwater, MN and Sacramento, CA		Drivers approach pedestrians in a crosswalk at slower speeds Crosswalk usage increases with markings Pedestrians tend to use the same level of caution with or without markings No changes found in vehicle yielding or pedestrian assertiveness Marking crosswalks at low-speed, low-volume unsignalized intersections is desirable

Table 2
Matrix of Recommended Treatments in Other Areas

Proposed or Recommended Treatment	Colleges/Universities												Cities				Total
	UGA	UNLV	Wisc	UC Bk	Marist	Rollins	G Wash	J Hopk	Drexel	MTU	Carltn	Bost U	Cambr	Brklyn	Sacrm	Seattle	
Crosswalk Improvements			✓	✓	✓			✓		✓	✓		✓		✓		8
New/Improved Signals		✓	✓	✓	✓	✓		✓				✓			✓		8
Enhanced Signage	✓	✓				✓			✓	✓							5
Curb Extensions												✓	✓	✓	✓		4
Sidewalk/Crosswalk Alignment		✓			✓	✓			✓								4
Ped Refuge Islands		✓	✓					✓					✓				4
Landscaping	✓					✓	✓										3
Raised Intersection	✓												✓	✓			3
Raised Crosswalk	✓						✓						✓				3
Exclusive Ped Phase/Leading Ped Interval	✓							✓						✓			3
Road Narrowing	✓										✓	✓					3
Greater Level of Enforcement		✓			✓					✓							3
Ped Overpass		✓					✓	✓									3
Chicanes													✓			✓	2
Ped Countdown Signal Timers					✓		✓										2
Lighting Improvements					✓	✓											2
1-Way to 2-Way Street Conversions				✓											✓		2
Speed Humps																✓	1

UGA = Univ. of Georgia
UNLV = Univ. of Nevada Las Vegas
Wisc = Univ. of Wisconsin
UC Bk = Univ. of California at Berkeley
G Wash = George Washington Univ.
J Hopk = Johns Hopkins Univ.
MTU = Michigan Technological Univ.
Carltn = Carleton Univ.
Bost U = Boston Univ. (Route 20 Study)
Cambr = Cambridge, MA
Brklyn = Brooklyn, NY
Sacrm = Sacramento, CA

There were a limited number of studies that presented results *after* the treatments had been implemented, with mostly favorable results. Some important results to note come from the FHWA study on the effect of crosswalk markings on driver and pedestrian behavior. This study found that drivers approach marked crosswalks more slowly, crosswalk usage increases with markings, pedestrians tend to use the same level of caution with or without markings, and there was no change in vehicle yielding with or without crosswalks. The study concluded that marking crosswalks at low-speed, low-volume, unsignalized intersections is desirable. Other studies demonstrated that traffic calming treatments with a vertical element (such as raised crosswalks or intersections) result in decreased vehicle speeds and more yielding to pedestrians, while curb extensions make pedestrians more visible and provide them with more crossing opportunities.

SUMMARY OF AT-GRADE PEDESTRIAN CROSSING TREATMENTS

Table 3 presents a summary of numerous treatment options for consideration to address at-grade pedestrian crossings, including descriptions of the treatments, their typical costs, advantages and disadvantages, and any studies with documented results.

Table 3
Summary of At-Grade Pedestrian Crossing Treatment Options

DESCRIPTION / OBJECTIVE	COST	ADVANTAGES / DISADVANTAGES	STUDIES / RESULTS
HIGH VISIBILITY MARKINGS AT UNCONTROLLED CROSSINGS			
Ladder or "Zebra"-style crosswalk pavement markings; Used to provide drivers greater information at locations where there are substantial numbers of pedestrians	$500 - $1,000 per crosswalk depending on materials used & width of the street	*Advantages:* Improves visibility of crosswalk *Disadvantages:* Not useful to blind pedestrians	An unpublished study by the City of Ventura, CA showed a reduction in pedestrian collisions where crossings were striped with high-visibility markings (however, other improvements such as warning signs were also implemented)
ADVANCED PLACEMENT OF STOP & YIELD LIMIT LINES AT UNCONTROLLED CROSSINGS			
Standard white stop or yield limit lines are placed typically 20 feet in advance of marked uncontrolled crosswalks (yield lines may be supplemented by yield signs); Used to encourage drivers to stop a greater distance from the marked crosswalk 	$300 - $500 per location depending on materials used & width of the street	*Advantages:* Encourages drivers to stop well in advance of the crosswalk, which helps to reduce the potential for pedestrian-related collisions that occur on multi-lane streets when one driver stops to let a pedestrian cross in the crosswalk and the pedestrian is struck by a trailing vehicle in an adjacent lane *Disadvantages:* Unpublished studies indicate that drivers are less likely to comply with 20-foot advance stop lines, but compliance is better with 5-foot advance stop lines	Studies by Van Houten on the effectiveness of installing stop and yield limit lines in advance of crosswalks on multi-lane streets found this treatment to be effective (however, the number of sites studied was limited)
FLUORESCENT YELLOW-GREEN SIGNS AT UNCONTROLLED CROSSINGS			
Pedestrian signs made of the FHWA-approved fluorescent yellow-green color; Used to enable drivers to detect warning signs with higher frequency & recognize them at further distances with greater accuracy	$200 - $300 per sign including labor & materials; If installed on an existing pole, $50 - $100 per sign	*Advantages:* Color attracts drivers' attention to crossings *Disadvantages:* Overuse may negate effectiveness (although no more than existing signs)	Kittle cites several studies performed by FHWA in 1992-1993 that conclude that fluorescent yellow-green signs improved the conspicuity of the signs' messages; Drivers were able to recognize them from greater distances than the standard yellow signs
OVERHEAD SIGNS AT UNCONTROLLED CROSSINGS			
Warning signs are installed using span wire or mast arms; Used to make signs more visible to drivers	$15,000 - $25,000 depending on whether span wire or mast arms are used	*Advantages:* Signs are more visible & have a greater impact on drivers *Disadvantages:* More costly to install and maintain, and create more visual clutter than post-mounted signs	None found
PEDESTRIAN RAILINGS AT UNCONTROLLED CROSSINGS			
Railings are placed along the top of the curb (typically must be 4 feet high to be effective and should include a horizontal rail 1-1.5 feet above the curb height for detection by the visually impaired traveling with the aid of a cane); Used to channelize pedestrians to the safest designated crossing points	Approx. $30 per linear foot (can be more if aesthetic enhancements incorporated)	*Advantages:* Railings direct pedestrians to appropriate crossing locations, and can prevent midblock crossings *Disadvantages:* Railings may be considered to diminish the aesthetic quality of the street environment Railings can become obstacles for accessing the sidewalk for pedestrians that ignore them	Lalani conducted studies on Pelican crossings for the GLC, which demonstrated an improved safety record when pedestrian railings were used to discourage pedestrians from crossing near the crossing instead of at the crossing where the pedestrian signal provided better protection

Table 3, continued
Summary of At-Grade Pedestrian Crossing Treatment Options

DESCRIPTION / OBJECTIVE	COST	ADVANTAGES / DISADVANTAGES	STUDIES / RESULTS
AUTOMATED DETECTION AT UNCONTROLLED CROSSINGS			
Uncontrolled crosswalks are fitted with automatic detection devices that activate flashing beacons, in-pavement raised markers with LED strobe lights, or other active warnings to alert drivers when pedestrians are present; Used to improve the effectiveness of the activated beacons	Cost per sensor for microwave & infrared sensors ranges from $500 - $1,000; camera sensors range from $15,000 - $25,000	*Advantages:* Pedestrians do not have to push a button to activate the warning devices *Disadvantages:* False calls have been reported by a number of agencies as a serious problem; Can be a problem for visually impaired pedestrians; Passive detection does not alert pedestrians to the fact that there is traffic control available other than the crosswalk stripes; Custom signs directing pedestrians to locate themselves correctly so that they can be detected pose user recognition and language problems where the population is multilingual	None found
FLASHING BEACONS AT UNCONTROLLED CROSSINGS			
Flashing amber lights are installed on overhead signs, signs in advance of the crosswalk, or signs located at the entrance to the crosswalk on pedestrian poles; when pedestrian detection is used to activate beacons, it is necessary to install accessible pedestrian signals (APSs) so that visually impaired pedestrians can identify the crossing interval; Used to increase driver attentiveness when approaching marked crosswalks at uncontrolled locations that are occupied by pedestrians	$10,000 - $40,000, depending on the placement of the flashing beacons 	*Advantages:* May draw driver attention to a crossing *Disadvantages:* Significant costs for installation & maintenance; Constant flashing causes beacons to be ignored by drivers	Studies conducted by Van Houten, et al, examined the effects of introducing flashing beacons and the "Yield When Flashing" sign - the percentage of drivers yielding to pedestrians increased to over 86% at both study locations, a statistically significant change; The City of Los Angeles studied 2 crosswalks across multilane major streets where overhead flashing beacons activated by microwave sensors had been installed - the results of the study indicated that the number of drivers yielding to pedestrians in the crosswalks increased by 10-14% after installation of the overhead beacons
CURB EXTENSIONS AT UNCONTROLLED CROSSINGS			
The sidewalk extends across the parking lanes to the edge of the travel lanes to narrow the distance of the road that a pedestrian has to cross; Used to improve the visibility of pedestrians waiting to cross by bringing them closer to the center of the driver's cone of vision and by minimizing the impact of parked vehicles on pedestrian visibility 	$5,000 - $25,000 per extension, depending on the need to modify drainage; if patterned concrete or other street furniture are included, costs can increase significantly	*Advantages:* Reduce the distance that pedestrians travel in the street; Make streets more pedestrian friendly; By tightening up the corner radius, they can help slow the speed of turning vehicles; Improve the visibility of pedestrians by placing them where drivers can see them, where parked vehicles do not obscure their presence; Make it difficult for drivers to park illegally at the corners of intersections; Help slow traffic and have a modest traffic calming effect *Disadvantages:* Can constitute fixed objects drivers may run into at night or inclement weather conditions; Provide no buffer between waiting pedestrians and passing vehicles; Can pose obstructions to street sweepers; Can create drainage problems; Impact the turning ability of trucks and other heavy vehicles	Ewing reports in ITE's Traffic Calming State of the Practice that very few problems have been reported with curb extensions other than the relatively high cost of curb work, drainage modifications, and frequently, landscaping or decorative pavements

Table 3, continued
Summary of At-Grade Pedestrian Crossing Treatment Options

DESCRIPTION / OBJECTIVE	COST	ADVANTAGES / DISADVANTAGES	STUDIES / RESULTS
STREET LIGHTING FOR PEDESTRIANS			
Lights are installed, generally 150-watt bulbs at 100-foot spacing, 10-12 feet high, on both sides of the street; Used to provide levels of lighting that are oriented towards pedestrian activity and not exclusively for pedestrian traffic	$2,000 - $3,000 per streetlight, depending on ornamental style and whether each pole carries 1 or 2 lamps; Conduit costs may also be higher	*Advantages:* Provides better ambient lighting conditions for drivers to see pedestrians, who feel safer in such environments *Disadvantages:* Energy costs for installing & operating pedestrian-oriented lighting is significantly higher than that for vehicle-oriented lighting	Lalani conducted studies for the GLC that demonstrated reductions in pedestrian-related collisions when light levels were increased at locations chosen for the treatment because their nighttime-related pedestrian collision rates were above average
TEXTURED SURFACES AT UNCONTROLLED CROSSINGS			
Crosswalks having stamped concrete or asphalt, or brick pavers laid in a pattern; Used to increase driver awareness of pedestrian activity by improving visibility and creating a different audible tone 	$10,000 - $35,000 depending on materials used & street width	*Advantages:* Helps crossing to stand out better; can provide a tactile cue to people with sight impairment (but care should be taken to assure that there is also a tactile cue that a person is leaving the sidewalk to cross the street) *Disadvantages:* High construction & maintenance costs; Does not provide smooth, accessible surfaces for pedestrians; Care should be taken to minimize gaps & settling of pavers to reduce vibrations for wheelchair & walker users; May cause a noise problem; some agencies report that high visibility markings are more effective than textured surface treatments; Repairing utility cuts is more costly & difficult; Pavement markings do not adhere as well to textured surfaces as they do to conventional pavement surfaces	None found
RAISED CROSSWALKS / RAISED INTERSECTIONS			
Crosswalks or intersections are raised up to 6 inches above the roadway pavement to an elevation that matches the adjacent sidewalk; Raised crosswalks have a flat area on top that constitutes the crosswalk that may be made with asphalt, patterned concrete, or brick pavers; Raised intersections also may use patterned concrete or brick pavers; Tactile treatments are needed at the sidewalk/street boundary so visually impaired pedestrians can identify the edge of the street; Used to control traffic speeds approaching and then traversing the crosswalk or intersection to improve the safety of pedestrians using the crosswalk or crossing at the intersection	$5,000 - $20,000 per raised crosswalk depending on the street width, whether drainage is affected, and the materials used $50,000 - $75,000 per raised intersection depending on materials used, drainage affected, and width of street	*Advantages:* Reduced traffic speeds at the crosswalks; Pedestrian crossing is highlighted which helps to focus activity in the desired location *Disadvantages:* Cost of installation; drivers with disabilities have expressed concern about the levels of discomfort caused by traffic calming installations with vertical deflection; Edge of street is not readily detectable without tactile cues	Watkins of the City of Cambridge showed that the average percentage of drivers yielding to pedestrians increased from an average of 15% before the installation to 55% after the raised crosswalk was installed, and the 85th percentile speed declined from 50 kph to 40 kph; In Beaverton, OR, crosswalks were raised 3 inches and sidewalks were lowered 3 inches at raised crosswalks

Table 3, continued
Summary of At-Grade Pedestrian Crossing Treatment Options

DESCRIPTION / OBJECTIVE	COST	ADVANTAGES / DISADVANTAGES	STUDIES / RESULTS
LEADING PEDESTRIAN SIGNAL INTERVALS (LPI)			
Pedestrian traffic is released a minimum of 3 seconds in advance of all movements (when left turns have permitted signal phasing); Allows pedestrians to begin crossing several seconds before the release of potentially conflicting motor vehicles at signalized intersections	$1000 or more, depending on the capabilities of the controller at the intersection, and the ability to add more intervals	*Advantages:* Reduces pedestrian-vehicle conflicts by allowing pedestrians to start crossing before vehicular traffic is given a green indication to turn across the crosswalk; This operation provides some of the benefit of an exclusive pedestrian phase, while still permitting most of the pedestrian crossing time to run concurrent with non-conflicting vehicle phases *Disadvantages:* Pedestrians with visual impairments are unable to take advantage of the LPI unless accessible pedestrian signals (APSs) are provided	Retting, et al, studied 3 urban intersections in St. Petersburg, FL at which LPI were installed, with results indicating that the number of pedestrian right-of-way violations by turning vehicles decreased significantly; These results were supported by a similar study conducted by Fleck at 2 intersections in San Francisco, CA
SCRAMBLE PATTERN AT SIGNALIZED INTERSECTIONS			
Pedestrians are permitted to cross in all directions at a signalized intersection, including diagonally, during an exclusive pedestrian phase; During the exclusive pedestrian phase, the vehicular indications display red on all approaches; Used to enable pedestrians to cross an intersection without any vehicular conflicts	$2,000 per intersection for the four additional pedestrian signal indications (for diagonal pedestrian flow) - this assumes the signal controller is capable of displaying an exclusive pedestrian phase	*Advantages:* Allows pedestrians to cross intersections diagonally instead of crossing two legs of the intersection, making signalized intersections more friendly; Reduced vehicle turning conflicts, which represent 60% of pedestrian-related collisions at intersections. *Disadvantages:* Capacity of the intersection for vehicular traffic is significantly reduced because vehicular signal indications are red for all directions during the exclusive pedestrian phase; Lowers the progression speed along corridors having this type of operation; Pedestrians with visual impairments require accessible pedestrian signals (APSs); Longer pedestrian clearance intervals needed for diagonal movements	Hannan evaluated scramble signals and compared them to leading pedestrian intervals (LPI) - comparison indicated that leading intervals were more effective treatments than scramble signals
COUNTDOWN PEDESTRIAN SIGNAL INDICATIONS AT SIGNALIZED INTERSECTIONS			
Used in conjunction with conventional pedestrian signals to provide information to pedestrians regarding the amount of time remaining to safely cross the intersection; The countdown timer starts either at the beginning of the pedestrian phase or at the onset of the pedestrian clearance interval (flashing Don't Walk), and continues counting down through the end of the pedestrian clearance interval 	$500 - $800 per signal indication	*Advantages:* Pedestrians are provided more information about how long the pedestrian phase will last, thereby discouraging people from crossing at the end of a phase *Disadvantages:* Higher installation & maintenance costs; Not accessible to pedestrians with impaired vision; Can create a possible legal conflict if a pedestrian starts crossing during the pedestrian clearance interval but cannot finish the crossing before the countdown timer reaches zero	Leonard, et al, evaluated the use of countdown-type pedestrian signals and concluded that they did not prevent pedestrians from initiating crossing at the beginning of the pedestrian clearance interval any more than conventional signals, but were successful in discouraging pedestrians from starting to cross with a few seconds left

Table 3, continued
Summary of At-Grade Pedestrian Crossing Treatment Options

DESCRIPTION / OBJECTIVE	COST	ADVANTAGES / DISADVANTAGES	STUDIES / RESULTS
IN-PAVEMENT RAISED MARKERS AT UNCONTROLLED CROSSINGS			
Both sides of a crosswalk are lined with durable encased raised pavement markers. Most of the treatments use amber LED strobe lighting in the raised pavement markers to alert drivers that they are approaching an occupied crosswalk. The LEDs in the raised pavement markers are activated either by push buttons or by automatic detection bollards using infrared sensors that cover the entrance to the crosswalk. Some applications include LED strobe lighting in the pedestrian crossing signs.	$15,000 - $40,000 per crossing depending on the width of the road, whether the treatment includes automatic detection bollards, and whether the amber LED strobe lighting is installed in the pedestrian crossing signs (W11 in the MUTCD). The markers have to be replaced after construction affecting the roadway surface; replacement cost is less than the initial installation.	*Advantages:* Increased driver awareness of pedestrians in the crossing, especially if the markers and pedestrian warning signs include amber strobe lighting that is activated by passive detectors that do not rely on pedestrians pushing a button. *Disadvantages:* Capital cost is significant; Markers have to be reinstalled when a road is resurfaced or affected by utility repairs; May reduce the impact of painted-only crosswalks; Overuse may diminish its effectiveness over time; Markers tend only to be seen by the first vehicle in a platoon; At low sun angles, the markers are not as apparent to drivers; Lack of long-range visibility; Could create a slipping hazard for bicyclists; Harsh on-street conditions may cause rapid degradation of the markers, including fogging	Studies by the City of Kirkland, WA showed that the percentage of drivers yielding to pedestrians and the distance from the crosswalk at which they started to brake increased significantly at two locations where in-pavement raised markers with amber LED strobe lighting were installed. Preliminary results from a yet-to-be published study by Katz, Okitsu & Associates reveal 80% fewer collisions than would be expected for traditional markers, based upon aggregate data of about 400 million vehicle crossings at about 40 sites, all of which are less than 3 years old.
WARNINGS OF TURNING VEHICLES AT SIGNALIZED INTERSECTIONS			
Word legends, signs, & auditory devices are placed at each end of the crosswalk so they are legible to pedestrians waiting to cross; Used to encourage pedestrians to watch for through and turning vehicles	$300 - $700 depending on whether paint or thermoplastic materials are used for pavement legends; Signs range from $100 - $200; Auditory devices range from $500 - $1,000	*Advantages:* Useful where there are high levels of pedestrians conflicting with large turning volumes of vehicles *Disadvantages:* Cost of installing this treatment at numerous locations could become significant; Overuse could negate impact	A study by Abdulsattar, et al, found this type of signing reduced left-turning vehicle conflicts with pedestrians by 20-60% and right-turning vehicle conflicts with pedestrians by 15-30%; A study by Retting, et al, reported that implementation of signs & pavement legends resulted in improvements in pedestrian safety at locations in the USA and Canada (percentage of pedestrians not looking for any threats from turning vehicles declined from 15-18% to 3% with both signs and painted legends on the pavement); Van Houten, et al, found a 75% reduction in the percentage of pedestrians not looking for threats and a similar reduction in the number of conflicts at an intersection fitted with speakers that provide an auditory message prompting pedestrians to look for turning vehicles during the Walk interval

Source: Alternative Treatments for At-Grade Pedestrian Crossings, An Informational Report by Nazir Lalani & the ITE Pedestrian and Bicycle Task Force, 2001.

COMPILATION OF DATA

Pedestrian and vehicle data were compiled for this study to help assess the need for, specify the types of, and locate potential improvements. Information collected includes pedestrian crash data, pedestrian and vehicle volumes, and observations of pedestrian and vehicle movement patterns.

PEDESTRIAN CRASH DATA

Pedestrian crash data for Miami-Dade County from 1996-2001 were supplied by the Miami-Dade MPO Bicycle and Pedestrian Program Staff. These were supplemented by records of crashes since 2001 on or near campus, kept by the MDC Wolfson Campus Administration. When both datasets were reviewed together, it was revealed that a total of 16 pedestrian crashes occurred between 1996 and 2003 within or directly adjacent to the study area. The locations of these crashes are shown in Figure 2 and summarized in Table 4.

As shown in Table 4, the 16 pedestrian crashes resulted in 11 injuries and 2 fatalities. Nine crashes were identified as occurring at intersections, while 4 occurred away from intersections, and 3 occurred in parking lots or garages. Weather and lighting conditions typically did not have an impact on the collisions, as only 2 of 16 occurred at night, and only 1 occurred when the roads were wet. Most often the driver was at fault in the crashes (9 times), while only once the pedestrian was solely at fault. In 2 of the crashes, neither driver nor pedestrian was at fault, and 4 times both parties were at fault.

An important point to note is that although the focus areas defined by the Study Advisory Committee are dangerous areas due to potential pedestrian-vehicle conflicts, there have not been any crashes identified directly within four of those five areas since 1996.

Focus Area B (intersection of NE 2nd Avenue and NE 5th Street) did have 3 crashes, including 1 fatality. This represents the highest frequency crash location within the project study area. However, there has not been a pattern to the crashes, as each was caused by different factors. The three crashes are briefly summarized as follows:

- Crash #9 (9/25/00) – A pedestrian who was jaywalking across NE 5th Street from north to south just east of NE 2nd Avenue, was killed by a vehicle making a southbound left turn onto 5th Street (both driver and pedestrian at fault)
- Crash #14 (7/17/03) – A pedestrian crossing NE 2nd Avenue in the south crosswalk along NE 5th Street was injured by a City bus that was making an eastbound right turn onto NE 2nd Avenue (driver at fault)
- Crash #15 (8/18/03) – A pedestrian crossing NE 5th Street in the west crosswalk at NE 2nd Avenue was injured by an eastbound motorist who ran a red light (driver at fault)

Pedestrian Crash Locations

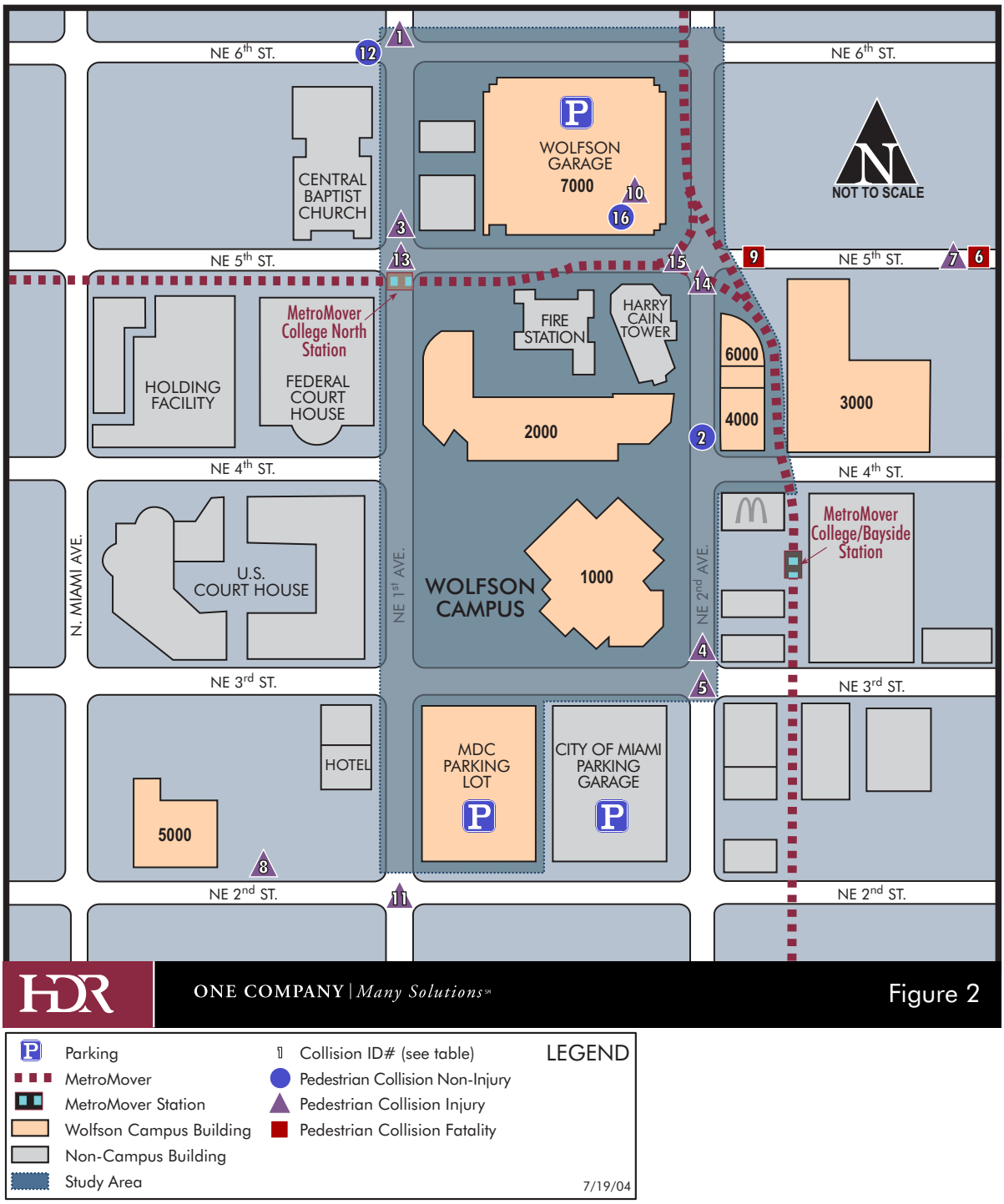


Table 4
Pedestrian Collision Summary (1996-2003)

STUDY PERIOD: 1996-2003 **COUNTY:** Dade

STUDY AREA: MDC Wolfson Campus **SOURCES OF DATA:** Miami-Dade County Pedestrian Crash Database (1996-2001)

CITY: Miami FL Dept. of Highway Safety & Motor Vehicles Traffic Crash Records

ID No.	Date	Location	Time	Site Location	Vehicle Type	Vehicle Dir	Vehicle Movement	Number of Peds	Fatality	Injuries	Day / Night	Wet / Dry	Fault	Driver Contributing Cause	Pedestrian Contributing Cause
1	2/10/97	NE 1st Ave & NE 6th St	1:50 PM	At Intersection	Heavy Truck	North	Right Turn	1	0	1	Day	Dry	Driver	Other	None
2	2/25/97	NE 2nd Ave & 4th St	12:35 PM	Not At Intersection	Auto	South	Backing	1	0	0	Day	Dry	Driver	Improper Backing	None
3	3/28/97	NE 1st Ave & 5th St	5:00 PM	At Intersection	Van	East	Left Turn	1	0	1	Day	Dry	Driver	Careless Driving	Other
4	9/6/97	300 NE 2nd Ave	11:20 AM	Parking Lot	Auto	East	Slowing	1	0	1	Day	Wet	Both	Other	Other
5	4/5/99	NE 2nd Ave & NE 3rd St	4:40 PM	At Intersection	Bus	West	Left Turn	2	0	1	Day	Dry	Driver	Careless Driving	None
6	1/21/00	Biscayne Blvd & NE 5th St	7:25 PM	Not At Intersection	Bus	East	Right Turn	1	1	0	Night	Dry	Neither	None	None
7	3/10/00	1000 ft. E. of NE 1st Ave & NE 5th St	1:14 PM	Not At Intersection	Auto	East	Straight	1	0	1	Day	Dry	Driver	Failure to Yield Right-of-Way	Other
8	5/16/00	200 ft. E. of N Miami Ave & NE 2nd St	12:30 PM	Not At Intersection	Auto	West	Backing	1	0	1	Day	Dry	Driver	Improper Backing	None
9	9/25/00	NE 2nd Ave & 5th St	6:50 AM	At Intersection	Bus	South	Left Turn	1	1	0	Day	Dry	Both	Careless Driving	Failure to Yield Right-of-Way
10	12/4/00	500 NE 2nd Ave	9:42 PM	Parking Lot	Auto	West	Straight	1	0	1	Night	Dry	Pedestrian	None	Other
11	3/22/01	NE 1st Ave & NE 2nd St	8:30 AM	At Intersection	Auto	East	Straight	1	0	1	Day	Dry	Both	Other	Other
12	5/24/01	NE 1st Ave & NE 6th St	3:45 PM	At Intersection	Auto	West	Left Turn	1	0	0	Day	Dry	Driver	Failure to Yield Right-of-Way	None
13	10/10/01	NE 1st Ave & NE 5th St	9:40 AM	At Intersection	Auto	North	Straight	2	0	1	Day	Dry	Both	Other	Other
14	7/17/03	NE 2nd Ave & NE 5th St	5:20 PM	At Intersection	Bus (Metro)	South	Right Turn	1	0	1	Day	Dry	Driver	Careless Driving	None
15	8/18/03	NE 2nd Ave & NE 5th St	7:25 AM	At Intersection	Auto	East	Straight	1	0	1	Day	Dry	Driver	Disregarded Traffic Signal	None
16	12/5/03	500 NE 2nd Ave (Wolfson Garage)	9:45 AM	Parking Lot	Auto	West	Right Turn	1	0	0	Day	Dry	Neither	Other	None

Total No.	Total Peds	Severity	Fatal	Injuries	Location	At Intersection	Not At Intersection	Parking Lot	At Fault	Driver	Pedestrian	Neither	Both	Hazards	Night	Wet
16	18	→	2	11	→	9	4	3	→	9	1	2	4	→	2	1
-	-	Percentage	13%	69%	Percentage	56%	25%	19%	Percentage	56%	6%	13%	25%	Percentage	13%	6%

One safety concern at this intersection is the conflicts between pedestrians crossing on the north and east sides of the intersection and southbound left turning vehicles (a movement with a heavy volume of large trucks traveling towards the Port of Miami). Many of the pedestrian – vehicle conflicts will be eliminated with a County project to construct a channelized southbound left turn lane.

View of 2nd Avenue crosswalk as seen from 5th Street. Any pedestrians in this crosswalk may be obstructed from motorists' view due to the Metromover support.

Another primary safety problem at this intersection is that vehicles making a right turn from NE 5th Street onto NE 2nd Avenue have an obstructed view of the southern crosswalk across NE 2nd Avenue due to the concrete support for the Metromover. Crash #14 was a direct result of this obstructed view, as the driver reported not seeing the crossing pedestrian.

VOLUME DATA AND OBSERVATIONS

Hourly pedestrian and vehicle volumes were collected and compiled for the areas adjacent to the Wolfson Campus for the specific locations shown on Figure 3. Figure 4 shows AM and PM peak hour turning volumes and pedestrian volumes that were collected at the following intersections in May 2002 for the I-95 New Port Access Ramp to Westbound SR 836 Interchange Operational Analysis Report (IOAR):

- NE 6th Street/NE 1st Avenue (Location 1)
- NE 6th Street/NE 2nd Avenue (Location 2)
- NE 5th Street/NE 1st Avenue (Location 3)
- NE 5th Street/NE 2nd Avenue (Location 4)

The Miami-Dade County Public Works Department completed pedestrian traffic counts in 2003 on NE 5th Street at the western Wolfson parking garage elevators as part of a pedestrian safety study. The pedestrian counts at this location (Location 5) are shown in Figure 5.

Additionally, HDR collected vehicle and pedestrian volume data at the following 3 locations in February 2004, which are shown in Figures 6 and 7:

- NE 4th Street/NE 2nd Avenue (Location 6)
- Midblock on NE 3rd Street, between NE 1st and 2nd Avenues (Location 7)
- Midblock on NE 1st Avenue, between NE 2nd and 3rd Streets (Location 8)

Count Locations

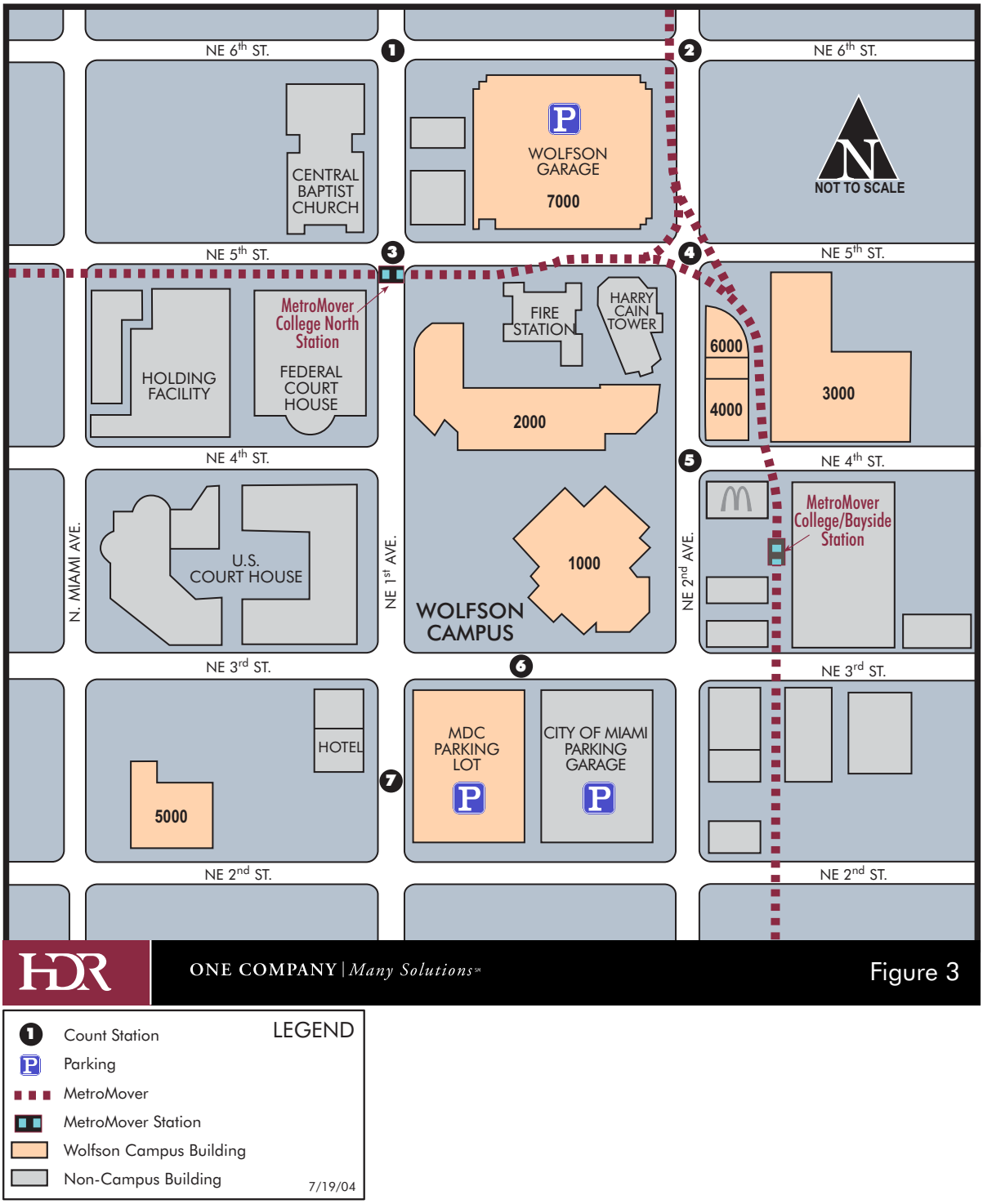
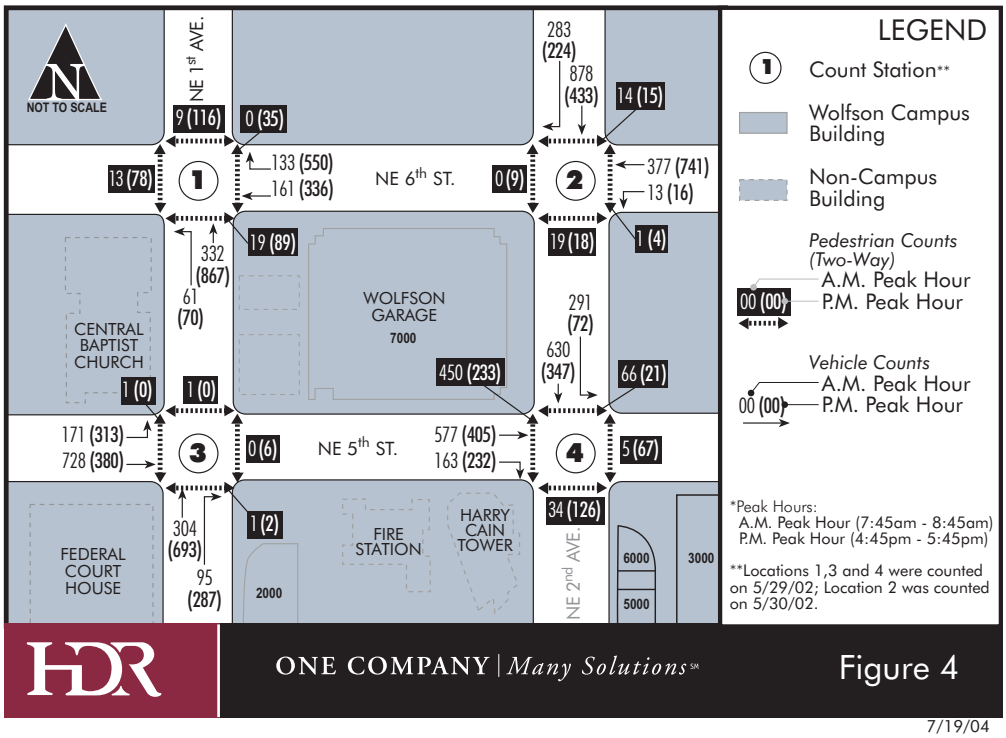


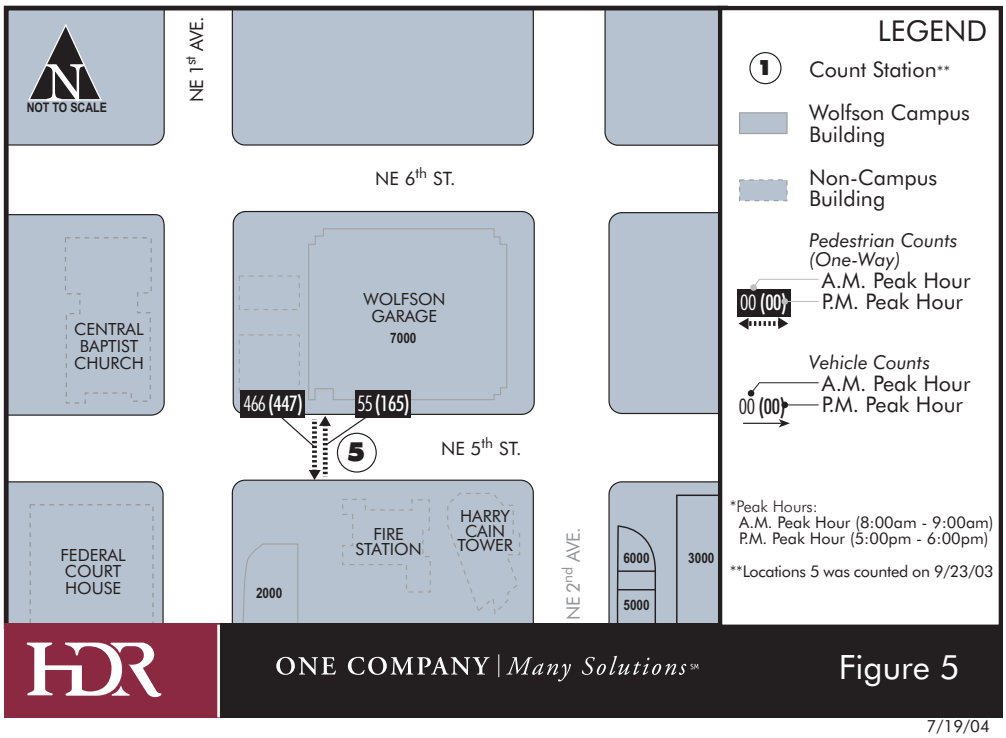
Figure 3

Peak Hour Traffic & Pedestrian Volumes – Locations 1-4



7/19/04

Peak Hour Traffic & Pedestrian Volumes – Location 5



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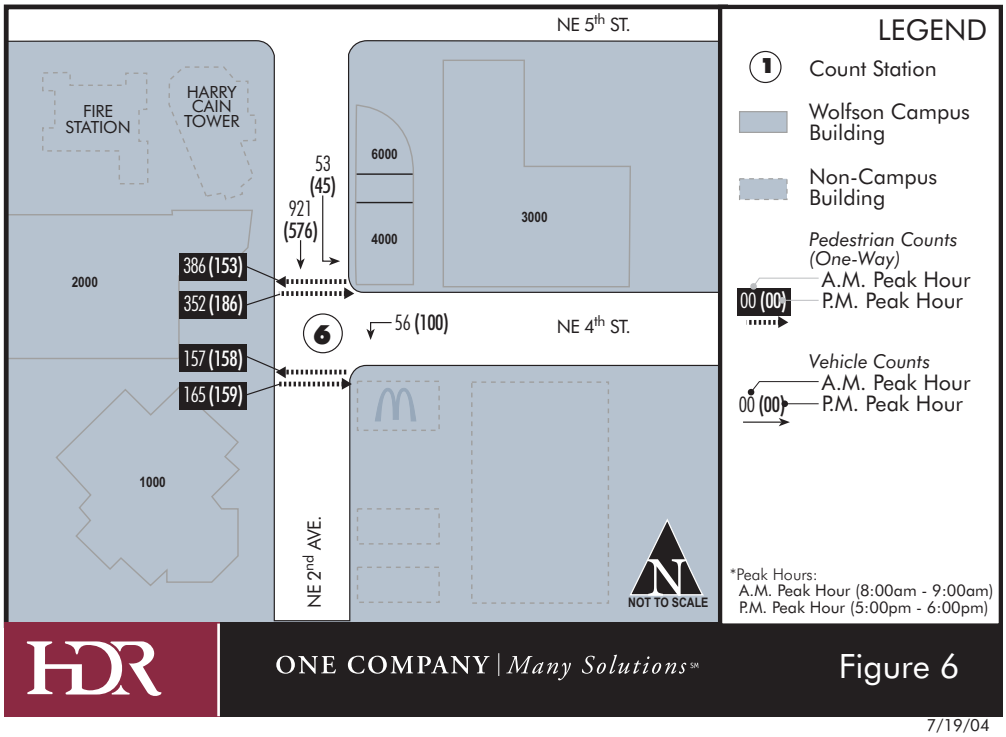
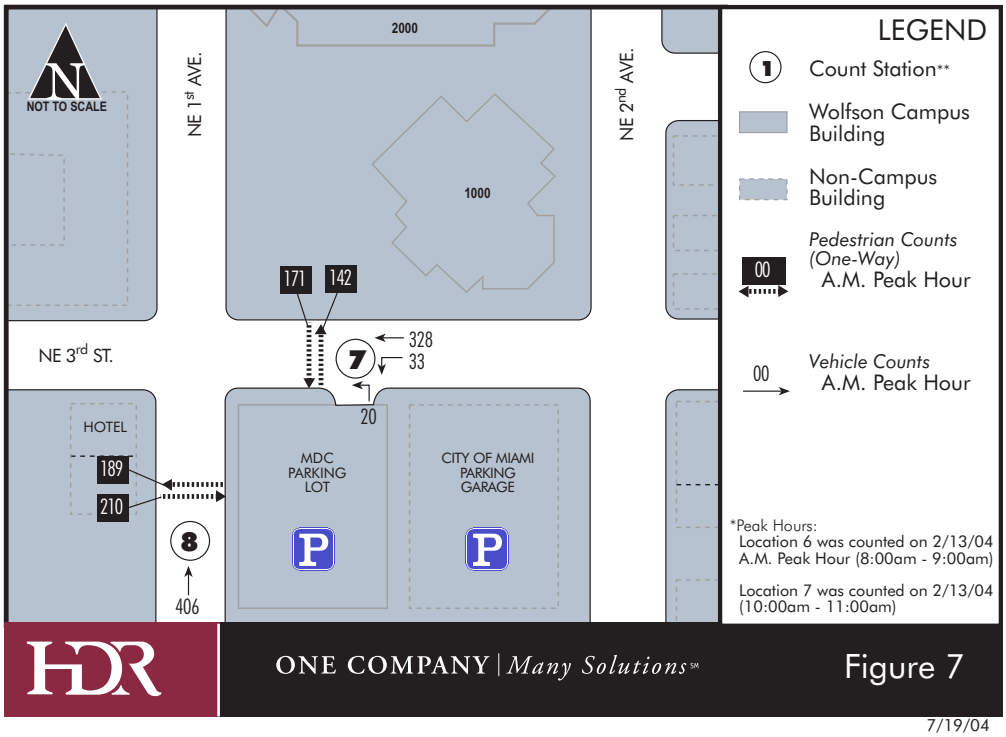
Peak Hour Traffic & Pedestrian Volumes – Locations 6



HDR ONE COMPANY | *Many Solutions*℠ Figure 6

7/19/04

Peak Hour Traffic & Pedestrian Volumes – Locations 7-8



HDR ONE COMPANY | *Many Solutions*℠ Figure 7

7/19/04

Note that the count data at location 8 does not correspond to a typical peak hour, but incorporates mid-morning conditions (10 – 11 AM), including pedestrians crossing the street midblock during class changes. This is appropriate for estimating current typical high volume pedestrian street crossing activity at this location.

Focus Areas A and B – NE 5th Street

Pedestrians crossing 5th Street at 2nd Avenue (looking south)

Focus Areas A and B are both located on NE 5th Street. However, all four streets that surround the Wolfson Parking Garage – NE 5th and 6th Streets and NE 1st and 2nd Avenues – are important to understanding the overall vehicle and pedestrian patterns in this area. Each of these one-way streets has 3 lanes, with NE 5th and 6th Streets running eastbound and westbound, respectively, and NE 1st and 2nd Avenues running northbound and southbound, respectively. The parking garage has 3 vehicle entrances/exits – one each on NE 5th Street, NE 6th Street, and NE 1st Avenue. Based on the 2003 parking garage entering volume totals supplied by Miami Dade College, the 6th Street entrance is used the most, with approximately 47% of all vehicles entering the garage there. The second most used entrance is from 5th Street, which accounts for approximately 40% of all entering vehicles. Finally, the entrance on 1st Avenue is used the least, accounting for only 13% of the entering vehicles.

As discussed earlier, vehicle and pedestrian counts at the four signalized intersections surrounding the parking garage (locations 1-4) were taken from the I-95 New Ramp Access IOAR. Further analysis of this data is presented in the section titled Level of Service Analysis.

Preferred pedestrian crossing path across 5th Street from the garage

Focus Area A is located on NE 5th Street at the west end of the Wolfson parking garage, where a significant amount of pedestrian crossing activity occurs. On this end of the garage, the building entrance/exit used by pedestrians is located about 175 feet east of the signal at 5th Street and 1st Avenue. However, the vast majority of pedestrians do not cross the street at the signal, but cross the street midblock, often at an angle of preferred path as shown in the adjacent picture. Pedestrian activity is fairly continuous, particularly during peak periods. Counts completed by Miami-Dade County show that the two-way pedestrian crossing volume during the AM peak hour (8:00-9:00 AM) is more than 500, and is more than 600 during the PM peak hour (5:00-6:00 PM).

Focus Area B is located at the intersection of NE 5th Street and NE 2nd Avenue at the eastern end of the Wolfson parking garage. This intersection also sees a significant volume of pedestrian activity, particularly in the north-south crosswalk on the west side of the intersection; 450 pedestrians were counted in that crosswalk during the AM peak hour in 2002. Because the

entrance/exit to the garage and adjoining facility space is located on 2nd Avenue north of 5th Street, the majority of the pedestrian activity in this focus area occurs at the intersection within the marked crosswalk. However, pedestrian visibility is still an issue, due primarily to the location of the Metromover guideway directly above the intersection and its support columns. As shown previously, pedestrians crossing 2nd Avenue in the crosswalk can be hidden from drivers approaching along 5th Street by these columns.

Focus Area C – NE 2nd Avenue/NE 4th Street

More than 1,000 pedestrians cross NE 2nd Avenue at the NE 4th Street intersection during the AM peak hour (8:00-9:00 AM). Another 650 pedestrians cross NE 2nd Avenue at the same intersection during the PM peak hour (5:00-6:00 PM). Because the primary issue at this intersection is the conflict between westbound left turning vehicles and the pedestrians crossing 2nd Avenue in the crosswalk on the south side of 4th Street, it is important to note the distribution of pedestrians between the crosswalks on the north and south side of the intersection. In the AM peak hour, approximately 70% of the pedestrians crossing 2nd Avenue use the north crosswalk, but in the PM peak hour, the distribution is split nearly evenly. In the morning the high percentage of people using the north crosswalk is likely due to the influence of class changes and the location of Wolfson Buildings 3, 4, and 6 on the north side of 4th Street. In the afternoon, the more even split in the two crosswalks could be attributed to more students accessing the Metromover station on the south side of 4th Street, perhaps to link to the Metrorail system. It is also expected that the location of the McDonald's on the southeast corner of the intersection plays a role in which crosswalk pedestrians may use, particularly during peak lunchtime hours.

Typical and recurrent pedestrian-vehicle conflict at 2nd Avenue & 4th Street

The volume of traffic using 4th Street is minor, with only 56 and 100 vehicles turning left onto 2nd Avenue during the AM and PM peak hours, respectively. During the PM peak hour when the vehicle volumes are higher on 4th Street, the pedestrian volumes in the south crosswalk alone are more than 3 times higher than the vehicle volume. Due to the low volumes using this roadway and the excess capacity on the adjacent streets such as 3rd and 5th Streets, this street remains a candidate for a partial or total street closure between 2nd Avenue and Biscayne Boulevard, as part of the proposed extension of the existing Wolfson Pedestrian Promenade.

Focus Area D – NE 3rd Street

NE 3rd Street between NE 1st and 2nd Avenues is a westbound, one-way roadway with two travel lanes and parallel parking on the north side of the road. Vehicle and pedestrian counts were collected on this street midblock at the Wolfson parking lot entrance during the AM peak hour (8:00-9:00 AM). During this time, the Wolfson parking lot on the south side of 3rd Street

A pedestrian shown crossing 3rd Street midblock at an angle from Building 1

became completely full, with only a low volume of trips in and out of the lot (33 in, 20 out). Additionally, the number of pedestrians crossing 3rd Street was approximately equal to the number of vehicles traveling westbound on 3rd Street (313 pedestrians versus 361 total vehicles). Due to the low number of vehicles using this roadway section, pedestrians generally have no difficulty in finding gaps in traffic to cross the street midblock. When vehicles and pedestrians are both present, the vehicles will often yield to allow the pedestrians to cross the street.

Most pedestrians were observed crossing the street in a location and manner that was most convenient for them, i.e., not at one specific location, and many times at an angle across the roadway. The location of most pedestrian crossings was between Wolfson Building 1 (see picture) and the Wolfson surface parking lot driveway. There were also some pedestrians that crossed the street either further east (towards the City of Miami parking garage) or further west (towards the NE 1st Avenue intersection) – pedestrians crossing the street within approximately 100 feet of the Wolfson parking lot driveway were included in the pedestrian count. And because the steps leading to the sidewalk from Building 1 are not perpendicular to the street but angled, reflecting the similarly angled Building 1, a large percentage of the pedestrians simply follow this building-walkway-steps angled path when crossing the roadway.

Focus Area E – NE 1st Avenue

Pedestrians crossing 1st Avenue midblock, south of 3rd Street

Vehicle and pedestrian counts were collected on NE 1st Avenue midblock between NE 2nd and 3rd Streets during the period from 10:00-11:00 AM. Although this time period is outside of the typical morning peak hour, it is representative of conditions during the majority of the morning hours. A significant volume of pedestrians cross this street midblock, primarily during the periods associated with class changes in Building 5, which hosts classes for the New World School of the Arts. Similar to the data collected on NE 3rd Street, the number of pedestrians crossing 1st Avenue was approximately equal to the number of vehicles traveling northbound on 1st Avenue – 399 pedestrians versus 406 vehicles.

The roadway at this location is one-way northbound with three travel lanes. Just south of 3rd Street, there are three metered parallel parking spaces on the west side of the street and one on the east side of the street. During the data collection period, pedestrians generally had no difficulty in finding gaps in traffic to cross the street midblock. Most pedestrian activity occurred during class changes, with the pedestrians taking the shortest path between Buildings 1 and 5. However, pedestrian crossings were not concentrated at one location midblock (see above photo), but rather occurred over the length of the entire block.

SIGNIFICANCE OF PEDESTRIAN VOLUMES AND ENVIRONMENT

The Manual on Uniform Traffic Control Devices (MUTCD) contains nationally accepted standards regarding the warrants needed to consider the installation of a traffic signal. Among the eight signal warrants is a pedestrian volume warrant, which is intended for application where the traffic

volume on a major street is so heavy that pedestrians experience excessive delay when crossing the major street. This requires that there be a minimum of 100 pedestrians crossing the street per hour for 4 hours of a day, or 190 pedestrians crossing the street during any 1 hour. It also requires that there be fewer than 60 gaps per hour in the traffic stream of sufficient length to allow pedestrians to cross the street, and that the installation of a signal will not restrict the progressive movement of traffic along the corridor (especially if the corridor is part of a coordinated signal system, as is the case in Downtown Miami CBD).

The 3 midblock crossing locations discussed previously (NE 5th Street, NE 3rd Street, and NE 1st Avenue) would certainly each meet the volume criteria of this warrant. However, even though no data was collected on the number of adequate gaps in the traffic stream, it would be difficult to make a case for not having enough gaps of sufficient length based on the sites and traffic observations made. As such, pedestrian signalization is unlikely to be warranted at any of the locations, with the exception of 5th Street, which has fewer gaps in its traffic stream than the other locations. In fact, Miami-Dade County (in a letter dated January 14, 2004) has stated that the 5th Street location does meet the requirements for a midblock pedestrian signal. It would be the responsibility of Miami Dade College to pay for the installation of a signal at this location, if desired, but the County would then assume future maintenance of the signal.

Unlike pedestrian signals, there are no nationally accepted standards for the installation of marked midblock crosswalks. However, some cities have adopted standards for when they would be considered for installation. One such city is the City of San Luis Obispo, California, which has the following requirements:

- Pedestrian volume is 40 or more per hour for a 1-hour period, or 30 groupings of 2 or more pedestrians for a continuous 2-hour period twice a day; and
- The 85th percentile approach speed is less than 40 mph; and
- The roadway has less than 3 travel lanes in one direction; and
- The proposed crosswalk has adequate lighting for nighttime visibility (or will have it installed as part of the crosswalk installation); and
- There is unrestricted visibility of the crosswalk for specified minimum distances (at 30 mph, the required sight distance is 200 feet); and
- There is no controlled crosswalk (by traffic signal or Stop sign) within one block of the proposed crosswalk.

The City Traffic Engineer may authorize the installation of a marked crosswalk that does not satisfy all the criteria if it is deemed that based on analysis, other unique circumstances warrant the installation of the marked crosswalk.

Based on the 1992 Uniform Vehicle Code (Section 1-112), ***legal crosswalks exist at all public intersections where there is a sidewalk on at least one side of the street, whether it is marked on the roadway surface or not***. However, a crosswalk can only exist at a midblock location if it is marked. The Federal Highway Administration's (FHWA) study titled Safety Effects of Marked vs. Unmarked Crosswalks at Uncontrolled Locations was completed in March 2002 to determine whether marked crosswalks at uncontrolled locations (i.e., locations with no traffic signal or stop sign on the approach) are safer than unmarked crosswalks under various traffic and roadway

conditions. Table 5 summarizes the recommendations from this study regarding the installation of marked crosswalks at uncontrolled intersections, including midblock locations.

As shown in Table 5, two and three lane roadways with an average daily traffic (ADT) volume of 12,000 or less and a speed limit of 30 mph are recommended as candidate sites for marked crosswalks. Each of the midblock crossing locations at the Wolfson Campus discussed previously have either 2 or 3 lanes, ADTs of less than 12,000, and posted speed limits of 30 mph, and as such would be candidates for marked crosswalks.

Table 5
FHWA Guidelines for Marked Crosswalk Installation (for Uncontrolled Intersections)*

Roadway Geometry	Vehicle ADT ≤ 9,000			Vehicle ADT > 9,000 - 12,000			Vehicle ADT > 12,000 - 15,000			Vehicle ADT > 15,000		
	Speed Limit (mph) **											
	30	35	40	30	35	40	30	35	40	30	35	40
2 Lanes	C	C	P	C	C	P	C	C	N	C	P	N
3 Lanes	C	C	P	C	P	P	P	P	N	P	N	N
Multi-Lane (4 or more lanes) with Raised Median ***	C	C	P	C	P	N	P	P	N	N	N	N
Multi-Lane (4 or more lanes) without Raised Median	C	P	N	P	P	N	N	N	N	N	N	N

C = Candidate sites for marked crosswalks. It is recommended that a minimum of 20 pedestrian crossings per hour exist at a location before placing a high priority on the installation of a marked crosswalk alone.

P = Possible increase in pedestrian crash may occur if crosswalks are added without other pedestrian facility enhancements. These locations should be closely monitored and enhanced with other pedestrian crossing improvements, if necessary, before adding a marked crosswalk.

N = Marked crosswalks alone are insufficient, since pedestrian crash risk may be increased due to providing marked crosswalks alone. Consider using other treatments, such as traffic calming treatments, traffic signals with pedestrians signals where warranted, or other substantital crossing improvement to improve crossing safety for pedstrians.

* These guidelines include intersection & midblock locations with no traffic signals or stop signs on the approach to the crossing. They do not apply to school crossings. A two-way left turn lane is not considered a median. These are general recommendations; good engineering judgment should be used in individual cases for deciding where to install crosswalks.

** Where the speed limit exceeds 40 mph, marked crosswalks alone should not be used at unsignalized locations.

*** The raised median or crossing island must be at least 4 feet wide and 6 feet long to adequately serve as a refuge area for pedestrians in accordance with MUTCD and AASHTO guidelines.

Source: Safety Effects of Marked Vs. Unmarked Crosswalks at Uncontrolled Locations: Executive Summary and Recommended Guidelines, FHWA, 2002.

LEVEL OF SERVICE ANALYSIS

Procedures within the Transportation Research Board's Highway Capacity Manual 2000 (HCM) yield roadway capacities in terms of level of service (LOS), which is a qualitative measure of operational conditions within the traffic stream and how these conditions are perceived by motorists. A LOS designation generally describes operational conditions in terms of factors such as speed, travel time, delay, freedom to maneuver within the traffic stream, comfort, convenience, and safety. Levels of service are given letter designations from A to F, with LOS A representing optimal free-flow conditions and LOS F representing forced-flow or breakdown conditions generally publicly associated with the term "gridlock".

LOS is measured differently for intersections than for arterials. Intersection LOS is measured in terms of the average delay in seconds per vehicle experienced as a result of traffic control devices (control delay), i.e., delay at a signal or stop sign. Arterial LOS is measured in terms of the average travel speed along the corridor in miles per hour, taking into account running time and intersection control delay. Arterials are divided into different classes, depending on their specific characteristics including street function, posted speed limit, signal density, and driveway/access point density. Based on the characteristics listed in HCM tables 10-3, 10-4, and 15-2, the CBD roadways adjacent to the Wolfson Campus would be considered Class IV arterials.

The roadways in the vicinity of the Wolfson parking garage were analyzed using the Synchro and SimTraffic software packages to determine the existing LOS for vehicles at the signalized intersections and along the corridors. Inputs included the existing vehicle and pedestrian volumes at the intersections, existing signal timings (as obtained from Miami-Dade County), and the roadway geometries. Due to the barricades currently placed around the Federal and U.S. Courthouses on NE 5th Street and NE 1st Avenue, portions of those roadways have effectively been narrowed to two lanes. In the analysis, the effected roadway sections were coded with only two through lanes instead of three.

The results of the analysis show that all the intersections analyzed operate at LOS B during both the AM and PM peak hours, with the exception of the NE 6th Street/NE 1st Avenue intersection, which operates at LOS A in the AM peak hour and LOS C during the PM peak hour. The 5th and 6th Street arterials operate at LOS D overall during both the AM and PM peak hours, when considering the travel speed along those corridors. The 1st and 2nd Avenue arterials operate at LOS C during the AM peak hour and LOS D during the PM peak hour. Tables showing the detailed results of the intersection and arterial LOS analyses are included in Appendix B.

The operation of the roadways in the vicinity of the Wolfson garage is significant in looking towards the future. The roadways operate at acceptable levels of service today with low amounts of delay to vehicles traveling through the area. The primary reason that the arterial LOS is at D for these roadways (compared to the intersection LOS which is typically at B) is that the spacing of blocks and signals is dense, and the timing of signals is actually *not* designed to allow high speed progression along these corridors.

Nevertheless, LOS D is a good level of service for a Downtown area, and signifies that the roadways still have excess capacity. According to the I-95 New Access Ramp IOAR, the projected area-wide growth in this area, based on the Miami Urban Area Transportation Study (MUATS) 1999 and 2025 travel demand model networks, is approximately 0.8% per year in a No Build

alternative (i.e., no new *proposed* facilities beyond those already *confirmed* for construction are included in the network). As such, the I-95 study projects a growth in volumes of approximately 20% over the next 25 years in this area. At this level of growth, the operational characteristics of the roadways adjacent to the Wolfson garage will *not* change significantly. Therefore, the future vehicular conditions at the potential midblock pedestrian crossing on NE 5th Street will remain similar to today's conditions.

ALTERNATIVES DEVELOPED AND ASSESSED

Based on the literature review of recommended pedestrian and traffic calming treatments from other college campuses and downtown urban environments, as well as the summary of at-grade pedestrian crossing treatments, there are numerous improvements that could be applied at the Wolfson Campus that would help to calm vehicular traffic while providing enhancements to the pedestrian environment.

INTERSECTION ENHANCEMENTS

The simplest improvements to make are enhancements to existing intersections, including items such as curb extensions on the corners of intersections and higher visibility crosswalk markings such as those in the zebra pattern. Curb extensions help make pedestrians more visible, provide them with more crossing opportunities, and shorten the required crossing distances. At the same time, they help slow turning vehicles down. They can be implemented on any intersection corner that has adjacent on-street parking, even if the parking is only on one side of the street. Locations where curb extensions could be implemented around campus include 2nd Avenue/5th Street, 2nd Avenue/4th Street, and 1st Avenue/3rd Street.

Signals are another area where there is an opportunity to provide enhancements. Some of the alternatives available include pedestrian countdown timer displays, leading pedestrian intervals, and exclusive pedestrian phases. The use of pedestrian countdown timers continues to increase across the country, and they have been shown to be effective in preventing pedestrians from beginning to cross the street at the end of the pedestrian phase when they would be likely to get caught in the roadway when the signal changes. Countdown timers would be an appropriate addition to any of the signalized intersections in the study area.

From a vehicular traffic standpoint, leading pedestrian intervals are more efficient than exclusive pedestrian phases, due to the limited time allotment given exclusively to pedestrians. A leading pedestrian interval allows pedestrians a few seconds to start crossing the street before vehicles are allowed to go. This small lead time for pedestrians has been shown to decrease the number of pedestrian right-of-way violations by turning vehicles. Exclusive pedestrian phases completely eliminate vehicle conflicts, but result in significantly more lost time for vehicles and potentially poorer vehicle progression along a corridor.

The installation of an exclusive pedestrian signal at a midblock crosswalk is another measure that could be used at the Wolfson Campus. The benefit of this type of signal is that pedestrians would have the exclusive right-of-way to allow them to cross the street safely without any vehicular conflicts. However, due to the location of the Wolfson Campus within the CBD's grid network of coordinated and pre-timed traffic signals, a new signal at a midblock crosswalk (i.e., 5th Street) would have to be coordinated with the other traffic signals in order to maintain good vehicular progression through the CBD area. Pedestrian signals work best on a "hot response", in which the signal responds immediately to a pedestrian push-button activation. Without this "hot response", many people who push the pedestrian button tend to cross the street at the first available gap in traffic, particularly during off-peak periods. When the signal finally does give a Walk indication for the crosswalk, the pedestrians may have already crossed the street, leaving the crosswalk empty. This occurrence leads to unnecessary vehicle delay during the pedestrian phase, which can be frustrating for motorists and has been experienced at numerous other locations

where pedestrian signals have been installed, such as on SR 426 at Rollins College in Winter Park, Florida.

MIDBLOCK CROSSING ENHANCEMENTS

Signage is another easy way to enhance crossings, particularly at midblock locations. While too much signage can diminish its effectiveness and lead to visual clutter, appropriate levels of signage can improve the pedestrian environment. Enhancements to midblock crossing signing can also be considered that would attract more driver attention to the crossing. At the proposed 5th Street midblock crosswalk, the standard pedestrian warning signage could be enhanced by installing it on a mast arm over the road. For further effect, the sign could be supplemented with flashing beacons, which could be illuminated only when a pedestrian was about to cross the street, through the use of automatic detection bollards. Alternatively, in-road (and in-sign) flashers could be used, serving the same purpose as the flashing beacons. While the in-road flashers are now recognized by the MUTCD, flashing beacons are a more traditional means of informing drivers to be cautious, and are generally visible to vehicles not in the front of a platoon of vehicles. Visibility is particularly important on 5th Street due to the large number of trucks, which may limit the visibility of following vehicles.

It is also important to install midblock crossings in such a way that pedestrians will use them. This could include angling the crosswalk alignment to match the preferred crossing paths of pedestrians, or including other modifications to help direct pedestrians to appropriate, safe crossing locations. The crosswalks currently being installed on NE 3rd and 5th Streets are both angled. In the case of 5th Street, the angle of the crosswalk matches the preferred pedestrian path. However, since the angle of the crosswalk on 3rd Street does *not* match the preferred pedestrian path at that location, additional measures such as landscaping on the north side of the street may be needed to guide pedestrians to the crosswalk. To ensure pedestrian use, it may be necessary to make more significant changes, such as moving the Wolfson surface parking lot driveway further to the west. If the 3rd Street midblock crosswalk was also concurrently modified to be perpendicular to the street rather than angled, pedestrians walking down the steps would be facing directly into the crosswalk and more likely to use it.

Finally, lighting is a critical element for pedestrian safety, especially at intersections, and also at midblock crosswalk locations since they are uncontrolled. Due to the number of students at the Wolfson Campus at night, ensuring that pedestrian crosswalks are well lit is extremely important. Lighting enhancements should be pedestrian-oriented, with lighting specifically focused on the appropriate crossing locations – the marked crosswalks. Lighting should also be implemented in a manner that minimizes the amount of light impacts to adjacent residential development, such as the Harry Cain Tower located on the corner of 5th Street and 2nd Avenue.

ELEMENTS WITH VERTICAL DEFLECTION

It is clear that some types of improvements are not appropriate for certain roadways in the CBD.

For example, installing any treatments on 2nd Avenue that have vertical deflection, such as a raised intersection or raised crosswalk would certainly have a traffic calming effect on traffic and reduce speeds. However, the character of the roadway (arterial), the volume of traffic (relatively high), and the percentage of heavy trucks (also relatively high) on the corridor make this type of

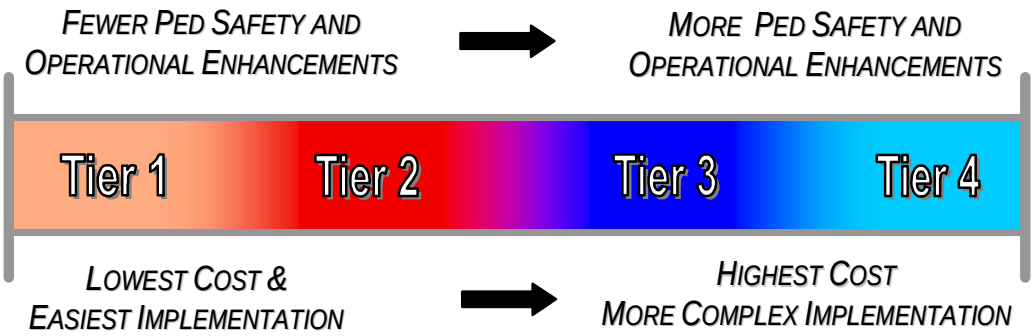
treatment inappropriate. In contrast, 3rd Street is a more ideal candidate for a raised crosswalk (at the midblock crosswalk location) due to low traffic volumes and a low truck percentage. A raised crosswalk at this location would also provide an even safer, more visible means for pedestrians to cross the street midblock, while keeping vehicles speeds low. Even if 3rd Street becomes a primary bus route through the CBD, the Miami-Dade Transit buses will not have any trouble negotiating a midblock raised crosswalk.

RE-ROUTING OF WOLFSON PARKING TRAFFIC

A consideration for the Wolfson Campus is a tradeoff between further enhancing pedestrian safety, and ingress and egress to the parking garage. The existing Wolfson parking garage access point on NE 5th Street is the 2nd busiest entrance and often queues back onto NE 5th Street during peak periods. When this queue accumulates just a few vehicles, it backs up to or beyond the 5th Street midblock crosswalk location. When this happens, pedestrians attempting to cross the street are subject to a higher probability of involvement in a multiple threat crash – that is, a crash that occurs when a pedestrian begins crossing the roadway in front of standing or stopped traffic and is struck by another vehicle traveling in an adjacent lane. To help minimize this crash risk, the 5th Street garage access could be converted to an exit only, so that no vehicles would queue at the garage entrance and potentially interfere with the pedestrian crosswalk. The traffic that previously entered the garage at 5th Street could be redirected (via signage on 5th Street and 1st Avenue) to the 1st Avenue entrance, which is currently the least used entrance.

DEVELOPMENT OF TIERED RECOMMENDATION PLAN

This section presents a tiered recommendation plan for each of the focus areas, which has been proposed to give the College some options regarding potential improvements at each of the focus areas. As depicted below the lower end tiers represent improvements that provide lower cost pedestrian enhancements that are easier to implement. Higher tiers include more pedestrian improvements that typically involve higher costs and more complex implementation. Most focus areas have 2 or 3 tiers, with only Focus Area A having 4 tiers.



The tiered recommendation plan is presented in Figure 8. Individual improvements are shown with symbols. Those symbols shown in gray are either existing conditions (if shown in Tier 1), or are improvements from a previous tier that are carried forward to the next tier.

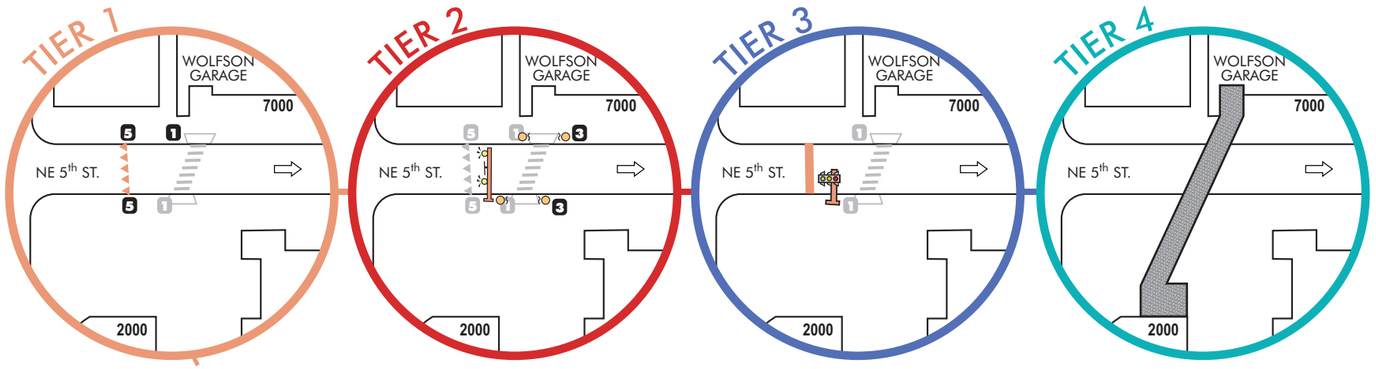
FOCUS AREA A – NE 5TH STREET AT WOLFSON GARAGE

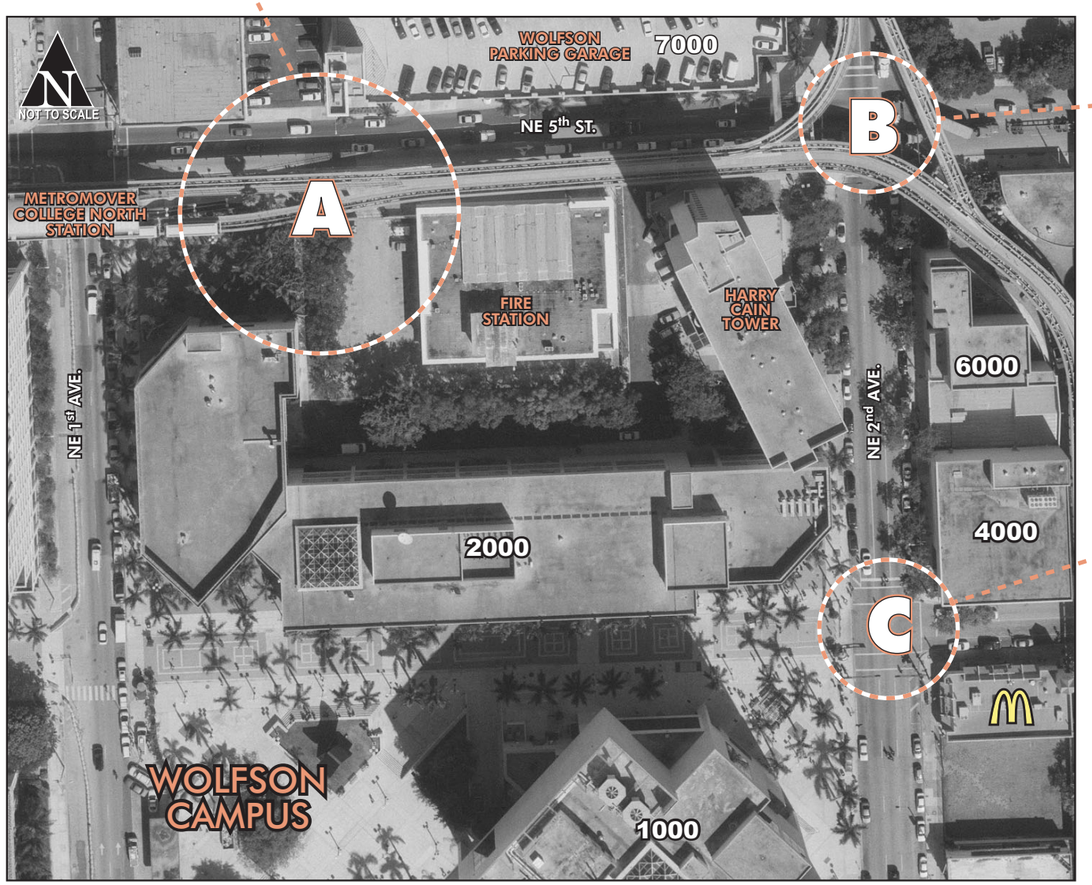
Hundreds of pedestrians cross NE 5th Street midblock each day at the west end of the Wolfson parking garage on their way to and from the Wolfson campus. Based on the roadway and traffic criteria shown previously in Table 5, this area is a clear candidate for a signed and marked midblock crosswalk, and one is currently being implemented at this location. The Miami-Dade County Public Works Department developed a concept plan for the midblock crosswalk (see Appendix A), for which they are responsible for signing and marking, with the City of Miami responsible for the installation of curb ramps. While pedestrian crossings here were not legal before the installation of the midblock crosswalk, they have not resulted in any reported pedestrian-vehicle crashes during the period from 1996-2003. Marking a crosswalk will give those pedestrians the legal right to cross at this location.

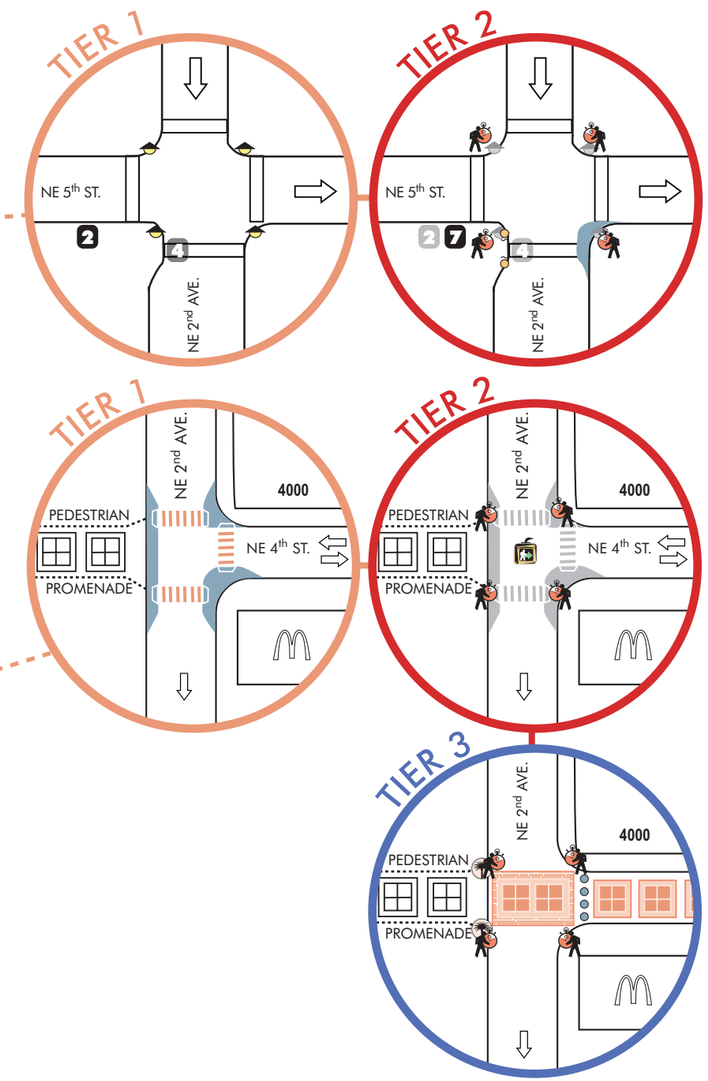
Each tier of the recommended improvements at *this* intersection has a slightly different focus, indicated by tier number, as follows:

1. Minor crosswalk enhancements to the County's plan
2. Major crosswalk enhancements to focus more driver attention on the crosswalk
3. Separation of vehicle and pedestrian movements in time
4. Separation of vehicle and pedestrian movements in space

MDC WOLFSON CAMPUS
Tiered Recommendations







LEGEND:

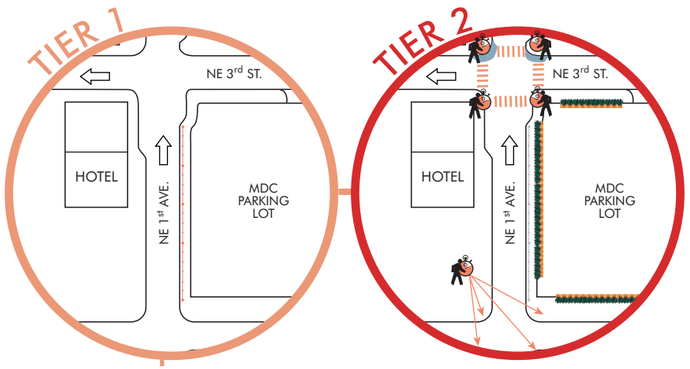
Symbols

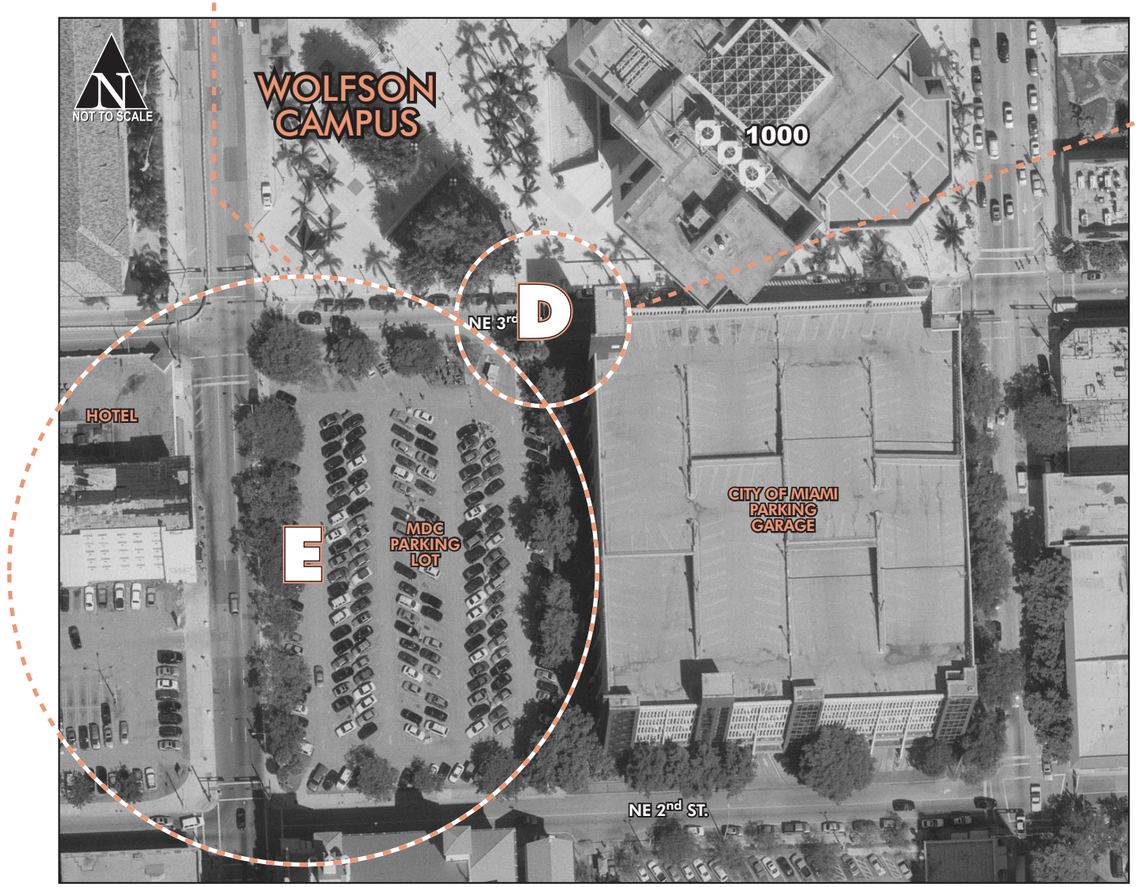
- Improvements from previous tier (or existing conditions)
- Direction of Traffic Flow
- Zebra Crosswalk Striping
- Advanced Yield Line
- Advanced Stop Line
- Curb Ramp
- Curb Extensions
- Mastarm with Exclusive Pedestrian Signal
- Mastarm with Overhead Pedestrian Warning Sign & Flashing Beacons
- Pedestrian bridge
- Textured Pavement within Intersection
- Pedestrian Promenade Extension
- Bollards
- Bollards with Automatic Pedestrian Detectors
- Pedestrian Oriented Street Lighting
- Pedestrian Railing
- Leading Pedestrian Signal Interval
- Countdown Pedestrian Signal Indicators
- Wolfson Campus Gateway Feature
- Landscaping & Fencing
- Handicap Accessible

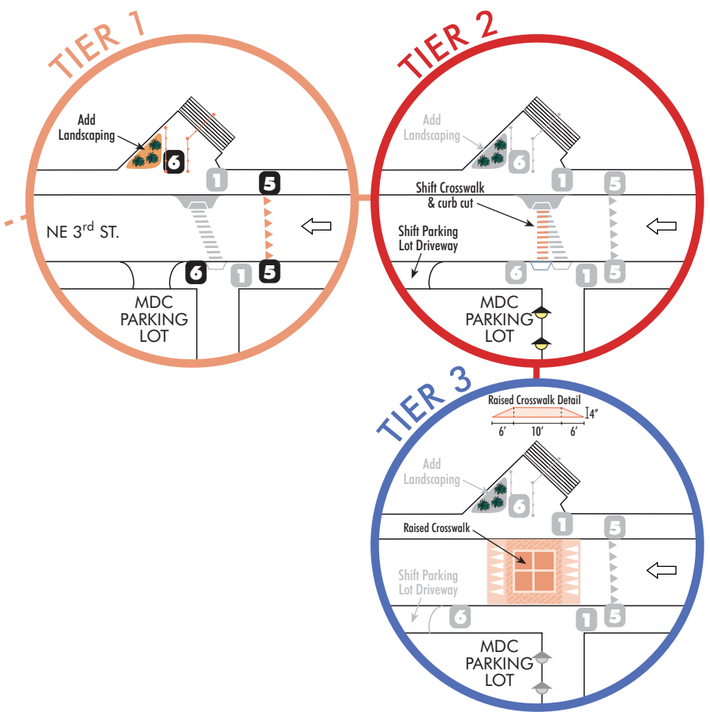
Signage & Striping

1		Pedestrian Crossing Warning Sign (W11-2, W16-7)
2	TURNING TRAFFIC MUST YIELD TO PEDESTRIANS	"Turning Traffic Must Yield to Pedestrians" Sign (R10-15)
3	WALK BETWEEN POSTS TO ACTIVATE FLASHING CROSSWALK / WATCH FOR CARS BEFORE CROSSING	"Walk Between Posts To Activate Flashing Crosswalk - Watch For Cars Before Crossing Sign
4	WATCH TURNING VEHICLES	"Watch Turning Vehicles" (Pavement Legend)
5	HERE TO	"Yield Here to Pedestrians" Sign (R1-5 or R1-5a)
6	USE CROSSWALK	"Use Crosswalk" Sign (R9-3b)
7	PEDESTRIAN IN CROSSWALK	"Pedestrian in Crosswalk" lighted sign - tied to automatic detectors in bollards

MDC WOLFSON CAMPUS
Tiered Recommendations







LEGEND:

Symbols

- Improvements from previous tier (or existing conditions)
- Direction of Traffic Flow
- Zebra Crosswalk Striping
- Advanced Yield Line
- Advanced Stop Line
- Curb Ramp
- Curb Extensions
- Mastarm with Exclusive Pedestrian Signal
- Mastarm with Overhead Pedestrian Warning Sign & Flashing Beacons
- Pedestrian bridge
- Textured Pavement within Intersection
- Pedestrian Promenade Extension
- Bollards
- Bollards with Automatic Pedestrian Detectors
- Pedestrian Oriented Street Lighting
- Pedestrian Railing
- Leading Pedestrian Signal Interval
- Countdown Pedestrian Signal Indicators
- Wolfson Campus Gateway Feature
- Landscaping & Fencing
- Handicap Accessible

Signage & Striping

1. Pedestrian Crossing Warning Sign (W11-2, W16-7)
2. "Turning Traffic Must Yield to Pedestrians" Sign (R10-15)
3. "Walk Between Posts To Activate Flashing Crosswalk - Watch For Cars Before Crossing Sign
4. "Watch Turning Vehicles" (Pavement Legend)
5. "Yield Here to Pedestrians" Sign (R1-5 or R1-5a)
6. "Use Crosswalk" Sign (R9-3b)
7. "Pedestrian in Crosswalk" lighted sign - tied to automatic detectors in bollards

Tier 1 builds on the County's signing and marking concept plan for a crosswalk at this location, which should be considered the minimum improvement. However, some minor additions should also be considered for Tier 1 improvements to further enhance the safety of crossing pedestrians due to the section having three travel lanes and a significant percentage of truck traffic. The first addition is the inclusion of pedestrian warning signs at the crosswalk on both sides of NE 5th Street (on the County's plan, only one is shown on the south side of the street). Additionally, these signs should be fluorescent yellow-green in color, as permitted in the MUTCD. The second addition is an advance placement yield line marked 20-50 feet west of the crosswalk, along with regulatory signs on both sides of the street reading "Yield Here to Pedestrians" (MUTCD sign R1-5 or R1-5a). The location of all new signing will have to be considered carefully at this location, as there is already a fire station warning sign located immediately beyond the location of the crosswalk.

Tier 2 includes some additional measures that will further attract driver attention to the crosswalk to enhance pedestrian visibility. This includes the use of overhead signage at the crosswalk location with flashing beacons. The beacons would be activated automatically by pedestrians who pass between a pair of bollards on either side of the street equipped with automatic detectors. This will limit beacon flashing to those only those times when pedestrians are present. The combination of these treatments will help to reduce the possibility of multiple threat crashes by alerting motorists in all lanes of the presence of pedestrians via the flashing beacons. Additionally, the positioning of the beacons on an overhead sign will help to make the warnings more visible to motorists in every lane, even in the presence of large trucks.

Tier 3 involves the upgrading of the midblock crosswalk to an exclusive pedestrian signal. The County (in a letter dated January 14, 2004) has stated that the 5th Street location does meet the requirements for a midblock pedestrian signal. It would be the responsibility of Miami Dade College to pay for the installation of a signal at this location, if desired, but the County would then assume future maintenance of the signal.

Tier 4 is the construction of a pedestrian bridge over NE 5th Street, which would vertically separate vehicles and pedestrians. In the optimal condition, a pedestrian bridge would connect directly from the parking garage to either Building 2 on the Wolfson Campus or to the Metromover College North Station above the intersection of NE 5th Street and NE 1st Avenue. However, there are several issues that would need to be addressed in order for the bridge to be constructed – these issues are discussed briefly as follows:

View from the 4th floor of the garage across 5th Street to Building 2

- The bridge would need to connect to the garage on the lowest floor possible (perhaps the third floor) to attract as many people as possible to use it. People parked on the lower floors, especially the first floor, may still cross the street at grade rather than taking the stairs or elevator to access the bridge.
- The bridge would have to be constructed over the top of the Metromover line with adequate clearance for the vehicles. If the bridge connected to the garage at level 3, the bridge would require an uphill grade to clear the Metromover.

- A direct connection to either the Metromover station or Wolfson Building 2 would result in no elevators or stairs needed on either end of the bridge. However, a direct connection to the Metromover station would likely be difficult due to the configuration of the station which has stairways on both ends of the station between the two Metromover tracks. Furthermore, a direct connection to Building 2 is not favored by the Wolfson administration due to the existing interior configuration of the building – a significant amount of additional work would be required to facilitate moving the bridge users through the building without disrupting classrooms and computer labs.
- Just north of the westernmost portion of Building 2 is a triangular-shaped natural area, which could potentially serve as the landing for the south terminus of a bridge. However, this would require an elevator and stairs, or alternatively ramps with landings.
- Finding adequate funding to design and construct the bridge is a serious concern. The costs typically associated with pedestrian bridges can easily reach into the millions of dollars, particularly if elevators are required (one would be required if the bridge could not connect directly to the Metromover station or to Building 2).
- Any construction to the Metromover station platform or over the Metromover tracks may make it difficult for the Metromover and potentially the station to remain open during the construction activities.

FOCUS AREA B – NE 5TH STREET/NE 2ND AVENUE

This intersection not only sees a very high volume of crossing pedestrian traffic, it has had the most recorded pedestrian crashes since 1996 of any location at the Wolfson Campus. The recommended improvements are separated into two tiers and focus on the following:

1. Improving the visibility of pedestrians in the crosswalk
2. Warning both pedestrians and drivers of potential conflicts

The first tier includes signing, marking, and lighting enhancements. Due to the Metromover column obscuring pedestrians waiting to cross eastbound across 2nd Avenue from the southwest corner of the intersection, it is strongly recommended that two signing and marking improvements be made. There already is an existing sign at the intersection facing eastbound traffic that reads "No Turn on Red When Pedestrians in Crosswalk". It is recommended that this sign be replaced with MUTCD sign R10-15, which reads "Turning Traffic Must Yield to Pedestrians". The second improvement is a pavement warning legend directed towards pedestrians crossing 2nd Avenue in an eastbound direction in the southern crosswalk, which reads "Watch Turning Vehicles". Finally, this intersection is very dark at night due to both a lack of lighting and obscuring of what lighting exists by the Metromover guideways and columns. It is recommended that pedestrian oriented lighting be installed at this intersection (potentially underneath the Metromover tracks or attached to the Metromover support columns) that is specifically focused on the four crosswalks. Lighting at this location should be installed to minimize light impacts to the adjacent Harry Cain Tower residences.

Tier 2 includes further enhancements to help pedestrians cross the street more easily – countdown pedestrian signal indications on all pedestrian signal heads and a curb extension on the southeast corner of the intersection. The countdown timers alert pedestrians as to how much time remains

to finish crossing the street once the flashing "Don't Walk" display has begun. The curb extension will shorten the required crossing distance for pedestrians, and is possible to construct due to the on-street parking on the east side of 2nd Avenue south of 5th Street. Tier 2 also includes devices intended to warn drivers of potential conflicts with pedestrians. This includes an illuminated sign that reads "Pedestrian in Crosswalk" when activated. The sign will be posted on the Metromover support column and oriented towards eastbound vehicles making a right turn onto 2nd Avenue. The sign's illuminated message would be activated automatically each time an eastbound pedestrian passes between a pair of bollards equipped with automatic detectors, which would be located on the southwest corner of the intersection. In this way, the sign will only illuminate when a pedestrian, who may be blocked from view by the Metromover column, enters the crosswalk.

FOCUS AREA C – NE 2ND AVENUE/NE 4TH STREET

In response to the primary issue at this intersection of vehicle – pedestrian conflicts during the side street green/walk phase, three tiers of recommendations have been developed, with a focus on the following issues:

1. Lessen vehicle – pedestrian conflicts through geometric improvements
2. Lessen vehicle – pedestrian conflicts through signal improvements
3. Eliminate vehicle – pedestrian conflicts by a partial or full closure of NE 4th Street to vehicular traffic

The Tier 1 recommendations include curb extensions on the northeast and southeast corners of the intersection and a curb extension across the entire western side of the intersection, along with high visibility zebra striped crosswalks. In addition to narrowing the crossing distance, the curb extensions would also help make pedestrians waiting to cross the street more visible to motorists. The curb extensions are possible due to on-street parking on both sides of NE 2nd Avenue and on the south side of NE 4th Street.

Tier 2 builds on the Tier 1 improvements, but also includes two modifications to the existing signal. The first modification is the inclusion of countdown pedestrian signal indications on all pedestrian signal heads. The second modification is the addition of a leading pedestrian interval (LPI) prior to the beginning of the 4th Street green phase. This LPI would provide 3-5 seconds of walk time to pedestrians crossing 2nd Avenue prior to the start of the green time for vehicles on 4th Street, which will help to lessen the vehicle – pedestrian conflicts and make crossing pedestrians more visible.

Tier 3 involves the partial (or full) closure of 4th Street to vehicle traffic and an extension of the existing Pedestrian Promenade. This is the preferred alternative for this location because it completely eliminates vehicle – pedestrian conflicts and already has funding through an approved Transportation Enhancements application. ***Tiers 1 or 2 should only be pursued in the event that at least a partial closure of 4th Street is not approved by the City of Miami***. However, the City has responded favorably to the proposed partial closure of the street west of the Holiday Inn parking lot. As such, bollards could be used on 4th Street at 2nd Avenue and west of the Holiday Inn parking lot to block that section of the street off to vehicle traffic. The bollards should be set up in a way that would allow emergency vehicle access if needed. Barring any legal obstacles to the closure, the City is expected to give final approval for the project.

The concept for the street closure is based on the Metromover – Bayside Pedestrian Promenade Concept Master Plan discussed previously. The concept recommended in that report includes the removal of the on-street parking spaces on the south side of the street, expansion of sidewalks, incorporation of decorative tree planting and street furniture, reconstruction of the street and sidewalk areas to one level with a valley gutter in between the two, and paving patterns that blend the street and sidewalk areas. The concept also includes the use of paving patterns within the 2nd Avenue/4th Street intersection that will visually tie the extension of the Pedestrian Promenade to the existing section west of 2nd Avenue. Two recommended additions in Tier 3 are the inclusion of countdown pedestrian signal indications at the 2nd Avenue/4th Street signal and the incorporation of a gateway feature to help more prominently identify the Wolfson Campus.

FOCUS AREA D – NE 3RD STREET

The situation midblock on NE 3rd Street is very similar to the situation midblock on NE 5th Street, for the following reasons:

- The Wolfson surface parking lot is located across 3rd Street from the main part of the Wolfson campus.
- A midblock crosswalk is being installed based on a concept plan developed by the Miami-Dade County Public Works Department (see Appendix A) – the County is responsible for signing and marking, while a curb extension and curb cuts are the City's responsibility.
- While pedestrian crossings in midblock were not legal before the installation of the midblock crosswalk, they have not resulted in any reported pedestrian-vehicle crashes during the period from 1996-2003. Marking a crosswalk will give pedestrians the legal right to cross at this location.

Three tiers of alternatives were developed, as follows, each with a slightly different focus:

1. Minor enhancements to the midblock crosswalk area
2. Modification of the crosswalk to be perpendicular to the street
3. Focus driver attention on the crosswalk and reduce vehicle speeds

The Tier 1 recommendations build on the County's midblock crosswalk plan at this location. Recommendations include a few upgrades such as an advance yield line 20-50 feet in advance of the crosswalk and "Yield Here to Pedestrians" signs (MUTCD sign R1-5 or R1-5a) on both sides of the street at the yield line. Because the crosswalk slants diagonally from the steps near Wolfson Building 1 towards the southeast to align with the existing walkway between the Wolfson surface parking lot and the City of Miami parking garage (see page 31 for a discussion of this issue), the crosswalk does not follow the preferred diagonal street crossing path of the majority of pedestrians who have been observed crossing the street at this location. As such, it is recommended to make improvements to the area of the steps to encourage pedestrians to use the crosswalk. As shown in Figure 8, these improvements include the addition of a triangular-shaped landscape planter box and pedestrian railings which would direct pedestrians towards the north end of the crosswalk. In addition, it is recommended that supplemental signs for pedestrians be installed on the north and south sides of the street that read "Use Crosswalk" with an arrow directing the pedestrians towards the crosswalk (MUTCD sign R9-3b).

Tier 2 incorporates all of the elements of Tier 1, but also includes a modification to the midblock crosswalk to make it perpendicular to the street, rather than angled. This tier assumes that the driveway for the Wolfson surface parking lot is relocated further to the west on 3rd Street so that the midblock crosswalk can extend directly across 3rd Street from the existing curb extension – the repositioning of the driveway could be addressed during a proposed Wolfson project to reorient the inbound and outbound movements at the driveway. Although the realigned crosswalk would no longer connect directly to the walkway between the Wolfson surface parking lot and the City parking garage, pedestrians will be much more likely to use a perpendicular crosswalk than one that is angled away from the preferred pedestrian path. Modifications needed to support this improvement include a curb ramp on the south side of 3rd Street and the potential relocation or removal of a shade tree on the south side of the street. Finally, Tier 2 seeks to improve pedestrian safety on the walkway between the Wolfson surface parking lot and the City garage by enhancing pedestrian-oriented lighting along the length of the walkway.

Tier 3 builds on Tier 2, but includes a raised crosswalk instead of just a marked crosswalk. The crosswalk would be raised to the height of 4 inches to help focus more driver attention and slow vehicles at the crossing location. Although raised crosswalks result in vertical vehicle deflection and are therefore typically not used on arterial roadways or roads with significant truck traffic, 3rd Street is an ideal candidate because it is a low volume collector street with only a small amount of truck traffic.

FOCUS AREA E – NE 1ST AVENUE

A significant number of pedestrians cross NE 1st Avenue midblock between NE 2nd Street and NE 3rd Street. Unfortunately, pedestrians cross the street in a wide variety of locations stretching over a 150-200 foot section of 1st Avenue. As such, installing a single midblock crosswalk will likely be ineffective. Therefore, the two tiers of recommended improvements that were developed for this location are designed to elicit the desired behavior from pedestrians, specifically crossing the street within marked crosswalks at the existing signalized intersections. The focus of the tiers is as follows:

1. Discourage midblock pedestrian crossings by directing pedestrians to safe marked crossing locations
2. Discourage pedestrian parking lot cut-through and enhance intersection crossings

Example of a railing used to channelize pedestrians to a safe crossing location

Tier 1 includes the installation of a pedestrian railing along the street-side edge of the sidewalk on the east side of 1st Avenue between 2nd and 3rd Streets. Just south of 3rd Street, there is one parallel parking space on the east side of the street, and the railing would need to terminate at the southern limit of the parking area. The use of the railing will prevent pedestrians from crossing the street midblock, and will encourage pedestrian activity at the proper locations – the signalized intersections at 2nd Street and 3rd Street.

Tier 2 builds on Tier 1, and includes 4 additional improvements as follows, which will further encourage the use of existing crosswalks at signals, and enhance those crosswalks:

- Landscaping and fencing along the borders of the Wolfson surface parking lot (with gaps at the corners along 1st Avenue to allow access to the 2nd and 3rd Street intersections) – this will help discourage parking lot cut-through by pedestrians and will further encourage the use of the signalized intersections to cross the street
- Curb extensions on the northeast and northwest corners of the 1st Avenue/3rd Street intersection (the northwest corner is currently blocked off by barriers in the street surrounding the U.S. and Federal Courthouses, but a curb extension could still be implemented here, as the barriers may not be permanent)
- High visibility zebra striped crosswalks on all legs of the 1st Avenue/3rd Street intersection
- Countdown pedestrian signal indications on all pedestrian signal heads at both the 2nd and 3rd Street intersections along 1st Avenue

NEW WOLFSON PARKING LOT ACQUISITION

As this study was drawing to conclusion, Miami Dade College acquired the existing parking lot located on the northeast corner of the NE 2nd Avenue/NE 5th Street intersection, which is intended to be used for faculty and staff parking. The College would like to pursue the installation of a treatment to help pedestrians cross 5th Street midblock, east of 2nd Avenue, between this parking lot and Wolfson Campus Building 3. Potential options include a signed and marked midblock crosswalk, an exclusive pedestrian signal, or a pedestrian bridge.

The evaluation of this location is beyond the scope of this study.

However, it is recommended that a tiered approach be used for this location, similar to that used at the five focus areas of this study. Pedestrian safety and impacts to traffic will have to be carefully examined and analyzed at this location due to higher traffic volumes on 5th Street east of 2nd Avenue, including a large percentage of heavy trucks traveling to the Port of Miami. Coordination with the City of Miami, Miami-Dade County, and the Miami-Dade Seaport will be needed regarding the recommended improvements.

SUMMARY OF ISSUES, RECOMMENDATIONS, AND BENEFITS

Table 6 presents a summary of the primary issues at each focus area, along with the recommendations proposed for each tier to address the issues, and planning level cost ranges for each of the recommended tiers. The cost estimates are discussed in the next section of the report.

Table 7 presents a list of all treatments recommended at the Wolfson Campus, along with the most important pedestrian benefits of each treatment.

MDC Wolfson Campus

Issues and Tiered Recommendations

Issues	Tier 1 Recommendations	Tier 2 Recommendations	Tier 3 Recommendations	Tier 4 Recommendations
Focus Area A: NE 5th Street at Wolfson Garage				
 ▪ Heavy ped volume midblock (500-600 crossing per hour during peak hours) ▪ Significant truck traffic ▪ 5th St is a primary route into the Port ▪ Potential for multiple threat ped crashes with 3-lane section	Advance Yield Line "Yield Here to Pedestrians" Signs Pedestrian Crossing Warning Sign *($900 - $1,400)*	Tier 1 Improvements, plus the following: Overhead Sign w/ Flashing Beacons Bollards w/ Automatic Detection "Walk Between Posts to Activate Flashing Crosswalk" Signs for Peds *($17,100 - $51,700)*	Exclusive Pedestrian Signal *($50,000 - $75,000)*	Pedestrian Bridge *($500,000 - $3,000,000)*
Focus Area B: NE 5th Street/NE 2nd Avenue				
 ▪ Significant pedestrian activity (450 per hour in west crosswalk during peak hours) ▪ Vehicle view of pedestrians can be obstructed by Metromover column ▪ 3 ped crashes (1996-2003), 1 fatality ▪ Lighting is very poor	"Watch Turning Vehicles" Pavement Legend for Peds "Turning Traffic Must Yield to Peds" Sign Ped-Oriented Street Lighting *($16,500 - $25,000)*	Tier 1 Improvements, plus the following: Countdown Ped Signal Indicators Curb Extension (SE corner) "Pedestrian in Crosswalk" Internally Illuminated "Smart Sign" *($31,500 - $71,400)*		
Focus Area C: NE 2nd Avenue/NE 4th Street				
 ▪ Very heavy ped traffic (650-1,000 crossing per hour during peak hours) ▪ Conflicts between WB left turning vehicles & pedestrians crossing in south crosswalk ▪ Low volume of vehicles using 4th St	Curb Extensions (NE/SE corner; W side) Zebra Crosswalk Striping *($16,500 - $63,000)*	Tier 1 Improvements, plus the following: Countdown Ped Signal Indicators Leading Pedestrian Signal Interval *($20,500 - $70,300)*	Pedestrian Promenade Extension Textured Pavement (2nd Ave/4th St) Countdown Ped Signal Indicators Wolfson Campus Gateway Feature *($1,467,000 - $1,669,000)*	
Focus Area D: NE 3rd Street				
 ▪ Heavy pedestrian activity crossing 3rd St midblock (300 per hour during peak hour) ▪ Bldg 1 steps are angled - peds tend to cross 3rd St at this same angle	Advance Yield Line "Yield Here to Pedestrians" Signs Landscaping Planter at Bldg 1 Steps Pedestrian Railing on Bldg 1 Steps "Use Crosswalk" Signs for Peds *($4,600 - $13,100)*	Tier 1 Improvements, plus the following: Shift MDC Parking Lot driveway west Shift Crosswalk (Curb Ramp, Zebra Crosswalk Striping) Ped-Oriented Lighting on Walkway E. of MDC Parking Lot *($19,900 - $36,600)*	Tier 2 Improvements, plus: Raised Crosswalk *($29,900 - $56,600)*	
Focus Area E: NE 1st Avenue				
 ▪ Heavy pedestrian activity crossing 3rd St midblock (400 per hour during peak hour) ▪ Midblock pedestrian crossings occur over the entire block, not at one location ▪ Many pedestrians cut through the MDC parking lot	Pedestrian Railing on E. sidewalk along 1st Ave *($6,250 - $8,750)*	Tier 1 Improvements, plus the following: Fencing & Landscaping along Borders of MDC Parking Lot Countdown Ped Signal Indicators (2nd & 3rd St intersections on 1st Ave) Zebra Crosswalk Striping (1st Ave/3rd St) *($35,690 - $83,250)*		

MDC Wolfson Campus

Benefits of Treatments

Recommended Improvement	Symbol	Benefit
Zebra Crosswalk Striping		Improves visibility of crosswalk
Advance Yield Line		Encourages drivers to stop well in advance of the crosswalk; Helps to reduce the potential for pedestrian crashes on multi-lane streets
Curb Ramp		Provides access to sidewalks for those with disabilities
Curb Extension		Reduces the distance that pedestrians travel in the street; Improves the visibility of pedestrians
Exclusive Pedestrian Signal		Eliminates pedestrian-vehicle conflicts by separating pedestrian and vehicle movements in time
Overhead Pedestrian Warning Sign w/ Flashing Beacons		Draws driver attention to a crosswalk; Drivers more likely to yield
Pedestrian Bridge		Eliminates pedestrian-vehicle conflicts by separating pedestrian and vehicle movements in space
Textured Pavement within Intersection		Increases driver awareness of pedestrian activity by improving visibility of crosswalk
Pedestrian Promenade Extension		Extends vehicle-free pedestrian corridor
Raised Crosswalk		Makes crosswalks more visible; Reduces driver speeds at the crosswalk
Bollard w/ Automatic Pedestrian Detection		Improves effectiveness of flashing beacons; Does not require pedestrians to push a button
Pedestrian-Oriented Lighting		Improves visibility of pedestrians by drivers; Pedestrians feel safer in well lit areas
Pedestrian Railing		Directs pedestrians to appropriate crossing locations; Prevents midblock crossings
Leading Pedestrian Signal Interval		Reduces ped-vehicle conflicts -- allows peds to start crossing a few seconds before vehicles are given a green indication to turn across the crosswalk
Countdown Pedestrian Signal Indicator		Shows peds how long the ped phase will last; Discourages crossing at the end of a phase
Wolfson Campus Gateway Feature		Identifies the college and the need for drivers to watch for pedestrians; Helps to slow speeds
Landscaping & Fencing		Provides a border; Helps to direct pedestrians to the appropriate walking paths
Landscaping Planter		Helps to direct pedestrians to the appropriate walking paths

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Table 7

MDC Wolfson Campus

Benefits of Treatments

Recommended Improvement	Symbol	Benefit
Pedestrian Crossing Warning Sign		Warns drivers of areas with high pedestrian activity
"Turning Traffic Must Yield to Pedestrians" Sign		Defines rule for turning vehicles with respect to peds
"Walk Between Posts to Activate Flashing Crosswalk - Watch for Cars Before Crossing" Sign		Shows pedestrians where to walk to activate flashing beacons
"Watch Turning Vehicles" Pavement Legend		Alerts pedestrians to watch for turning vehicles while crossing the street
"Yield Here to Pedestrians" Sign		Shows drivers the appropriate location to yield to pedestrians
"Use Crosswalk" Sign		Encourages pedestrians to use a marked crosswalk
"Pedestrian in Crosswalk" Internally Illuminated Sign activated by bollards with automatic detection		Alerts drivers to the presence of a crossing pedestrian when the driver's view may be obstructed

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Table 7 (continued)

COST ESTIMATES AND FUNDING OPTIONS

COST ESTIMATES

Planning level cost ranges have been developed for each of the recommended tiers of improvements, and are presented in Table 8. In some cases, such as the pedestrian railing and landscaping/fencing, the quantity is in terms of linear feet.

The source of the majority of the cost ranges is Alternative Treatments for At-Grade Pedestrian Crossings, published in 2001 by the Institute of Transportation Engineers. The range of these costs takes into consideration differing conditions at various sites, such as drainage requirements (for curb extensions) and materials used. The low end unit cost for the landscaping and fencing improvement in Tier 2 for Focus Area E is based on a double row of 3 gallon shrubs, an ornamental shade tree every 25 feet, and 9 gauge 3-foot vinyl fencing. The high end cost assumes a more elaborate landscaping scheme. The estimated costs for the landscape planter box in Tier 1 for Focus Area D assumes a range of planter box from stacked wood on a paved base to a custom pre-cast concrete box.

FUNDING OPTIONS

There are several ways in which the various recommended improvements can be funded. Several options are discussed below:

- *City of Miami and/or Miami-Dade County Capital Improvement Program (CIP)*. Projects can be either stand alone projects or incorporated as a component of another area project. One example of this is a proposed City sidewalk enhancement/streetscaping project on NE 1st Avenue – this project has been postponed due to security concerns since September 11th at the U.S. and Federal Courthouses located adjacent to NE 1st Avenue (these buildings are currently surrounded by barricades). Recommendations from this project can be incorporated into that or other City and/or County CIP projects by coordinating the improvement schemes with the City and the County. This action will require immediate attention by the College because the City and County are aggressively implementing their CIP's, and the window of opportunity begins to close once design is underway.
- *People's Transportation Plan (PTP), from the City of Miami allocation*. Miami-Dade County's 1-cent sales tax provides a dedicated funding source for transportation improvements, with a portion of the money earmarked for transit improvements, but other funds are available for projects involving roadway and non-motorized modes. One identified PTP project includes upgrade of the County's traffic signalization system. The recommendations from this study, including pedestrian countdown timers, qualify as signal upgrades and upgrade features to the County system.

Table 8
Tiered Recommendation Plan Cost Estimates

Tier	Improvement	Qty	Unit Cost Low	Unit Cost High	Total Cost Low	Total Cost High
	FOCUS AREA A: 5th St midblock					
1	Midblock Crosswalk - Minor Enhancements				$ 900	$ 1,400
	Advanced placement of yield line	1	$ 300	$ 500	$ 300	$ 500
	"Yield Here to Pedestrians" regulatory signs	2	$ 200	$ 300	$ 400	$ 600
	Fluorescent yellow-green pedestrian warning sign	1	$ 200	$ 300	$ 200	$ 300
2	Midblock Crosswalk - Major Enhancements				$ 17,100	$ 51,700
	Tier 1 Improvements (minus ped warning sign)				$ 700	$ 1,100
	Overhead signage w/ flashing beacons	1	$ 10,000	$ 40,000	$ 10,000	$ 40,000
	Automatic detection w/ bollards	4	$ 1,500	$ 2,500	$ 6,000	$ 10,000
	"Walk Between Posts to Activate Flashing Crosswalk" Signs	2	$ 200	$ 300	$ 400	$ 600
3	Exclusive Pedestrian Signal	1	$ 50,000	$ 75,000	$ 50,000	$ 75,000
4	Pedestrian Overpass	1	$ 500,000	$ 3,000,000	$ 500,000	$ 3,000,000
	FOCUS AREA B: 5th St/2nd Ave					
1	Signing, Marking, & Lighting Enhancements				$ 16,500	$ 25,000
	"Watch Turning Vehicles" (pavement legend)	1	$ 300	$ 700	$ 300	$ 700
	"Turning traffic must yield to pedestrians" sign	1	$ 200	$ 300	$ 200	$ 300
	Ped-oriented street lights	8	$ 2,000	$ 3,000	$ 16,000	$ 24,000
2	Signal & "Smart" Sign Enhancements				$ 31,500	$ 71,400
	Tier 1 Improvements				$ 16,500	$ 25,000
	Curb extension	1	$ 5,000	$ 20,000	$ 5,000	$ 20,000
	Countdown Pedestrian Signal Indications	8	$ 500	$ 800	$ 4,000	$ 6,400
	"Pedestrian in Crosswalk" lighted "smart" sign	1	$ 3,000	$ 15,000	$ 3,000	$ 15,000
	Automatic detection w/ bollards	2	$ 1,500	$ 2,500	$ 3,000	$ 5,000
	FOCUS AREA C: 2nd Ave/4th St					
1	Curb Extensions & Striping				$ 16,500	$ 63,000
	Zebra striping	3	$ 500	$ 1,000	$ 1,500	$ 3,000
	Curb extensions	3	$ 5,000	$ 20,000	$ 15,000	$ 60,000
2	Signal Enhancements				$ 20,500	$ 70,300
	Tier 1 Improvements				$ 16,500	$ 63,000
	Leading Pedestrian Signal Interval	1	$ 1,000	$ 2,500	$ 1,000	$ 2,500
	Countdown Pedestrian Signal Indications	6	$ 500	$ 800	$ 3,000	$ 4,800
3	Street Closure/Pedestrian Promenade/Gateway				$ 1,467,163	$ 1,668,963
	Street Closure/Pedestrian Promenade	1	$ 1,414,163	$ 1,414,163	$ 1,414,163	$ 1,414,163
	Countdown Pedestrian Signal Indications	6	$ 500	$ 800	$ 3,000	$ 4,800
	Other Gateway Feature	1	$ 50,000	$ 250,000	$ 50,000	$ 250,000

Table 8, continued
Tiered Recommendation Plan Cost Estimates

Tier	Improvement	Qty	Unit Cost Low	Unit Cost High	Total Cost Low	Total Cost High
	FOCUS AREA D: 3rd St midblock					
1	Midblock Crosswalk - Minor Enhancements				$ 4,600	$ 13,100
	Advanced placement of yield line	1	$ 300	$ 500	$ 300	$ 500
	"Yield Here to Pedestrians" regulatory signs	2	$ 200	$ 300	$ 400	$ 600
	"Use Crosswalk" regulatory signs for pedestrians	2	$ 200	$ 300	$ 400	$ 600
	Ped railings on Bldg.1 steps to sidewalk	40	$ 25	$ 35	$ 1,000	$ 1,400
	Landscaping planter	1	$ 2,500	$ 10,000	$ 2,500	$ 10,000
2	Shifting of Midblock Crosswalk & Walkway Lighting *				$ 19,900	$ 36,600
	Tier 1 Improvements				$ 4,600	$ 13,100
	Zebra striping	1	$ 500	$ 1,000	$ 500	$ 1,000
	Curb ramp (on S. side of 3rd Street)	1	$ 800	$ 1,500	$ 800	$ 1,500
	Ped-oriented street lights (walkway between parking lot & garage)	7	$ 2,000	$ 3,000	$ 14,000	$ 21,000
3	Raised Crosswalk				$ 29,900	$ 56,600
	Tier 2 Improvements				$ 19,900	$ 36,600
	Raised Crosswalk	1	$ 10,000	$ 20,000	$ 10,000	$ 20,000
	FOCUS AREA E: 1st Ave midblock					
1	Midblock Crossing Discouragement				$ 6,250	$ 8,750
	Pedestrian railing along edge of eastern sidewalk	250	$ 25	$ 35	$ 6,250	$ 8,750
2	Crosswalk Enhancements & Landscaping				$ 35,690	$ 83,250
	Tier 1 Improvements				$ 6,250	$ 8,750
	Zebra striping (1st Ave/3rd St)	4	$ 500	$ 1,000	$ 2,000	$ 4,000
	Curb extensions	2	$ 5,000	$ 20,000	$ 10,000	$ 40,000
	Countdown Pedestrian Signal Indications (1st Ave at 2nd & 3rd St)	16	$ 500	$ 800	$ 8,000	$ 12,800
	Fencing & landscaping along borders of Wolfson parking lot	590	$ 16	$ 30	$ 9,440	$ 17,700

* Assumes that the entrance/exit driveway for the MDC Wolfson surface parking lot has been relocated to the west of its existing location.

- *Coordination with other projects*. Numerous capital projects are underway in the vicinity of the Wolfson Campus. An example of this is potential coordination with the proposed City of Miami Streetcar project, a portion of which is planned to run on NE 1st Avenue adjacent to the Wolfson Campus and will require street reconstruction to install the streetcar guideway. The recommended projects from this study along NE 1st Avenue can be incorporated as part of the street reconstruction required for streetcar. The benefit of implementation through a "piggyback" with other projects comes with cost savings in procurement, mobilization, and economics of scale. However, the timing of when various projects occur will be a consideration for using this approach. For example, streetcar will not occur until 2008 at the earliest.
- *Coordination with new large scale developments*. Recommended projects from this study can be included in non-motorized mitigation required for any new large scale development/redevelopment projects in the area near the Wolfson Campus. The College must advise of these improvements with the City and clearly relate the value of the improvements as a form of mitigation for some undesirable effect caused by the new development, such as increased traffic volumes around the Wolfson Campus.
- *TEA-21 (or its successor)*. Various categories of TEA-21 funding can be used for pedestrian improvements, such as:
- *Transportation Enhancement, Surface Transportation Program (STP), or Hazard Elimination Program (HEP)* funding can be used for sidewalk improvements, improved pedestrian crossings, spot improvements, or traffic calming. Transportation Enhancement funding has already been approved for the 4th Street Pedestrian Promenade Extension project.
- *Transit Enhancements* funding can be used for sidewalk improvements or improved pedestrian crossings associated with transit.
- *Transportation and Community and System Preservation Pilot Program (TCSP)* funding can be used for traffic calming improvements.

Access to TEA-21 funds is generally obtained through the Metropolitan Planning Organization (MPO), which plans, prioritizes, and submits projects for the use of these funds to the Florida Department of Transportation.

The first step in getting the recommended projects funded is for representatives from the MDC Wolfson Campus to meet with the City of Miami and Miami-Dade County to determine how these projects may be accommodated first and foremost as a component of other projects or programs, including sidewalk, safety, or spot improvement programs.

APPENDIX

APPENDIX A

MIAMI-DADE COUNTY MIDBLOCK CROSSING PLANS

MIAMI-DADE COUNTY, FLORIDA

MIAMI-DADE

STEPHEN P. CLARK CENTER

PUBLIC WORKS DEPARTMENT
SUITE 1610
111 N.W. 1st STREET
MIAMI, FLORIDA 33128-1970
(305) 375-2960

January 14, 2004

Mr. Ayman El Baz
Campus Facilities Planner
Miami Dade Community College
627 SW 27 Avenue
Miami, Florida 33135

Re: Pedestrian safety study at
NE 5 Street, east of NE 1 Avenue and
NE 2 Avenue and NE 5 Street

Dear Mr. El Baz:

This is a follow up response to your meeting with staff concerning the referenced matter. Please be advised of the following:

NE 5 Street between NE 1 Avenue and NE 2 Avenue: A traffic study was conducted to evaluate the need for a pedestrian signal at this location. As a result, it was determined that the existing pedestrian crossing just east of NE 1 Avenue meets the requirements for the installation of a mid-block signal. This device will allow pedestrians to safely cross NE 5 Street, at that point connecting the exit from the parking garage to the Wolfson Campus main buildings.

Since both the classroom buildings and the parking garage are Miami-Dade College (MDC) facilities, it is the responsibility of the MDC to provide a Traffic Signal to facilitate access to and from the garage. Should MDC desire to pursue the installation of a pedestrian signal at this location, a consulting engineer must be employed to prepare constructions plans, which should then be submitted to this Department for review. Upon approval, a construction permit may be secured by a qualified contractor from the City to accomplish this work, at MDC's expense. Subsequently, this Department will accept the signal for future maintenance. Please note that the average cost for the installation of this device is currently estimated at $75,000.00.

Since NE 5 Street falls under the maintenance jurisdiction of City of Miami, by copy of this letter to Ms. Stephanie Grindell, P.E., Director, PWD City of Miami, we are also requesting the construction of pedestrian ramps on both sides of NE 5 Street, as per enclosed sketch of the ramp locations. Upon

completion of this work, as an interim measure until the pedestrian signal becomes operational, the Department will proceed with the installation of Zebra crosswalk markings and crosswalk warning signage.

NE 2 Avenue and NE 5 Street: An evaluation of pedestrian activity was conducted to determine the need for an exclusive pedestrian phase for pedestrians crossing diagonally at this signalized intersection. As a result, it was determined that the volume of pedestrian crossings diagonally, during a.m. and p.m. peak hours, is minimal at this intersection. Therefore, no changes in the signal phasing are justified at this time. Nonetheless, please note that under Miami Dade County Road Improvements Project No. 651007, this intersection will be re-constructed along with others along NE 1 Avenue and NE 2 Avenue, which will enhance operational safety along their corridors.

NE 3 Street between NE 1 Avenue and NE 2 Avenue: Our collected traffic data revealed that this location does not meet any warrant for a pedestrian signal installation. However, to provide guidance for pedestrians who are crossing NE 3rd Street, at this location, the Department will install Zebra crosswalk markings and signage, once pedestrian ramps are completed as per the enclosed sketch. Since NE 3 Street is maintained by City of Miami, by copy of this letter to Ms. Grindell, we are also requesting the construction of the required ramps and the removal of three municipal parking meters.

NE 2 Avenue and NE 4 Street: A traffic study was conducted at this intersection, which revealed that the traffic control devices are operating at an acceptable level. Please note that the existing signal includes pre-timed pedestrian phases on both streets. Further, at this time, work orders will be issued to install Advance Intersection Lane Control signs on both sides of NE 2 Avenue to face southbound traffic, to indicate the configuration of all lanes ahead. This work will be accomplished by our Traffic Signals and Signs Division within the next four weeks.

Should you have any questions or require additional information, please do not hesitate to contact Ms. Angela Suarez, Area Engineer, Traffic Engineering Division at (305) 375-2030.

Sincerely,

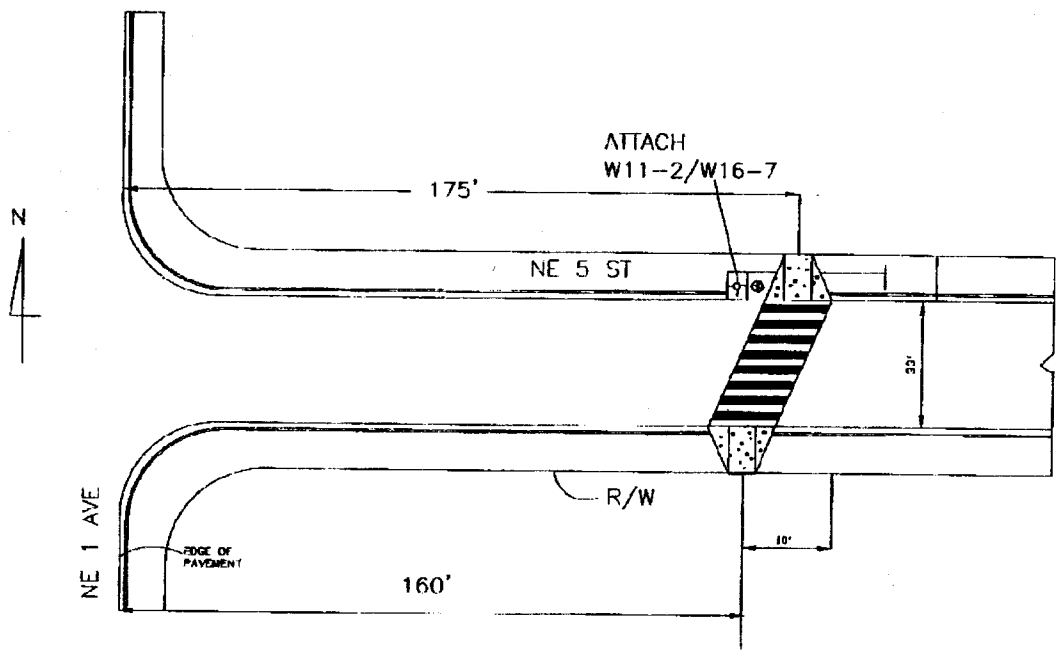
Muhammed M. Hasan, P.E., Chief
Traffic Engineering Division

Enclosure

cc: Stephanie Grindell, P.E., Director, PWD City of Miami
Mary H. Conway, P.E., Transportation Director, City of Miami
Jeffrey Cohen, P.E., Acting Assistant Chief

MIAMI-DADE COUNTY PUBLIC WORKS DEPT.
TRAFFIC ENGINEERING DIVISION

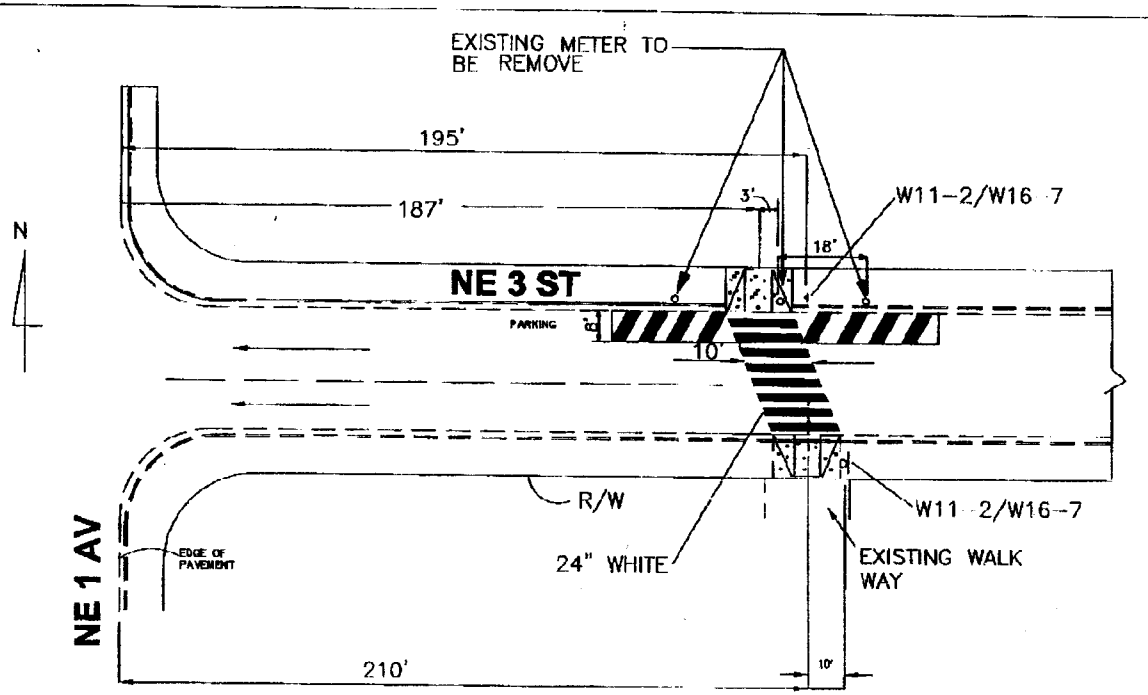
PROJECT NO. 662320 SHEET 114 OF



NOTES: 1. CLEARING & GRUBBING 20 SY
2. CONSTRUCT PEDESTRIAN RAMPS INCLUDING 24 LF OF CONC CURB & GUTTER.

REVISIONS			ZEBRA CROSSING NE 1 AV & NE 5 ST INTERSECTION IDENTIFICATION				
DATE	DESCRIPTION	BY	DESIGNED BY	DRAWN BY	CHECKED BY	DATE	FILE NO.
			JCL	JCL	V.R.	12/2003	

MIAMI-DADE COUNTY PUBLIC WORKS DEPT.
TRAFFIC ENGINEERING DIVISION
PROJECT NO. 662320 SHEET 114 OF



NOTES: 1. CLEARING & GRUBBING 12 SY
2. CONSTRUCT PEDESTRIAN RAMPS INCLUDING 24 LF OF CONC. CURB & GUTTER.

REVISIONS		
DATE	DESCRIPTION	BY

CROSS WALK
NE 1 AV & NE 3 ST
INTERSECTION IDENTIFICATION

DESIGNED BY	DRAWN BY	CHECKED BY	DATE	FILE NO.
JCL	JCL	V.R.	1-12-04	

APPENDIX B

LEVEL OF SERVICE ANALYSIS RESULTS

Table B-1
Average Intersection Delay and LOS

Approach / Movement		Existing Conditions *			
		PM Peak Hour		AM Peak Hour	
		Delay	LOS	Delay	LOS
NE 6th St/NE 1st Ave					
WB	Thru	15.2	B	10.7	B
	Right	37.8	D	16.1	B
NB	Left	14.7	B	5.3	A
	Thru	12.1	B	4.2	A
	Intersection	**20.1**	**C**	**8.7**	**A**
NE 6th St/NE 2nd Ave					
WB	Left	9.8	A	20.1	C
	Thru	18.5	B	21.0	C
SB	Thru	15.3	B	9.3	A
	Right	16.2	B	7.3	A
	Intersection	**17.1**	**B**	**11.9**	**B**
NE 5th St/NE 1st Ave					
EB	Left	18.1	B	17.1	B
	Thru	17.5	B	15.9	B
NB	Thru	20.2	C	17.6	B
	Right	18.7	B	11.4	B
	Intersection	**19.0**	**B**	**16.1**	**B**
NE 5th St/NE 2nd Ave					
EB	Thru	16.7	B	21.3	C
	Right	16.7	B	18.7	B
SB	Left	9.6	A	7.3	A
	Thru	7.5	A	3.9	A
	Intersection	**12.9**	**B**	**11.5**	**B**
NE 4th St/NE 2nd Ave					
WB	Left	19.4	B	27.3	C
SB	Left	18.9	B	12.9	B
	Thru	18.2	B	12.2	B
	Intersection	**18.4**	**B**	**13.1**	**B**

* Existing peak hour turning volumes were collected in May 2002 as part of the I-95 New Port Access Ramp to Westbound SR 836 PD&E Study, with the exception of the 2nd Ave/4th St volumes which were collected in Feb. 2004.

Table B-2
Roadway Segment Level of Service (LOS) Analysis - PM Peak Hour Existing Conditions

Existing PM Peak Hour *	Arterial Class	Flow Speed	Running Time (s)	Tot Delay (s)	Travel Time (s)	Dist (mi)	Arterial Speed (mph)	Arterial LOS **
Northbound 1st Ave								
NE 3rd St to NE 5th St	IV	30	14.9	20.2	35.1	0.12	12.7	D
NE 5th St to NE 6th St	IV	30	7.8	12.1	19.9	0.06	11.8	D
Total	IV	30	22.7	32.3	55.0	0.19	12.4	D
Southbound 2nd Ave								
N. of NE 6th St	IV	30	8.1	15.3	23.4	0.07	10.4	D
NE 6th St to NE 5th St	IV	30	7.7	7.5	15.2	0.06	15.2	C
NE 5th St to NE 4th St	IV	30	7.7	18.2	25.9	0.06	8.9	E
Total	IV	30	23.4	41.0	64.4	0.20	10.9	D
Eastbound 5th St								
W. of NE 1st Ave	IV	30	12.1	17.5	29.6	0.10	12.3	D
NE 1st Ave to NE 2nd Ave	IV	30	12.0	26.1	38.1	0.10	9.5	D
Total	IV	30	24.2	43.6	67.8	0.20	10.7	D
Westbound 6th St								
E. of NE 2nd Ave	IV	30	9.3	18.5	27.8	0.08	10.0	D
NE 2nd Ave to NE 1st Ave	IV	30	12.0	15.2	27.2	0.10	13.2	C
Total	IV	30	21.3	33.7	55.0	0.18	11.6	D

* Existing peak hour turning volumes were collected in May 2002 as part of the I-95 New Port Access Ramp to Westbound SR 836 PD&E Study, with the exception of the 2nd Ave/4th St volumes which were collected in Feb. 2004.

** Arterial LOS based on arterial travel speeds from HCM 2000 Exhibit 15-2.

Table B-3
Roadway Segment Level of Service (LOS) Analysis - AM Peak Hour Existing Conditions

Existing AM Peak Hour *	Arterial Class	Flow Speed	Running Time (s)	Tot Delay (s)	Travel Time (s)	Dist (mi)	Arterial Speed (mph)	Arterial LOS **
Northbound 1st Ave								
NE 3rd St to NE 5th St	IV	30	14.9	17.6	32.5	0.12	13.8	C
NE 5th St to NE 6th St	IV	30	7.8	4.2	12.0	0.06	19.5	B
Total	IV	30	22.7	21.8	44.5	0.19	15.3	C
Southbound 2nd Ave								
N. of NE 6th St	IV	30	8.1	9.3	17.4	0.07	14.0	C
NE 6th St to NE 5th St	IV	30	7.7	3.9	11.6	0.06	19.9	B
NE 5th St to NE 4th St	IV	30	7.7	12.2	19.9	0.06	11.6	D
Total	IV	30	23.4	25.4	48.8	0.20	14.4	C
Eastbound 5th St								
W. of NE 1st Ave	IV	30	12.1	15.9	28.0	0.10	13.0	D
NE 1st Ave to NE 2nd Ave	IV	30	12.0	31.2	43.2	0.10	8.4	E
Total	IV	30	24.2	47.1	71.3	0.20	10.2	D
Westbound 6th St								
E. of NE 2nd Ave	IV	30	9.3	21.0	30.3	0.08	9.2	D
NE 2nd Ave to NE 1st Ave	IV	30	12.0	10.7	22.7	0.10	15.8	C
Total	IV	30	21.3	31.7	53.0	0.18	12.0	D

* Existing peak hour turning volumes were collected in May 2002 as part of the I-95 New Port Access Ramp to Westbound SR 836 PD&E Study, with the exception of the 2nd Ave/4th St volumes which were collected in Feb. 2004.

** Arterial LOS based on arterial travel speeds from HCM 2000 Exhibit 15-2.