CITY OF DOTHAN BICYCLE AND PEDESTRIAN MASTER PLAN

September 21, 2011

walk and bike DOTHAN

PREPARED FOR:
The City of Dothan, Alabama

PREPARED BY: NEEL-SCHAFFER Solutions you can build upon PRAESTARE ENGINEERING

ACKNOWLEDGEMENTS

The City of Dothan recognizes the efforts of the numerous residents and other walking / bicycling enthusiasts who participated in the development of this plan. Their creativity, energy, and commitment helped to shape this planning document.

The following residents and city staff contributed regularly to the Dothan Bicycle and Pedestrian Master Plan throughout its development:

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Mr. Mike West, City Manager

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Mr. Amos Newsome, District 2
Mr. Albert Kirkland, District 3
Mr. John Craig, District 4
Mr. Taylor Barbaree, District 5
Mr. Hamp Baxley, District 6

The Dothan Bicycle and Pedestrian Advisory Committee:

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Mr. Joe Varner
Mr. Jeff Coleman, The Bike Shop
Mr. John Anderson, Dothan Cycle & Fitness

City of Dothan Representatives:
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Mr. Mike West, City Manager
Mr. Jerry Corbin, Public Works Director

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Dothan Bicycle and Pedestrian Plan

Introduction

The City of Dothan has recognized an increased interest in bicycling and walking in recent years that indicates an apparent need for a planning effort to guide the future development of bicycle and pedestrian facilities. This need was further substantiated by the Southeast Wiregrass Metropolitan Planning Organization's (MPO) 2035 Long Range Transportation Plan statement that successful transportation planning relies on careful consideration of all modes of transportation including pedestrian and bicycle facilities and its recommendation that a bicycle and pedestrian plan be developed.

This planning effort represents an attempt to provide planning proposals, design and development standards, organization and education / promotional activities related to bicycle and pedestrian facilities in Dothan. From the information presented it is clear that the potential for such facilities has not been fully realized and that currently there is no overall direction or means for guiding the development of bicycle and pedestrian facilities and activities. This Plan is designed to give those responsible for making decisions a guide for assuring that bicycle and pedestrian facilities become a viable part of Dothan's transportation and recreational experience.

The Process

The Bicycle and Pedestrian Plan was prepared for the City of Dothan by a team of consultants from Neel-Schaffer, Inc. and Praestare Engineering. The consultant team, along with city staff, met numerous times with a Bicycle and Pedestrian Advisory Committee, held public information meetings and public hearings during the planning process. Draft reports were presented for review and comment by the city staff, city officials and the public.

The Plan was developed through: the collection of pertinent data related to bicycling and pedestrian activity; an assessment of conditions and opportunities for bicycle and pedestrian facilities; citizen input through a survey made available on a special web site designed for the project and distributed to citizens and through public meetings; review and comment obtained from the Bicycle and Pedestrian Advisory Committee and input and coordination between city departments and local groups.

Public Involvement

Public Involvement is an important part of developing a workable and practical plan that meets the needs of the pedestrian and bicycle public. To this end, public input is considered a critical part of identifying bicycling and pedestrian needs and the public was engaged early and often in the plan's development. The intent is to create public awareness relative to goals, objectives, and process, as well as publicize the public participation opportunities and activities available throughout the planning process. Public involvement has consisted of:

- meetings with the Bicycle and Pedestrian Advisory Committee;
- public information meetings and public hearings;
- public distribution of a Bicycle and Pedestrian Plan questionnaire; and
- a web site for posting plan development progress including draft reports and maps.

Bicycle and Pedestrian Advisory Committee

The City created a Bicycle and Pedestrian Advisory Committee consisting of representatives from affected organizations, the community at large and city staff / officials to assist in completing the planning project. The Consultant Team worked closely with the Advisory Committee through meetings, field trips and visioning work sessions to obtain input and guidance throughout the planning process.

Public Meetings

Throughout the course of analyzing and developing planning proposals, Public Information Meetings were held to provide the public with information as well as solicit their comments on the plan.

<u>Public Meeting #1: February 3, 2011</u>

This public meeting was held in two sessions, one in the morning and one in the late afternoon. It was an opportunity to introduce the Bicycle and Pedestrian Plan process to the public. A review of the Bicycle and Pedestrian Plan process and an outline of the proposed scope of work were presented along with the distribution of a form for public comment. Concerns were expressed regarding bicycle safety on streets, the need for bike lanes in Dothan, pedestrian and bike safety at Westgate Park, speed limit enforcement for vehicles and names of streets that should be provided with bicycle lanes and/or pedestrian sidewalks were mentioned. There were 22 people in attendance at the two sessions.

<u>Public Meeting #2: April 7, 2011</u>

This meeting included a presentation of the findings of the inventory and analysis pertaining to existing street and sidewalk characteristics, bicycle and pedestrian destinations, bicycle and pedestrian collision data, results of the Bicycle and Pedestrian Survey and goals and objectives. Also a preliminary presentation was made of proposed bicycle and pedestrian improvements and attendees were given maps to the proposed improvements on which to make comments and personally draw additional improvement ideas. The proposed improvements generally received a favorable response, especially utilization of utility easements for off-street facilities. Some concerns were expressed about cost and the actual implementation of improvements. There were 13 people in attendance at the meeting.

Planning Commission Presentation: September 21, 2011, Presentation of Master Plan.

Public Meeting #3 / City Commission Presentation: October 18, 2011, Presentation of Final Master Plan.

Web Site Postings

A project specific Web Site, www.walkandbikedothan.org, was developed and activated in the initial phases of the planning process. The Web Site described the overall Plan, the goals and activities associated with the Plan, provided updates, the latest news, and links to various bicycle and pedestrian resources. Drafts of written reports and maps were posted for public review and comment.

Background / Purpose

The Bicycle and Pedestrian Plan has been designed as a policy level plan that seeks to preserve and enhance the area's bicycling and pedestrian network and to improve the safety, attractiveness, and overall viability of biking and walking as legitimate transportation alternatives. It seeks to establish policies and guidelines for future bicycle and pedestrian facilities and related amenities within Dothan.

Review of Existing Plans

This is the City of Dothan's first effort devoted specifically to the development of a bicycle and pedestrian plan. However, a review of existing plans found that three reports have touched on bicycle and pedestrian planning. They are:

- City of Dothan Long Range Development Plan, A Sense of New Beginnings (adopted March 16, 2011);
- Southeast Wiregrass MPO 2035 Long Range Transportation Plan, June 2010; and
- Master Plan for Parks and Recreation in Dothan, October 16, 2006.

Pertinent information included in these planning studies was summarized and, when appropriate, information, analyses and proposals from these plans were used in developing the bicycle and pedestrian plan. In some instances text was used verbatim from these reports. Every effort was made to give credit when using parts of these planning reports and if credit was not given, it was not intentional. Persons reviewing this report and deciding on bicycle and pedestrian proposals would be well advised to become familiar with the three plans listed above for an insight into land development, transportation and recreation analyses and plans, all of which are related to bikeways and walkways.

Inventory and Analysis of Existing Conditions

The inventory and analysis of existing conditions includes a wide range of factors that are pertinent to and will form the basis for the preparation of planning proposals for bicycle and pedestrian facilities. These factors include the use of land, the streets system, sidewalks, recreation facilities, schools, major destinations and bicycle / pedestrian facilities.

Land Use

The existing types of land use and pattern of development can significantly influence future planning proposals and policies related to bicycle and pedestrian facilities. For reference purposes when reviewing analysis conclusions and recommended projects, Map 1 Existing

Land Use shows the existing use of land throughout the corporate limits of Dothan. The source of this map along with the following table is the City of Dothan Long Range Development Plan 2010-2030, A Sense of New Beginnings (adopted March 16, 2011), and is available for review on the City of Dothan's web site (www.dothan.org).

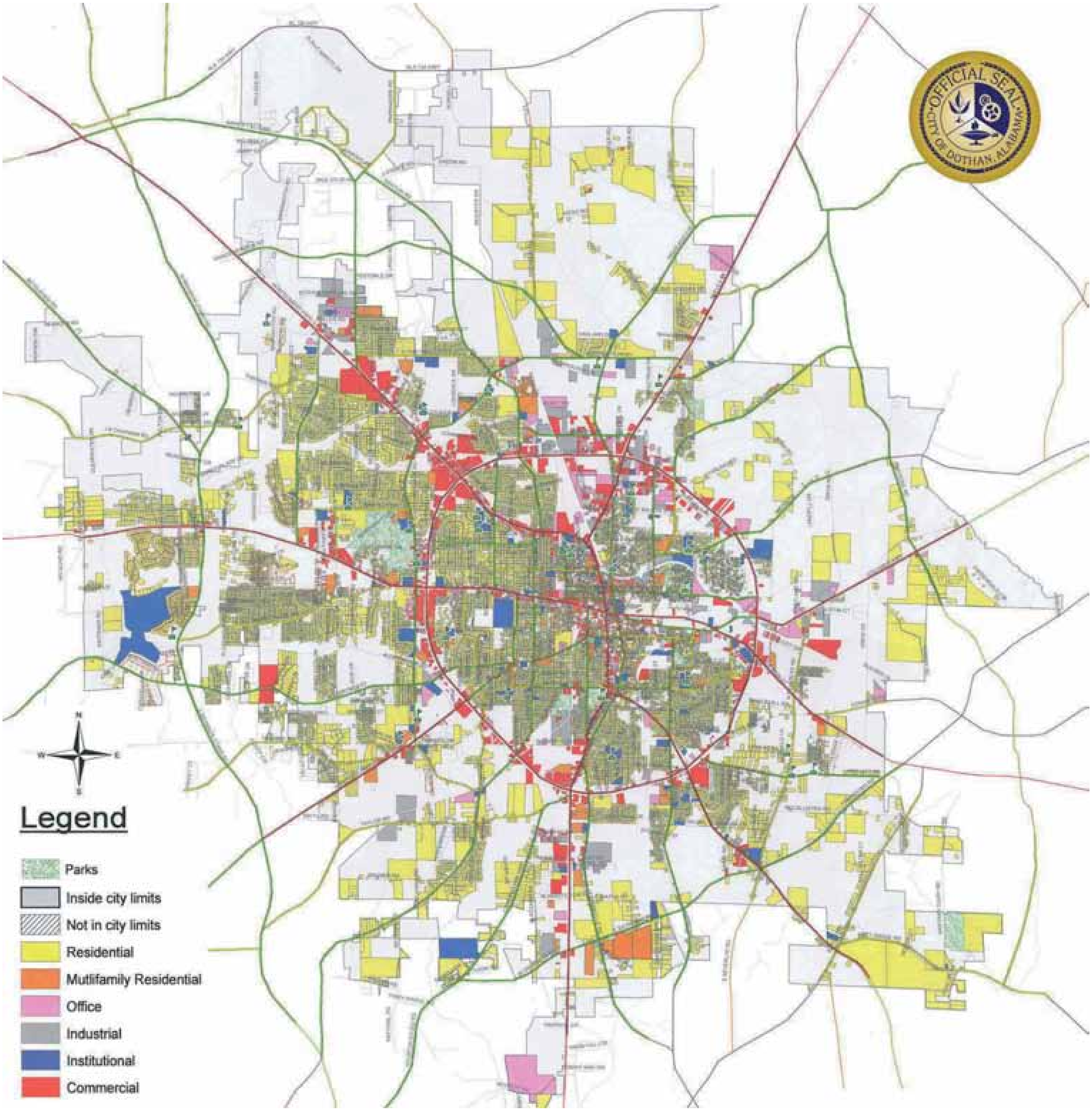
The Long Range Development Plan states that the acreage figures in Table 1 are derived from tax assessment information and is dependent on the County codes by parcel for tax purpose, not from actual field observations and that as the planning program continues the figures will be refined using actual field observations.

Table 1

Land Use Distribution – 2006

Type of Use	Acres	Percent of Developed Land	Percent of Total Land
Residential	**16,442**	**65.0**	**28.8**
Residential	15,756	62.3	27.6
Multi-family	686	2.7	1.2
Non-Residential	**6,679**	**26.4**	**11.7**
Commercial	2,042	8.1	3.6
Institutional	1,056	4.2	1.8
Industrial	2,634	10.4	4.6
Office	947	3.7	1.7
Open Space / Agricultural	**2,181**	**8.6**	**3.8**
Parks	489	1.9	0.9
Agricultural-Open Space-Develop	1,692	6.7	2.9
TOTAL DEVELOPED LAND	**25,302**	**100.0**	**44.4**
Undeveloped Land	31,845		55.7
TOTAL LAND AREA	**57,147**		**100.0**

Source: City of Dothan, Long Range Development Plan, 2010-2030, Adopted March 16, 2011



MAP 1

CITY OF DOTHAN EXISTING LAND USE

Source: City of Dothan GIS Data Base

Major Streets

Major streets are important to the development of bicycle and pedestrian facilities as they are the resource that provides connectivity between different parts of the community and major destinations and the base infrastructure for forming a bicycle / pedestrian network. Characteristics regarding these streets are basic to the formulation of bicycle / pedestrian facility proposals. Accordingly, a field survey of certain characteristics was conducted combined with a review of information and analyses in the MPO Report.

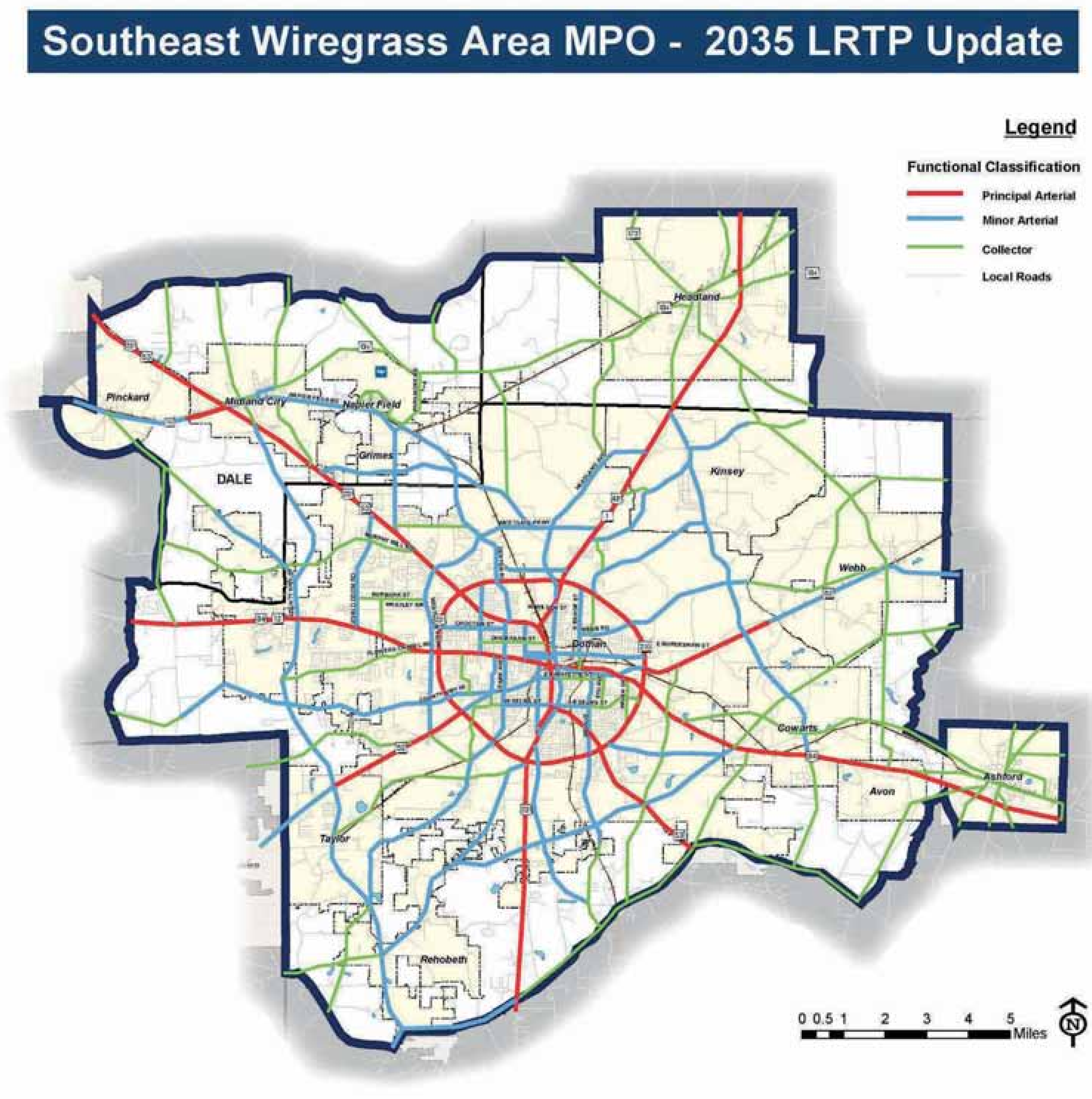
Accessibility in Dothan is enhanced by nine urban principal arterials, thirty-four urban minor arterials and thirty-three collector streets. They are shown by these classifications on Map 2 - Roadway Functional Classifications. An understanding of these streets and their physical characteristics is important in recommending bicycle and pedestrian projects and especially to the prioritization of recommended projects. Tables 3, 4 and 5 provide information on pertinent characteristics of these streets. All streets in the City of Dothan not listed in Tables 3 – 5 are classified as urban local streets.

The most important streets for moving traffic and providing access through Dothan are Ross Clark Circle, U.S. Highways 84, 231, 431 and State Highways 52 and 53. However, not necessarily because of an ability to move traffic but from the standpoint of accessibility to destinations likely to encourage bicycle and pedestrian activity and providing connectivity between these destinations, some of the most important streets are:

- Westgate Parkway / Honeysuckle Road with its accessibility to the City's largest park, 5 schools, intersection with Montgomery Highway's major commercial activity and numerous intersections with short access to development on Ross Clark Circle makes it probably one of the most important sections of bicycle / pedestrian roadway in the City.
- Streets in and within the vicinity of Downtown Dothan are important providers of access throughout Downtown commercial activities and public facilities.
- South Foster Street is important because it provides access between Downtown and the Dothan High School / Doug Tew Recreation Center area.
- Montgomery Highway with its major concentration of commercial development.
- The numerous streets, many of which are classified as urban local, that serve as routes between neighborhoods and nearby schools and recreation facilities.

Volume To Capacity Comparison

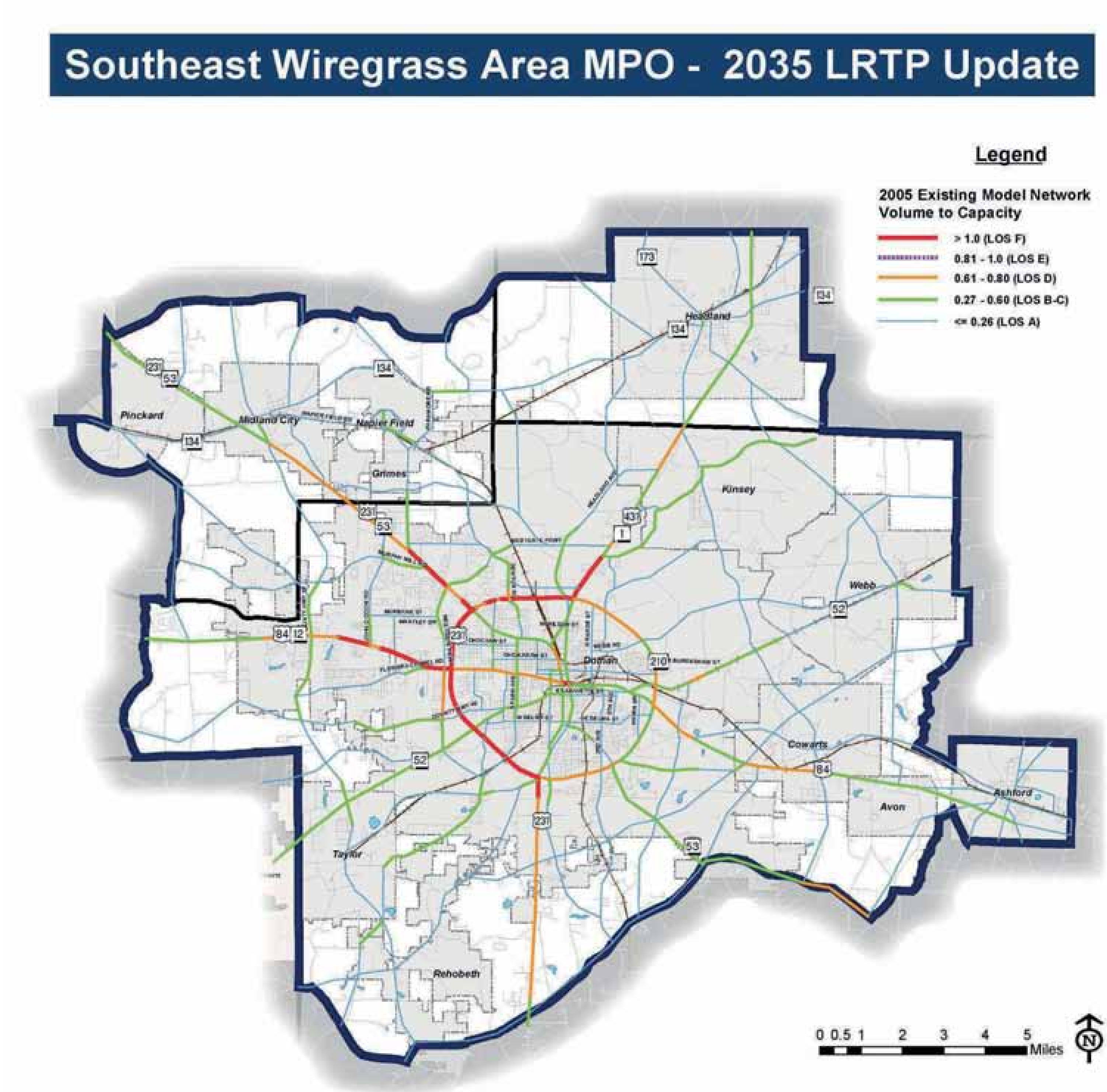
Roadway characteristics are an important factor in the development of planning proposals, especially on-street bicycle path recommendations. The 2035 Long Range Transportation Plan identified volume to capacity comparisons for Dothan's most heavily used streets as shown on Map 3 - 2005 Existing Network, Volume to Capacity Comparison. Segments having greater than half the capacity of a new lane were identified as needing capacity improvements. Segments with deficiency between 15 and 50 percent of the capacity of a new lane were considered for operational improvements, intersection modifications, and/or access management. Segments with a deficiency of less than 15 percent were considered for minor operational improvements or signal upgrades. Using these criteria, the MPO Report identified congested roadway segments requiring capacity additions and operational improvements. These needs are included in this existing conditions analysis (see Table 2) as they present an opportunity to incorporate recommended bicycle or pedestrian facilities when improvements are undertaken.



MAP 2

ROADWAY FUNCTIONAL CLASSIFICATIONS

Source: Southeast Wiregrass MPO, 2035 Long Range Transportation Plan, Adopted July 2010



MAP 3

2005 EXISTING NETWORK, VOLUME TO CAPACITY COMPARISON

Source: Southeast Wiregrass MPO, 2035 Long Range Transportation Plan, Adopted July 2010

Table 2

2035 Roadway and Operational Improvement Needs

Roadway	Location Between	Identified Need
Brannon Stand Road	CR 47 / CR 59, south of Whitfield	Operational Improvement
Headland Avenue	Westgate Parkway and Suggs Road	Operational Improvement
Ross Clark Circle	Bauman and U. S. 231 South	Major Capacity Improvement
Ross Clark Circle	U. S. 231 North and U. S. 231 South	Minor Capacity Improvement
South Park Avenue	Montgomery Highway and Fortner Street	Minor Capacity Improvement
SR 52	Ross Clark Circle and CR 41	Operational Improvement
Reeves Street	Ross Clark Circle and East Main Street	Minor Capacity Improvement
U. S. 84 West	John D. Odom Road and City Limit	Major Capacity Improvement
U. S. 84 West	Ross Clark Circle and John D. Odom Rd	Minor Capacity Improvement
West Main Street	Ross Clark Circle and Oates Street	Minor Capacity Improvement
East Main Street	Ross Clark Circle and Cowarts Road	Operational Improvement
East Main Street	Cowarts Road and Old Highway 84	Minor Capacity Improvement
Montgomery Highway	Ross Clark Circle and City Limit	Minor Capacity Improvement
Oates Street South	Moffett Road and City Limit	Minor Capacity Improvement
Oates Street South	Ross Clark Circle and Moffett Road	Operational Improvement
North Oates Street	West Main Street and Blackshear Street	Minor Capacity Improvement
Westgate Parkway	U. S. 231 and Fortner Street	Minor Capacity Improvement
Honeysuckle Road	Fortner Street and South Park Avenue	Operational Improvement

Source: Southeast Wiregrass Metropolitan Planning Organization's 2010-2035 Long Range Transportation Plan

Table 3

Roadway Characteristics – Urban Principal Arterials

Street	Lanes	Median	Pavement Edge	Crosswalk	Crosswalk Condition	Crosswalk Signage	Crosswalk Signal	Shoulder	Shoulder Material	Shoulder Condition
Ross Clark Circle										
U.S. 231 - U.S. 84 W	4	Yes	None	None				Yes	Grass	Good
U.S. 84 W - AL 52 W	4	Yes	None	None				Yes	Grass	Good
AL 52 W - U.S. 231 S	4	Yes	None	None				Yes	Grass	Good
U.S. 231 S - U.S. 84 E	4	Yes	None	None				Yes	Grass	Good
U.S. 84 E - U.S. 431 N	4	Yes	None	None				Yes	Grass	Good
U.S. 431 N - U.S. 231 N	4	Yes	None	None				Yes	Grass	Good
Columbia Hwy (AL 52 E)										
Ross Clark Circle - City Limits	2		None	None				Yes	Grass	Good
Hartford Hwy (AL 52 W)										
Ross Clark Circle - City Limits	5		C & G	None				Yes	Grass	Good
Alabama Highway 53										
S. Oates - Ross Clark Circle	4		None	None				Yes	Grass	Good
Ross Clark Circle - Mimosa	4		Curb	None				Yes	Grass	Good
Mimosa - City Limits	2		Curb	None				Yes	Grass	Good
E Main Street (U.S. 84 E)										
South Oates - Appletree	4		Curb	Yes	Good	Yes	No	Yes	Grass	Good
Appletree – Ross Clark Circle	6	Yes	C & G	None				Yes	Grass	Good
Ross Clark Circle - City Limits	6	Yes	C & G	None				Yes	Grass	Good
W Main Street (U.S. 84 W)										
S Oates - Ross Clark Circle	4		Curb	Yes (12)	Fair	Yes	Yes	Yes	Grass	Good
Ross Clark Circle - City Limits	4	Yes	None	None				Yes	Asphalt	Good
U. S. 231 North										
Main St - Ross Clark Circle	4	Yes	C & G	Yes (11)	Fair-Poor	No	No	No		
Ross Clark Circle - Westgate	4	Yes	None	None				Yes	Grass	Good
Westgate - City Limits	4	Yes	None	None				Yes	Grass	Good
U. S. 231 South										
Main St - Ross Clark Circle	4		Curb	Yes (6)	Fair-Poor	Yes	No	Yes	Grass	Good
Ross Clark Circle - Saunders	4	Yes	None	None				Yes	Grass	Good
Saunders - City Limits	4	Yes	None	None				Yes	Grass	Good
Reeves St (U.S. 431 N)										
U.S.231 Bus - Ross Clark Cir	4		Curb	None				No		
Ross Clark Circle - City Limits	4	Yes	None	Yes (1) ADA	Good-Fair	Yes	No	Yes	Grass	Good

Source: Field Survey by Praestare Engineers
Notes: *C & G indicates Curb and Gutter
*Crosswalks are not ADA accessible unless ADA is indicated.
*Unless otherwise noted, all listed streets include only the portion located within the Dothan city limits.

Table 4

Roadway Characteristics – Urban Minor Arterials

Street	Lanes	Pavement Edge	Shoulder Characteristics	Crosswalk Characteristics
Adams Street	2	C & G	Grass, Fair Condition	
Alice Street South	2	C & G	Grass, Good Condition	6 Crosswalks, fair condition, no signage or signals
Bethlehem Road	2	None	Grass, Good Condition	
Brannon Strand Road	2	None	Grass, Good Condition	
Campbellton Highway	2	None	Grass, Fair Condition	
Cherokee	2,3	C&G/Curb	None	1 Crosswalk, good condition, no signage or signals
Choctaw	2	C & G	None	
Columbia Hwy (E. of Ross Clark)	3	Curb	None	
Denton Road (Outside Ross Clark Circle)	2,4	C & G	Grass, Good Condition	
Denton Road (Inside Ross Clark Circle)	4	C&G/Curb	Grass, Good Condition	
Dykes Street	2	C & G	None	
Forrester Road	2	None	Grass, Good Condition	
Fortner Street (Oates - Ross Clark Circle)	2	None	Grass, Good Condition	4 Crosswalks, fair condition, no signage or signals
Fortner Street (Ross Clark Circle - City Limit)	2,3	None	Grass, Good Condition	2 Crosswalks, fair condition, no signage or signals
Headland Ave (Outside Ross Clark Circle)	2	None	Grass, Good Condition	
Headland Ave (Inside Ross Clark Circle)	2	C & G	None	1 Crosswalk, fair condition, no signage or signals
Hodgesville Road	2	Curb	Grass, Good Condition	
Honeysuckle (N. of Hartford Hwy)	3	Curb	Grass, Fair Condition	2 Crosswalks, fair condition, no signage or signals
J. D. Odom Rd (U. S. 84 - Murphy Mill Rd)	3	None	Grass, Good Condition	2 Crosswalks, good condition, ADA with signage and signals
J. D. Odom Rd (Murphy Mill Rd-U. S. 231)	2,3	None	Grass, Good Condition	1 Crosswalk, good condition, ADA with signage and signals
Kinsey Road	2	None	Grass, Good Condition	
Mance Newton Road	2	None	Grass, Good Condition	
Murray Road	3	C & G	None	
Napier Field Rd	4	None	Grass, Good Condition	
Omussee Road	2	None	Grass, Good Condition	
Park Avenue	2,3,4	Mixed	Grass, Good Condition	7 Crosswalks in fair condition, no signage or signals
Prevatt Road	2,3	None	Grass, Good Condition	2 Crosswalks in good condition, with signage and signals
Range St (Adams to Ross Clark)	2,3	Curb	Grass, Good Condition	
Roney Road	2	None	Grass, Good Condition	
St. Andrews Street (South of U. S. 84)	2	C & G	None	
St. Andrews Street (North of U. S. 84)	2	C & G	None	10 Crosswalks in fair condition, no signage or signals
Saunders Road	2	None	Grass, Good Condition	
Selma Street (S. Park to Third)	2	C & G	Grass, Good Condition	11 Crosswalks in fair condition, no signals, sign at one crosswalk
Third Ave (Lafayette to Ross Clark Circle)	2	C & G	None	3 Crosswalks in fair condition, no signage or signals
Third Ave (Ross Clark Circle - City Limits)	2	None	None	
Troy Street	2	Curb		
Webb Road	2	Curb	Grass, Good Condition	3 Crosswalks with
Westgate Parkway	5	C&G/Curb	Grass, Good/Fair C'dition	1 Crosswalk, ADA, signage but no signal
Wheat Street	2	C & G	None	

Source: Field Survey by Praestare Engineers

Notes: None of the Minor Arterials have medians; Crosswalks not ADA accessible unless ADA is indicated

Notes: Street data is only for portion within the city limits; *C & G indicates Curb and Gutter

Table 5

Roadway Characteristics – Collector Streets

Street	Lanes	Pavement Edge	Shoulder Characteristics	Crosswalk Characteristics
6th Avenue	2	C&G/Curb	Grass, Good Condition	3 Crosswalks, fair condition, with signage or signals
Airport Drive	2	None	Grass, Good Condition	
Alexander Drive	2	Curb	Grass, Good Condition	
Beverlye Road	2	None	Grass, Good Condition	
Bracewell Avenue	2	None	Grass, Good Condition	
Chickasaw	2	C & G	Grass, Good Condition	2 Crosswalks, 1-ADA, fair condition, signals but no signage
Cowarts Road	2	None	Grass, Good Condition	
Eddins Road	3	None	Grass, Good Condition	
Flowers Chapel Road	2	None	Grass, Good Condition	
Flynn Road	2	None	Grass, Good Condition	
Grey Hodges Rd (E. of Reeves St)	2	None	Grass, Good Condition	
Harrison Road	2	None	Grass, Good Condition	
Hatton Road	2	None	Grass, Good Condition	
Haven Drive	2	Curb	Grass, Good Condition	1 Crosswalk, good condition, ADA with signage and signals
Honeysuckle (S. of Hartford Hwy)	2	None	Grass, Good Condition	
Kinsey Road	2	Curb/None	Grass, Good Condition	2 Crosswalks, fair condition, no signage or signals
Lafayette St E. (E. of St. Andrews)	2	C&G/Curb	Grass, Good Condition	7 Crosswalks, good condition, no signage and signals
Lucy Grade Road	2	None	Grass, Good Condition	
Murphy Mill Road	2	None	Grass, Good Condition	2 Crosswalks, good condition, no signage or signals
North Shady Lane	2	None	Grass, Good Condition	
Parramore Road	2	None	Grass, Good Condition	
Range Street (south of E. Adams)	2	C & G	Grass, Good Condition	2 Crosswalks, good condition, with signals but no signage
Rocky Branch Road	2	None	Grass, Good Condition	
Selma Street E. (E. of Third Ave)	2	C&G	Grass, Good Condition	2 Crosswalks, good condition, no signage or signals
Selma Street W. (W, of S. Park)	2	C&G	Grass, Good Condition	2 Crosswalks, good condition, no signals, one sign
Stonebridge Road	2	Curb	Grass, Fair Condition	
Suggs Road	3	None	Grass, Good Condition	
Trawick Road	2	None	Grass, Fair Condition	
Timbers Drive	2	None	Grass, Good Condition	
Taylor Road	2	None	Grass, Good Condition	
Whatley Drive	2	Mixed	Grass, Good Condition	1 Crosswalk, fair condition, with signage and signals
Woodland Drive	2	Curb	Grass, Good Condition	1 Crosswalk, fair condition, no signage or signals

Source: Field Survey by Praestare Engineers
Notes: *Unless otherwise noted, all listed streets include only the portion located within the Dothan city limits.
*C & G indicates Curb and Gutter
*Crosswalks are not ADA accessible unless ADA is indicated.
*None of the Collector Streets have medians.

Existing Bicycle and Pedestrian Facilities

Pedestrian and especially bicycle facilities are limited in Dothan, which is a condition that has led to a desire to develop a plan for such facilities. Although limited, this section of the planning effort identifies those facilities that do exist because of their importance in forming the base for comprehensive bicycle and pedestrian facility recommendations and establishing project priorities. Large Map 1 Existing Bicycle, Pedestrian Facilities / Potential Biking and Walking Destinations, which is located in the Appendix of this document shows the location of on- and off-street bicycle and pedestrian facilities including sidewalks throughout the city limits. This map also addresses potential walking destinations such as schools, recreation facilities, institutional uses and commercial concentrations. In discussing existing facilities and later setting forth planning proposals, the following definitions should prove helpful.

Bicycle Facility Definitions

The Federal Highway Administration's Best Practices Design Guide sets forth the following related definitions of bicycle facilities:

Bicycle facilities: Improvements and provisions made to accommodate or encourage bicycling.

Bicycle: Every vehicle propelled solely by human power upon which any person may ride, having two tandem wheels, except scooters and similar devices.

Bicycle or Bike Lane: A portion of roadway that has been designated by striping, signage and pavement markings for the preferential or exclusive use of bicyclists.

Bicycle Path, Bike Path, or Shared Use Path: A bikeway physically separated from motorized vehicular traffic by an open space or barrier and either within the street right of way or within an independent right of way. Shared use paths may also be used by pedestrians, skaters, wheelchair users, joggers and other non-motorized users.

Bikeway: A generic term for any road, street, path or way, which in some manner is specifically designated for bicycle travel, regardless of whether such facilities are designated for the exclusive use of bicycles or are to be shared with other transportation modes.

Shared Roadway: A roadway, which is open to both bicycle and motor vehicle travel. This may be an existing roadway, street with wide curb lanes, or road with paved shoulders.

Trail: A path of travel for recreation and/or transportation within a park, natural environment, or designated corridor that is not classified as a highway, road, or street. For the purposes of this study, bicycle facilities are examined via the following categories: shared roadways, bicycle lanes, bicycle paths and trails, and bicycle racks.

Pedestrian Facility Definitions

The Federal Highway Administration's Best Practices Design Guide sets forth the following related definitions of pedestrian facilities:

Pedestrian: A person who travels on foot or who uses assistive devices, such as a wheelchair, for mobility.

Curb Ramp: A combined ramp and landing to accomplish a change in level at a curb. This element provides street and sidewalk access to pedestrians using wheelchairs.

Ramp: A slope transition between two elevation levels.

Sidewalk: The portion of a highway, road, or street intended for pedestrians.

Shared Use Path: A trail that permits more than one type of user, such as a trail designated for use by both pedestrians and bicyclists.

Trail: A path of travel for recreation and/or transportation within a park, natural environment, or designated corridor that is not classified as a highway, road, or street.

Off-Street Bicycle Facilities

The Larry & Ronna Dykes Trail, Westgate Park (top & bottom)

There is one off-street bicycle facility and one mountain bike trail in Dothan. The bicycle facility is the 3.28 mile paved Larry and Ronna Dykes Trail at Westgate Park. This ten foot wide trail is very well developed with adequate signage and provides an attractive ride through a scenic part of the park grounds.

Trojan Trails mountain bike trailhead, Troy State University, Dothan campus

Troy State University has a 5.8 mile single track mountain bike trail, part of the University's "Trojan Trails".

On-Street Bicycle Facilities

The recently constructed bicycle lanes on John D. Odom Drive between Whatley Road and Murphy Hill Road is the only location of on-street bicycle lanes in Dothan. This five foot lane is adequately marked and was created as part of recent roadway improvements. Hopefully, additional bicycle lanes will become an integral part of improvements undertaken on streets designated for bike lanes by this plan.

The new John D. Odom Drive on-street bicycle lanes

With only some 850 feet of designated bicycle lane in the entire city, it is apparent that bicycle lanes are needed in Dothan. In planning and constructing lane improvements the AASHTO *Guide for the Development of Bicycle Facilities* states that the purpose of bicycle lanes "should be to improve conditions for bicyclists on the street.” AASHTO further indicates that bike lanes should be “established with appropriate pavement markings and signing along streets in corridors where there is significant bicycle demand and where there are distinct needs that can be served by them.”

When space is properly designated for the use of bicycles with lanes distinguished through adequate bicycle lane width, pavement markings and signage properly visible to motorist, bicycle riders have a sense of safety from traffic and bicycling will be greatly encouraged.

Off-Street Walkways

Off-street walking facilities available in Dothan consist of the following five public facilities and one non-profit facility:

- Westgate Park: 3.33 mile Larry and Ronna Dykes Jogging / Walking Trail that is unpaved but uses a mix of the natural soil and a polymer soil binder.
- Kiwanis Park at Westgate Park: ½ mile paved Kiwanis walking trail.
- Gussie McMillan Park: 1/6 mile paved walking trail.
- Walton Park: 0.66 mile unpaved walking trail.
- Eastgate Park: 2 mile unpaved walking trail.
- Landmark Park: a non-profit facility with a nature trail, ½ mile of which is a broad walk and ¾ mile of which is a rough unpaved trail. A fee is charged for entrance into the Landmark Park grounds, which include a variety of recreational and informative facilities.
- Troy University: 2 miles of unpaved walking trail that is part of the University’s “ Trojan Trails”, which also includes a mountain bike trail.

Kiwanis Park 10 ft. wide off-street asphalt walking trail

These trails provide convenient walking facilities to all of the Dothan Department of Leisure Service’s four delineated regions except the southwest region. The proposed James O. Oates Park, which proposes a ball field complex might be a possible site for walking facilities to serve the southwest region.

The National Parks and Recreation Association does not have quantitative standards for off-street walking facilities per 1,000 population but rather indicates that such facilities are best related to supply versus demand and the size of the community. Regardless, Dothan’s 0.09 miles of walking trail suitable for exercise type walking per 1,000 people would appear to be fairly low.

On-Street Walkways

On-street pedestrian facilities consist of sidewalks that have been constructed through the years with no overall plan for connectivity or consideration for priority destinations. Large Map 1 Existing Bicycle, Pedestrian Facilities / Potential Biking and Walking Destinations, which is located in the Appendix shows the location of sidewalks throughout the city limits as well as potential walking locations such as schools, recreation facilities, institutional uses and commercial concentrations. The only concentration of sidewalk connectivity is Downtown Dothan and in the immediate vicinity of Downtown. Subdivision regulations requirements have increased sidewalks on outlying local streets; however, these sidewalks are contained within each individual development with no connections to schools or parks or, in some instances nearby shopping.

Table 6, which shows the percentages of sidewalk to total street miles, indicates that only 17 percent of the streets within the corporate limits have a sidewalk on at least one side. Of note also is that the availability of sidewalks on streets classified as urban collectors is less than one percent. This is significant as such streets typically provide access from residential areas to development located on arterials.

Table 6

Percent of Sidewalks to Total Street Mileage in the City of Dothan

Street Classification	% Sidewalk 1-Side Only	% Sidewalk Both-Sides	% Street With Sidewalk	% Frontage With Sidewalk
Urban Principal Arterials	0.4	1.4	1.9	0.6
Urban Minor Arterials	1.7	1.6	3.3	1.3
Urban Collectors	0.2	0.5	0.8	0.3
Total Major Streets	2.4	3.5	5.9	2.1
Urban Local	0.6	12.0	10.9	3.3
Total	3.0	15.0	16.8	5.4
No Sidewalk			83.2	94.6

An estimated 30 miles (or 35%) of Dothan's 86 miles of sidewalk are located on Urban Principal or Minor Arterials and Collector streets. All but 5 miles of the sidewalks are located in or within one mile of the downtown area. The only significant sidewalks, other than on local streets, located outside of Ross Clark Circle are 10,500 feet on Westgate Parkway, 10,500 feet on Montgomery Highway, 1,700 feet on Reeves Street in the vicinity of Northview High School and 1,000 feet on East Main Street. Table 7 identifies the location of sidewalks on these major streets and provides data on physical characteristics.

Brick-paved on-street sidewalk located in Dothan's Downtown Historic District, adjacent to Porter Park

The Dothan Subdivision Regulations require that five foot wide sidewalks at least 24-inches from the back of the curb and/or in line with existing area sidewalks with a grassed or landscaped area between the sidewalk and curb shall be provided in residential subdivisions. Whether the sidewalks shall be provided on one or both sides of the street depends on density and street classification. Except for townhouse developments in the R-4 districts, sidewalks are not required on cul-de-sacs unless trips are expected to exceed 400 per day. The regulations state that the provision of sidewalks in non-residential areas shall be as approved on the development plan. The City of Dothan does not have a specific provision to provide sidewalks when widening local roads, though it may be considered.

Table 7

Existing Public Sidewalks

Principal Arterials	Location	1-Side	2-Sides	Rd Edge Offset	Condition
E. Main Street	Oates Street - Appletree	300'	500'	8' 0	Good
E. Main Street	Ross Clark Circle - Crossing Ln	1,000'	0		
W. Main Street	S. Oates Street - Orange Ave	2,300'	4,000'	5' 0	Good
W. Main Street	Westchester Dr - Bracewell St	600'	0		
Montgomery Hwy	Ross Clark Cir-Napier Field Rd	4,000'	6,500'	4' 10'	Good
North Oates St	Main Street - Stephens Street	1,000'	2,300'	5' 0	Good
South Oates St	Main Street - Kornegay Street	1,300'	5,400'	5' 3'	Good
Reeves Street	Roney Road - Bunche Street	1,700'	0	4' 0	Good
Reeves Street	Wilson Street - Hardy Street	500'	700'	3' 4'	Fair
Minor Arterials	**Location**	**1-Side**	**2-Sides**	**Rd Edge Offset**	**Condition**
Adams Street	Wheat Street - Bayline Railroad	200'	4,400'	4' 2'	Fair
Alice Street South	Somerset Street - Crawford St	2,300'	0	4' 2'	Good
Cherokee Avenue	Moneh Drive - Dakota Street	1,000'	0	5' 0	Good
Columbia Highway	Museum Avenue - Third Ave	700'	2,500'	5' 0	Fair
Fortner Street	Woodland Drive - Edgewood St	3,300'	1,800'	4' varies	Good
Headland Avenue	Depot - Wilson Street	300'	1,000'	4' 1'	Fair
Honeysuckle Road	Fortner Street - Hartford Hwy	3,900'	0	4' 4'	Good
Lafayette Street E.	Alice Street – College Street	4,000'	800'	3' 0	Good
Park Avenue North	Burdeshaw Ave - Chickasaw	0	1,200'	5' 10'	Good
Range Street	Monument Street - Spring St	2,200'	1,900'	3' 0	Good
Saint Andrews St	E. Cottonwood - Main Street	400'	4,600'	5' 0	Good
Selma Street	South Park - Third Avenue	10,000'	600'	4' 0	Fair
Third Ave	Columbia Highway - Grant St	4,100'	0	4' 2'	Good
Troy Street	Alice Street - Foster Street	0	1,100'	6' 0	Good
Webb Road	Range Road - Allen Street	3,600	0	4' 0	Good
Westgate Parkway	Bel Aire Dr - Montgomery Hwy	10,500'	0	4' 2'	Good
Collectors	**Location**	**1-Side**	**2-Sides**	**Rd Edge Offset**	**Condition**
6th Avenue	Summit Street - Selma Street	1,500'	0	4' 3'	Good
Chickasaw	Edgewood Drive - Oates Street	400'	2,600'	4' 2'	Fair
Lafayette Street E.	Saint Andrews-Bayline Railroad	200'	2,200'	4' 2'	Fair
Range Street	Adams Street - Main Street	800'	0	4' 0	Fair
Rocky Branch Rd.	Along Walton Park frontage	1,400'	0	4' 0	Good
Selma Street	Third Avenue - Sixth Avenue	1,500'	0	4' 0	Good
Selma Street	South Park - Woodland Drive	1,200	0	4' 4'	Fair
Woodland Drive	Selma Street - Hartford Hwy	0	1,300'	4' 3'	Fair
Woodland Drive	Woodlawn Drive - Main Street	2,000'	0	4' 3'	Fair

Source: City of Dothan maps for location; Praestare Engineers for dimensions and condition.
Note: The sections with four-foot wide sidewalks do not meet the five-foot minimum width requirement of the Dothan Subdivision Regulations or of the Alabama Department of Transportation.

Shared Use Facilities

There are two shared use facilities in Dothan consisting of: limited sections of the Larry & Ronna Dykes Bicycle Trail and the Larry & Ronna Dykes Walking Trail at Westgate Park that merge for short distances at irregular intervals; the Eastgate Park two mile trail that can be used by cyclists (trail bikes) and pedestrians.

Bicycle Suitability

The 2010 – 2035 Long Range Transportation Plan (LRTP) analyzed bicycle conditions on the existing roadway network in Dothan and assigned each a suitability score based on travel volume, travel speeds and functional classification. The source of the following text, tables and maps is the LRTP Plan. Table 8 shows the numeric value for each of the factors.

Table 8

Bicycle Suitability Methodology

Factor	Condition	Score
Traffic volume	Less than 2,500 vehicles per day per lane	4
	Between 2,500 and 5,000 vehicles per day per lane	2
	More than 5,000 vehicles per day per lane	0
Traffic Speed	Traffic speed Less than or equal to 30 mph	4
	Between 30 and 40 mph	2
	Greater than 40 mph	0
Functional Classification	Functional Classification Local streets/collectors	4
	Minor arterials	2
	Other (major arterials/ highways)	0

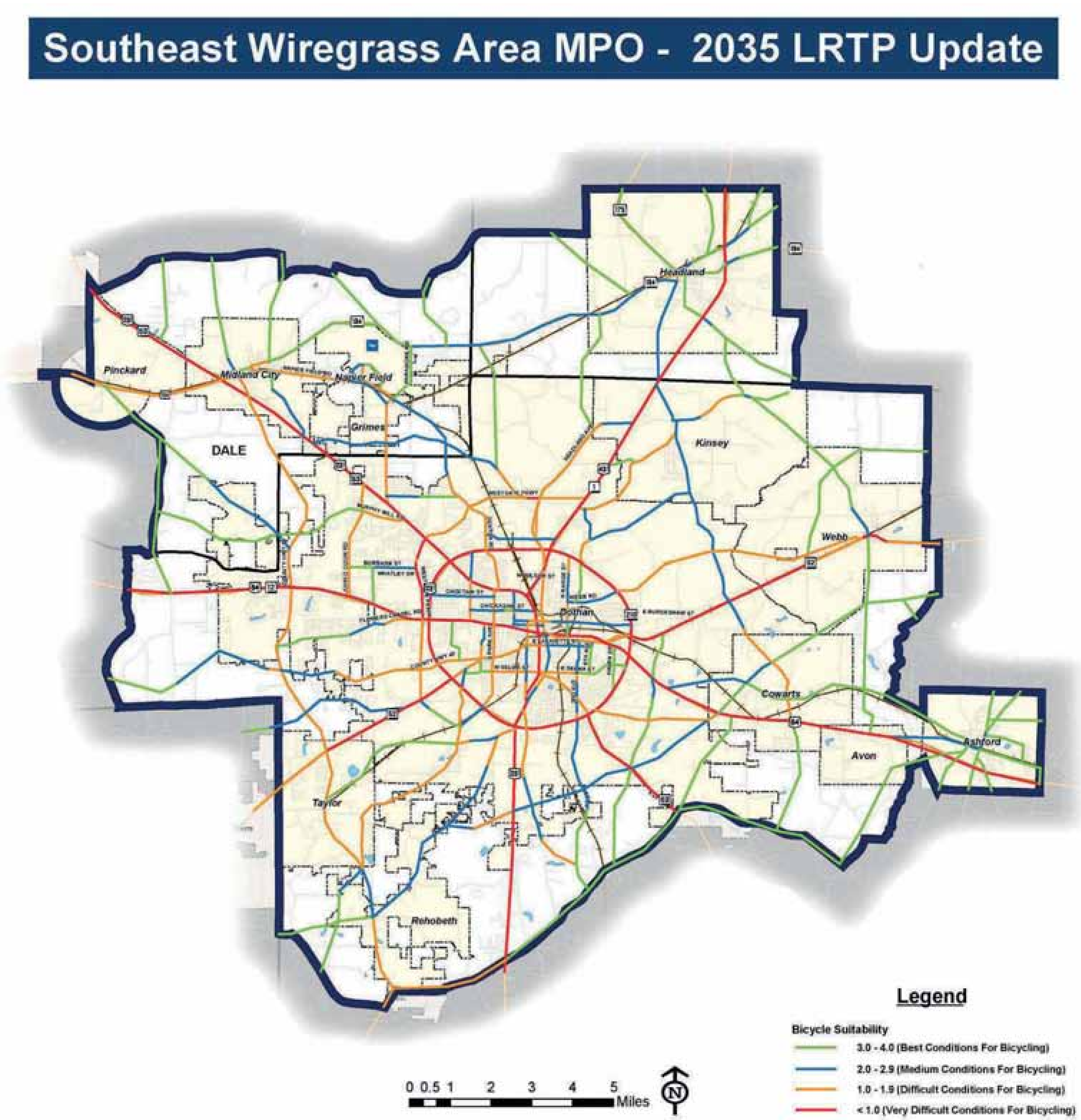
The scores for each factor was divided by three to determine the score for each section of road, the roadway sections then received a descriptive rating as follows:

3-4.0 Best conditions for bicycling
2-2.9 Medium conditions for bicycling
1-1.9 Difficult conditions for bicycling
<1 Very difficult conditions for bicycling

Map 4 illustrates the results of this analysis, showing which roadways offer best, medium, difficult and very difficult conditions for biking.

This type of assessment requires a more in depth look at the characteristics of each of these roads, the identification of key origins and destinations for bicycle travel and the preference of the community as to what type of facility bicyclists prefer for different travel purposes.

The LRTP's procedure for calculating bicycle suitability provides a standard, system wide review of conditions related to potential on-street bicycle use. Using this procedure in the Dothan MPO Area, which extends beyond the Dothan city limits, 36 percent of the roadways have the best conditions for bicyclists, 37 percent have medium conditions, 10 percent have difficult conditions and 17 percent have very difficult conditions. It is reasonable to assume that these percentages would basically hold true within the Dothan corporate limits. Nearly all roads classified as collector or local received a best or medium rating. Most roads classified as minor arterials were rated as medium with a few rated as best, and all of the major arterials were classified as difficult.



MAP 4

ROADWAY BICYCLE SUITABILITY (BASED ON TRAFFIC VOLUMES)

Source: Southeast Wiregrass MPO, 2035 Long Range Transportation Plan, Adopted July 2010

Public Facilities & Other Destinations

Public facilities such as parks, schools, community centers, libraries, government offices, commercial concentrations are potential destinations for bicyclist and walkers. Large Map 1, Existing Bicycle, Pedestrian Facilities / Potential Biking / Walking Destinations, which is located in the Appendix shows the location of schools, parks and recreation facilities, commercial concentrations, institutional uses and other potential destinations within Dothan. As previously indicated, Dothan has only one short on-street bicycle lane (and it does not access any specific destination) none of these destinations are accessible via a safe bike ride with proper striping and signage. Therefore, the analysis of accessibility and connectivity will be limited to existing sidewalk access and deficiencies.

Park and Recreation Facilities

The Dothan Department of Leisure Services delineates the City into four recreation regions. Sidewalk access and needs for the parks within these regions are as follows:

Region I (Northeast Dothan)

Walton Park Entrance off Rocky Branch Road

WALTON PARK has a sidewalk that runs from Bunche Road to Young America Drive but there is no sidewalks connecting into adjacent subdivisions immediately north and south of the park or to the nearby Northview High School.

ANDREW BELLE RECREATION CENTER has a small amount of sidewalk that is not continuous bordering the north part of the site on Lake Street but there is no sidewalk access to the surrounding residential areas.

POPLAR HEAD PARK is located in Downtown Dothan and has excellent sidewalk access.

MORNINGVIEW PARK has no sidewalks at its site or in the immediate vicinity.

WALTER C. BYRD PARK has sidewalk on the south along Webb Road. This sidewalk extends both north and south on Webb Road. There is no sidewalk access to the interior of the residential area north of Byrd Park.

GUSSIE McMILLAN PARK has a sidewalk system that connects to the adjacent parking lot and to the interior of the park. However, there are no sidewalk connections to the surrounding residential areas.

Gussie McMillan Park

Region II (Southeast Dothan)

EASTGATE PARK has no sidewalks nor are there any sidewalks in this part of Dothan.

FAIRLANE PARK has a sidewalk along East Selma Street that connects with a sidewalk on 6th Avenue that runs north to the Grandview Elementary School and the Wiregrass Recreation Center.

PINE HILLS PARK is located to the rear of a single-family subdivision and is accessed only through the subdivision. There are no sidewalks in this part of Dothan.

PINE HILLS PARK is located to the rear of a single-family subdivision and is accessed only through the subdivision. There are no sidewalks in this part of Dothan.

Eastgate Park, Rountree Athletic Complex area

WIREGRASS RECREATION CENTER has a sidewalk along 3rd Avenue to the east and a sidewalk on 6th Avenue stops within 200 feet of the park site. Sidewalks connections are needed to all of the surrounding neighborhoods.

ROSE HILL SENIOR CENTER has sidewalk connectivity to all of Downtown Dothan.

Region III (Southwest Dothan)

DOUG TEW RECREATION CENTER has no sidewalks in its immediate vicinity. Connection to existing sidewalks on West Selma Street and to the adjacent neighborhood to the west would be desirable.

RIP HEWES STADIUM has no sidewalks in its immediate vicinity. Sidewalk access along Stadium Street is needed.

YOUNG JUNIOR has sidewalk access on South Alice Street, Sonesta Street and West Lafayette Street.

RAMSEY PARK has no sidewalk access in the immediate vicinity or to the surrounding neighborhoods.

PROPOSED JAMES O. OATES PARK site has no sidewalks in the immediate vicinity.

Region IV (Northwest Dothan)

WESTGATE PARK and KIWANIS PARK are served by a sidewalk on Westgate Parkway that extends north to Montgomery Highway and south almost to U. S. Highway 84. However, there is no sidewalk access to this heavily used, popular facility from the large areas of residential development to the north and northwest.

KINNEY PARK is served by sidewalk along Chickasaw Street with sidewalk connections into Downtown Dothan.


Westgate Park main entrance, extension of Choctaw Street

EMERALD LAKE has no sidewalk at the site or in the surrounding area.

SOLOMON PARK does not have sidewalk access. Sidewalk connections are needed to the surrounding residential areas and to the nearby Girard Elementary School.

Landmark Park, a non-profit facility, is not part of the Dothan Park System; however, it is located on Highway 431 just inside the Dothan city limits and provides a variety of recreational and cultural facilities to people throughout the region. There are no sidewalks in this part of Dothan.

Schools

TROY UNIVERSITY (DOTHAN CAMPUS) does not have sidewalks in its immediate vicinity nor are there sidewalks in this part of Dothan other than in isolated subdivisions.

Dothan High School

Northview High School

Carver Middle School

Jerry Lee Faine Elementary School

Honeysuckle Middle School

DOTHAN HIGH SCHOOL has sidewalks at the north part of its site with good sidewalk access to the north, east and west. However, sidewalk access is needed to the south.

NORTHVIEW HIGH SCHOOL has a sidewalk along its frontage on U. S. Highway 431 (Headland Highway) but it does not connect with any of the surrounding residential developments.

CARVER MIDDLE SCHOOL and JERRY LEE FAINE ELEMENTARY SCHOOL are located near each other and sidewalks to the east and west on Stringer Street provide access to Carver Magnet School but they do not connect to the Stringer Street Elementary School. There are no sidewalks to access residences southeast of these schools.

HONEYSUCKLE MIDDLE SCHOOL has sidewalk access along Honeysuckle Road to the north and south. Sidewalk access needs to be extended to the south and west. Such extension would also provide good sidewalk access to EMMANUEL CHRISTIAN SCHOOL, which is located nearby off of Hartford Highway.

CLOVERDALE ELEMENTARY SCHOOL has no sidewalk access. It is located in the center of a large residential area and needs sidewalk access to the east, south, west and north.

GIRARD ELEMENTARY & MIDDLE SCHOOLS have sidewalks along the school properties on Girard Avenue and on North Pontiac Avenue. The sidewalk on Girard Avenue extends to the north and south but the sidewalk on Pontiac Avenue is only along the school property. There is no sidewalk connection to the interior of large sections of residential to the north, east, south and west.

GRANDVIEW ELEMENTARY SCHOOL has a sidewalk along its frontage on 6th Avenue that needs to be connected to a sidewalk to the west on Third Avenue. Sidewalk access is needed to residential area east and south of the school site.

HEARD ELEMENTARY SCHOOL does not have sidewalk access, which is needed to the large areas of residential to the north, east and south of the school.

HIDDEN LAKES ELEMENTARY SCHOOL and BEVERLYE MIDDLE SCHOOL are located on adjacent sites in southeast Dothan. An adjacent subdivision has a sidewalk that connects from the subdivision to the school site. There are no other sidewalks in this part of Dothan except for one other subdivision to west off of Tiffany Drive. Sidewalk connections along Tiffany Drive, Prevatt Road and Beverlye Road would be desirable.


Cloverdale Elementary School


Girard Middle School


Girard Elementary School


Grandview Elementary School


Heard Elementary School

HIGHLANDS ELEMENTARY SCHOOL has no sidewalks on the roads leading up to the school site; however, subdivisions to the north and south are well served with sidewalks. There are no sidewalks leading to the large residential areas to the east on Flowers Chapel Road.

KELLY SPRINGS ELEMENTARY SCHOOL does not have sidewalk access. Nearby subdivisions accessed from Brannon Stand Road have sidewalks but they do not connect to the school site as there are no sidewalks on Brannon Stand Road. The Troy State Mountain Bike trail is located at the northwest corner of the Kelly Springs property.

LANDMARK ELEMENTARY SCHOOL has no sidewalk access and there are no sidewalks in the surrounding areas.

MONTANA STREET ELEMENTARY SCHOOL has no sidewalks in its vicinity nor does the nearby DOTHAN HEAD START SCHOOL. Sidewalks are needed in the area, especially on Choctaw and Montana Streets.

SELMA STREET ELEMENTARY SCHOOL can be accessed from the east by a sidewalk on West Selma Street and from the north by a sidewalk on Woodland Drive. Both of these sidewalks end at the northeast corner of the school site. There is no sidewalk access to the south or west.

BEULAH LAND CHRISTIAN ACADEMY has sidewalks along the west and south sides of its property, which provide direct to the sidewalk system in Downtown Dothan.

CROSSROADS BAPTIST ACADEMY is located in a part of Dothan that has no sidewalks. Sidewalks are needed on Westgate Parkway, that this schools fronts, as part of a connectivity strategy to link Westgate Park and Northview High School.

HOUSTON ACADEMY does not have sidewalk access but the need for sidewalk connections to nearby Westgate Park is likely to give it sidewalk access in the future.

NORTHSIDE METHODIST ACADEMY is not accessed by sidewalks.

PROVIDENCE CHRISTIAN SCHOOL is located in the northwest section of Dothan that has no sidewalks.

WESTGATE CHRISTIAN SCHOOL has adequate sidewalk access along Westgate Parkway, which connects to the north and south.


Hidden Lakes Elementary School

Highlands Elementary School

Kelly Springs Elementary School

Landmark Elementary School

Highlands Elementary School

Kelly Springs Elementary School

Institutional Uses

DOTHAN CITY HALL / CIVIC CENTER has adequate sidewalk access that connects with uses throughout the Downtown area.

HOUSTON LOVE MEMORIAL LIBRARY is surrounded by sidewalks in its immediate vicinity but there is a lack of sidewalk on its Burdeshaw Street frontage between North Lena Street and Oates Street. Sidewalks in the vicinity on both North Lena and Oates connect with the Downtown Area and the surrounding neighborhood.

Pavilion Mall Area (limited sidewalks)

FLOWERS HOSPITAL has no sidewalk access in its immediate vicinity and there are no sidewalks in this part of Dothan other than in isolated subdivisions.

NATIONAL PEANUT FESTIVAL SITE is in an outlying area with no sidewalks and with no apparent need for sidewalks. Bicycle access would, however, be desirable.

CULTURAL ARTS CENTER has sidewalk access along South Saint Andrews Street that extends north into the Downtown Area.

Pavilion Mall Area (limited sidewalks)

Shopping Areas Sidewalk access to shopping areas is limited to Downtown Dothan and to Montgomery Highway between Ross Clark Circle and Napier Field Road.

Northside Mall Area (no sidewalks)

Northside Mall Area (no sidewalks)

Downtown is served by sidewalks that connect into surrounding neighborhoods. The sidewalks along Montgomery Highway were recently constructed and do not connect into the surrounding area except for Westgate Parkway. Westgate Parkway, to the south of Montgomery Highway, has a sidewalk on the west side that stops within a few hundred feet of Montgomery Highway. This sidewalk extends south on Westgate Parkway past Westgate Park almost to Flowers Chapel Road. There are no designated bicycle lanes serving any of the City's commercial establishments.

Bicycle / Pedestrian Collision Analysis

Using existing and available data, an analysis was made of reported automotive vehicle collisions with bicyclist and pedestrians in Dothan for the years 2008 through 2010. This data was provided by the Traffic Safety Division of the Dothan Police Department and is shown in Table 9.

Only two bicycle collisions occurred during this time period; therefore, it is not feasible to determine any particular intersection or stretch of roadway that is overly dangerous for bicycle activity. The low incidence of bicycle collisions is probably related to the lack of designated on-street bicycle routes, which in turn discourages bicycling. One of the bicycle collisions, which occurred on South Oates Street at night in a non-illuminated area, resulted in a fatality due to the bicyclist being under the influence of alcohol. The other bicycle crash occurred on North Alice Street and was caused by improper cyclist action. Neither bicyclist used any reflective material.

There were 23 roadway pedestrian collisions during the years of 2008-2010, two of which were fatal because the pedestrian was under the influence of alcohol / drugs. Both fatalities occurred at night in an illuminated area but neither pedestrian had any reflective clothing. Pedestrian accidents involved some eighteen different streets with no one street dominant. Six streets (Montgomery Highway, North Alice Street, North Range Street, North Oates Street, Ross Clark Circle and Third Avenue] had two incidents while only one incident occurred on each of the other twelve streets. Thirteen of the pedestrian collisions were during daylight hours and ten at night with all but three of the nighttime incidents happening in illuminated areas. The location characteristics of pedestrian collisions were about evenly divided with 11 occurring in commercial areas, 10 in residential areas and 2 in areas of sparse, rural type development. Only two pedestrian collisions were recorded in downtown Dothan.

Table 9

Bicycle / Pedestrian Collisions (2008-2010)

Date	Location	Prime Contributing Circumstance
Bicycle Incidents		
04/2010	South Oates Street	Cyclist Under the Influence of alcohol (fatal)
06/2008	North Alice Street	Improper Cyclist Action
Pedestrian Incidents Year 2010		
December	199 West Burdeshaw Street	Fail to Yield Right-of-way to Pedestrian in Crosswalk
October	1900 Montgomery Highway	DUI
October	2086 Montgomery Highway	Unseen Object/Person
September	100 East Main Street	Fail to Yield Right-of-way to Pedestrian in Crosswalk
June	802 Linden Street	Pedestrian Under Influence of Alcohol / Drugs
May	799 North Alice Street	Vehicle Travelling on Wrong Side of Road
April	100 Hedstrom Drive	Unseen Object / Person
February	799 North Range Street	Improper Pedestrian Action
Pedestrian Incidents Year 2009		
December	2499 Third Avenue	Unseen Object / Person
January	2199 Third Avenue	Improper Pedestrian Action
October	2399 South Beverlye Road	Driver Distracted by Passenger
October	999 West Selma Street	Pedestrian Under Influence of Alcohol / Drugs (fatal)
July	100 North Oates Street	Fail to Yield Right-of-way to Pedestrian in Crosswalk
June	2499 North Range Street	Pedestrian Under Influence of Alcohol / Drugs (fatal)
May	4773 East Cottonwood Road	Improper Pedestrian Action
February	500 North Oates Street	Pedestrian Under Influence of Alcohol / Drugs
January	205 Dunbar Court	Unseen Object / Person
January	399 Headland Avenue	Improper Pedestrian Action
Pedestrian Incidents 2008		
December	2299 Stringer Street	Unseen Object / Person
December	399 North Lena Street	Improper Pedestrian Action
December	3000 Ross Clark Circle	Unseen Object / Person
July	899 Ross Clark Circle	Unseen Object / Person
February	405 Sixth Avenue	Improper Pedestrian Action

Source: Dothan Police Department, Traffic Safety Division, Pedestrian/Bicycle Stats 2008-2011

During this same time period, 42 pedestrian collisions occurred on private property, which according to the Police Department was an accident located outside the public right-of-way. The year 2010 had 11 such collisions, which was a 30 percent decrease, compared to 16 and 15 collisions recorded in 2009 and 2008 respectively. No information was available regarding the contributing circumstance of the private property collisions. However, all but five collisions occurred in commercial areas and, although there are no records of the collision details, it is reasonable to assume, based on a review of aerial photographs, they happened in parking lots. Almost half of the pedestrian collisions on private property occurred along Oates Street and Ross Clark Circle.

Although not directly related to the location of bicycle and pedestrian accidents, the MPO 2035 Long Range Transportation Plan report provided information on high crash locations within the City of Dothan. Table 10 provides information on high crash locations and the number of crashes, injuries and fatalities as presented in the MPO Report, which did not separate crashes involving pedestrians and bicyclist. All but two of the high crash locations involved either Montgomery Highway or Ross Clark Circle. These locations should be given special attention in the design of proposed bicycle and pedestrian facilities.

Table 10

High Crash Locations

Location	Number of Crashes	Number of Units	Number of Injuries	Number of Fatalities
West Main Street at Ross Clark Circle	46	98	8	0
Montgomery Highway at Ross Clark Circle	46	94	11	0
Montgomery Highway at Westgate Parkway	44	90	16	0
South Oates Street at Ross Clark Circle	38	77	4	0
3300 Block of South Oates Street	35	78	9	0
West Main Street at Brannon Stand Road	21	46	6	0
Montgomery Highway at Redmond Road	18	40	3	0
3100 Block of Ross Clark Circle	18	37	8	0
Reeves Street at Ross Clark Circle	16	32	2	0
3400 Block of Ross Clark Circle	16	31	5	0

Source: Southeast Wiregrass Metropolitan Planning Organization's (MPO) 2035 Long Range Transportation Plan

Bicycle and Pedestrian Survey

As part of the Scope of Work for the Bicycle and Pedestrian Plan, a Bicycle and Pedestrian Survey was developed as a tool to assist in determining the public's knowledge and opinion of the existing bicycle and pedestrian facilities in Dothan, awareness of bicycle and pedestrian safety, current use of existing facilities, desired facilities and potential use if additional and improved facilities were available. The results of this survey were utilized to assist in developing recommendations for the overall Plan.

The Bicycle and Pedestrian Survey was available both online, at public locations and at a bike shop. A total of 125 surveys were completed; 65 were completed online and 60 were completed manually. In addition to the Survey, a form for written comments was given to participants at the first public meeting.

Although not part of the Bicycle and Pedestrian Plan work task, a survey made as part of the City's Long Range Development Plan indicated the following: "Most people want a defined bikeway/pedestrian trail system planned for and built throughout Dothan and most people desire sidewalks installed in neighborhoods." Also, as part of the Comprehensive Plan, the City staff did a Visual Preference Survey that indicated the following:

- Most people liked the appearance of neighborhoods with sidewalks and those with a landscaped separation between the sidewalk and the curb of the street.
- The public favored sidewalks that were separate from vehicle traffic and those that were paved with pavers. They also were in favor of wider sidewalks in the downtown area which would offer spaces for benches, ornamental street lights and landscaping.

Key Findings of Bicycle and Pedestrian Survey

The survey responses were tabulated and analyzed to reveal the following key findings.

General:

- Most of the respondents either live or work in the City of Dothan.
- Almost 60 percent of the respondents were males.
- Almost half of the respondents were between the ages of 45 to 64.

Key findings related to both bicyclists and walkers**:**

- Over 60 percent of the respondents indicated they never walk or bicycle.
- Both walkers and bicyclist overwhelmingly do so for recreation / exercise purposes.
- Schools or library are the destination of less than 2 percent of walkers and bicyclists.
- The highest percentage of both walking and biking is done off-street.
- Both walkers and bicyclist consider connectivity to be important.
- Personal safety is a significant concern of both walkers and bicyclist.

Key findings regarding walking related questions include**:**

- Less than 2% walk between home and work, school or to run an errand.
- Of the respondents that walk, 35% do it daily and 28% at least weekly.
- An overwhelming majority (71%) walk for recreation / exercise purposes or to visit a park or community center with walking to visit friends a distant second at 15 percent
- Rarely walk to work, school or library destinations.
- Cited distance as a deterrent to walking for purposes other than recreation.
- Highest percentage of walkers that walk along a street do so in the street, which is a good indicator of the lack of sidewalks throughout most of Dothan.
- Indicated that lack of sidewalks, lack of off-street trails, difficulty of crossing unsafe streets and concerns about personal safety were the major reasons for not walking.
- More off-street trails is the most important factor to encourage more walking followed by better connectivity to sidewalks and to a lesser degree wider sidewalks, safer intersection crossings and better lighting.

Key findings regarding bicycling related questions include**:**

- Most bicyclists classify their skill level as intermediate.
- Of the respondents that bike, 18% do it daily and 30% at least weekly.
- Bicycle activity is primarily for recreation / exercise purposes or to visit a park or community center (70%) with biking to visit friends a distant second at 12%.
- Less than 2% bike between home and school or to run errands and 6% to work.
- Major reasons preventing bicycling are a lack of bicycle lanes, a lack of off-street facilities, aggressive, speeding drivers and personal safety concerns.
- Cited concerns about traffic as the main reason why they don't bicycle more.
- Dedicated bicycle lanes, trails and paved shoulders would encourage more bicycling.

- It is interesting to note that a significant number of respondents bike outside of Dothan.

Statistical Analysis of Survey Responses

Following is a statistical analysis and a list of comments received in response to each individual question on the Bicycle and Pedestrian Survey instrument and on the Comment Form distributed at the first public meeting:

1. Are you a resident of the City of Dothan? 126 Responses		
Yes	113	89.7%
No	13	10.3%
2. Do you work in the City of Dothan? 124 Responses		
Yes	89	71.8%
No	35	28.2%
3. What is your gender? 125 Responses		
Male	74	59.2%
Female	51	40.8%
4. What is your age? 124 Responses		
16 or Less	3	2.4%
17 – 24	9	7.3%
25 – 34	21	16.9%
35 – 44	19	15.3%
45 – 54	26	21.0%
55 – 64	35	28.2%
Over 65	11	8.9%

5. How often do you walk or bicycle between home and work or home and school or run errand?				
	Walk		Bicycle	
Daily	24	20.0%	10	8.7%
Weekly	12	10.0%	13	11.3%
Bi-weekly	3	2.5%	5	4.3%
Monthly	8	6.7%	10	8.7%
Never	73	60.8%	77	67.0%
Total Responses	120		115	

6. How often do you walk or bicycle for recreation or exercise purposes?				
	Walk		Bicycle	
Daily	41	34.5%	20	17.5%
Weekly	33	27.7%	34	29.8%
Bi-weekly	14	11.8%	10	8.8%
Monthly	12	10.1%	18	15.8%
Never	19	16.0%	32	28.1%
Total Responses	120		115	

7. Where do you go when you walk or bicycle? (check all that apply)				
	Walk		Bicycle	
Work	4	2.4%	9	6.3%
Errands/Shopping	14	8.3%	12	8.5%
Park or Com Center	32	19.0%	25	17.6%
School	3	1.8%	2	1.4%
Library	3	1.8%	2	1.4%
Family or Friend	25	14.9%	17	12.0%
Recreation	87	51.8%	75	52.8%
Total Checked	168		142	

8. Where do you primarily walk or bicycle? (check all that apply)				
	Walk		Bicycle	
Sidewalks	26	16.7%	18	10.2%
Streets	54	34.6%	20	11.3%
Off-Street	41	26.3%	49	27.7%
Other	35	22.4%	54	30.5%
Outside Dothan			36	20.3%
Total Checked	156		177	

9. What prevents you from walking or bicycling more or at all? (check all that apply)					
Walking			Bicycling		
Lack of Sidewalks	56	20.7%	Lack of Bicycle Lanes	77	21.6%
Lack of Off-street Walking Trails	43	15.9%	Lack of Off-street Bicycle Trails	54	15.2%
Sidewalks Too Narrow	8	3.0%	Streets Too Narrow	25	7.0%
Difficult Unsafe Streets to Cross	42	15.6%	Concerns About Bicycle Theft	13	3.7%
Sidewalks Poor Condition	14	5.2%	Amount and Speed of Traffic	48	13.5%
Intersection Crossing Time	18	6.7%	Aggressive Drivers	52	14.6%
Concerns About Personal Safety	46	17.0%	Concerns About Personal Safety	55	15.4%
Poor Health, Handicapped	2	0.7%	Poor Health, Handicapped	1	0.3%
Too Far to Walk Where to Go	23	8.5%	Too Far to Bicycle Where to Go	14	3.9%
Not Interested in Walking	15	5.6%	Don't Have a Bicycle	17	4.8%
Other	3	1.1%			
Total Checked	270		Total Checked	356	

Comments Received:

- I run and bike anyway, have to be careful.
- Dark when I get home from work – no street lights in the country.
- Ross Clark Circle is spectacularly unsafe for pedestrians / bicyclists.

10. What would encourage you to walk or bicycle more? (check all that apply)					
Walking			Bicycling		
Less or Slower Traffic	18	6.7%	Dedicated Bicycle Lanes	76	20.4%
Off-street Walking Trails	62	23.0%	Off-street Bicycle Trails	68	18.3%
Wider Sidewalks	28	10.4%	Paved Shoulders	44	11.8%
Better Connectivity to Sidewalks	48	17.8%	Better Connectivity to Bike Facilities	47	12.6%
Sidewalks in Better Condition	26	9.6%	Better Traffic Enforcement	33	8.9%
Safer Crossings at Intersections	32	11.9%	Bicycle Detection at Intersection	29	7.8%
Better Street Lighting	29	10.7%	Better Street Lighting	25	6.7%
Shopping, Schools, Parks Close	27	10.0%	Shopping, Schools, Parks Close	22	5.9%
			Employer Provides Car for Trips	3	0.8%
			Better Bicycle Parking	25	6.7%
Total Checked	270		Total Checked	372	

Comments Received:

- Sidewalks in my neighborhood.
- Mass transit.
- Nothing, not interested.
- Pave shoulders on South Park outside of the Circle within City Limits.

11. Bicycling Only: What skill level do you consider yourself as a bicyclist?		
Advanced, Experienced Riders Comfortable with Traffic	30	29.7%
Comfortable with Night Streets, Bike Lanes, Wide Shoulders	69	68.3%
Child or Pre-teen	2	2.0%
Total Responses	101	

12. You are encouraged to provide any additional comments or concerns about improving walking and/or bicycling in the City of Dothan. The following comments were received:

- Anything to improve accessibility is great.
- No dogs to worry about, wider streets.
- Resurface more streets.
- Would love to see more rails to trails.
- Would love to see path along Flowers Chapel Road.
- We need more bicycle areas and walking areas for Dothan residents. This is considered a draw for industry. The look at the amenities afforded their future employees in the city.
- Waiting on sidewalks from Land Mark School to NHS to ride bicycles and walk.
- I am a passionate recreational bicyclist, retired, and have 10,000 miles logged in Dothan since June 2007. Paved shoulders would be the single most important safety upgrade to enable my personal safety. PSA's reminding citizens to "Share the Road" might help. As more drivers are distracted (because of personal electronics), things are getting worst instead of better.

Comments From Questions asked on the Comment Form Distributed at Public Meeting No. 1
1. What specific roadway / intersection locations within the City do you feel that bicycle and pedestrian safety should be improved upon? Can you also briefly explain the reasons for these concerns?
▪ North Brannon Stand between Murphy Hill and U. S. 84. Traffic ignores speed limit and many vehicles do not respond well to a bicyclist. ▪ Pedestrian safety on Westgate Parkway from park north. Limited crosswalks. ▪ I have not felt safe enough to bike on any streets since we moved to Dothan three years ago. It has really hindered my ability to grow in my training. I would love to see improvements on Main Street and throughout the Garden District. Also, U. S. Highway 84.
2. Please list the names of roads you feel it is important to provide pedestrian sidewalks or bicycle lanes on.
▪ Murphy Hill; John D. Odom; Brannon Stand ▪ Extend / add bike lanes on Honeysuckle; Westgate Parkway; Bike lanes around Eddins Road / Eastgate Park ▪ John D. Odom; Whatley
3. Please identify major destinations that your neighborhood lacks sidewalks or bike route connections to.
▪ Bike lanes to Eastgate Park ▪ If they could make the bike trail at Westgate all road so road bike could be used, that would be very helpful.
4. Do you have any other comments / concerns you would like the Bicycle & Pedestrian Plan to address?
▪ I would love to see lots of bike lanes throughout Dothan. I would definitely use them several days a week if I felt safe. ▪ Improve coordination with Dothan City Police to ensure respect of speed limits and traffic laws impacting bicycle safety. ▪ Extension at Eastgate Park.

User Needs Assessment

Adequately identifying user concerns enables the development of more practical bikeway and walkway proposals and will aid policy-makers in implementation of the bicycle and pedestrian plan recommendations. This section presents an overview of the concerns of existing and potential pedestrians and bicyclists in Dothan. User needs arrived at both from sources such as standardized needs documented by national organizations, interviews with city officials, public meetings and user surveys and from a quantitative analysis of estimated existing and future walking and bicycling demand.

Needs and Types of Bicyclists

It is important to understand that the needs and preferences of bicyclists vary depending on the skill level of the cyclist and the type of trip the cyclist is taking. For example, bicyclists who bicycle for recreational purposes may prefer scenic, winding, off-street trails. The *AASHTO Guide for the Development of Bicycle Facilities* identifies three classes of bicyclists based on rider ability and level of acceptance to travel in mixed traffic. These classes are as follows:

- ***Class A cyclists*** are experienced riders who typically look for: speed, convenience, and direct travel routes and do not mind traveling with traffic. These riders can travel at the mid to top range of cycling speed and generally prefer on-street travel, especially in relation to multi-use paths.
- ***Class B cyclists*** are occasional riders who are less secure about travel in mixed traffic. These riders have basic skills, typically travel near the middle range of cycling speed and typically prefer to travel along off-road trails or designated bike lanes.

- ***Class C cyclists*** are novice riders, primarily children, who are not likely to ride in mixed traffic. These riders operate at speeds closer to that of pedestrians and typically prefer travel along facilitates that are completely separated from traffic.

The following summarizes the needs of both advanced and casual bicyclists.

Advanced Bicycle Riders (Class A Skill Level)

Advanced (Class A) Bicycle Riders Typically Prefer:

- On-street or bicycle-only facilities as opposed to shared-use paths.
- Comfortable negotiating streets like a motor vehicle, including vehicle lane occupancy and using left-turn lanes.
- May prefer a more direct route.
- Rides on-street with the flow of traffic and avoids riding on sidewalks or on shared-use paths.
- Rides at speeds up to 20 MPH on flat ground, up to 40 MPH on steep descents.
- May bicycle longer distances, sometimes more than 100 miles.

User needs that will benefit the advanced bicyclist are a connected network of bike lanes on higher-volume arterials, wider curb lanes and loop detectors at signals. The experienced bicyclist who is primarily interested in exercise will benefit from loop routes leading back to their point of origin.

Casual Bicycle Riders (Class B and Class C Skill Levels)

Casual (Class B and Class C) Bicycle Riders Typically Prefer:

- Off-street shared-use paths or bike lanes along low-volume, low-speed streets.
- May have difficulty gauging traffic and may be unfamiliar with the rules of the road. May walk bicycle across intersections.
- May use a less direct route to avoid arterial roads with heavy traffic volumes.
- May ride on sidewalks and ride the wrong way on streets and sidewalks.
- May ride at speeds comparable to walking, or slightly faster than walking.
- Bicycle for shorter distances: up to 2 miles.

The casual bicyclist will benefit from user needs such as route markers, shared use paths, bike lanes on lower volume streets, traffic calming, and educational programs. Casual bicyclists may also benefit from a connected network of marked routes leading to parks, schools, shopping areas, and other destinations. To encourage youth to ride, routes must be safe enough for their parents to allow them to ride.

Characteristics of Recreational, Utilitarian and Commuting Trips

For planning purposes, bicycle trips are separated into two trip types: recreational and utilitarian. Recreational trips can range from a 50-mile weekend group ride along rural roads to a family outing, and all levels in between. Utilitarian trips include commuter bicyclists, which are a primary focus of State and Federal bicycle funding, as well as bicyclists going to school, shopping or running other errands. Utilitarian cyclists include those who choose to live with one less car, as well as those who have no other alternative transportation due to economic reasons. The following list summarizes general characteristics of both recreational and utilitarian bicycle trips.

Recreational Trips:

- Directness of route not as important as visual interest, shade, protection from wind.
- Loop trips may be preferred to backtracking.
- Trips may range from under a mile to over 50 miles.
- Short-term bicycle parking should be provided at recreational sites, parks, trailheads and other activity centers.
- Varied topography may be desired, depending on the skill level of the cyclist.
- May be riding in a group.
- May drive with their bicycles to the starting point of a ride.
- Trips typically occur on the weekend or on weekdays before morning commute hours or after evening commute hours.
- Type of facility varies, depending on the skill level of the cyclist.

Utilitarian Type Trips:

- Directness of route and connected, continuous facilities more important than visual interest, etc.
- Trips generally travel from residential to recreation, school, institutional, shopping or work areas and back.
- Trips generally are 1-5 miles in length.
- Short-term and long-term bicycle parking should be provided at stores, transit stations, schools, workplaces.
- Flat topography is desired.
- Often ride alone.
- Use bicycle as primary transportation mode for the trip; may or may not have access to a car for the trip.
- Trips typically occur during morning and evening commute hours (commute to school and work). Shopping trips also occur on weekends.
- Generally use on-street facilities, may use trails if they provide easier access to destinations than on-street facilities.

Recreational bicyclists' needs vary depending on their skill level. Road bicyclists out for a 100-mile weekend ride may prefer well-maintained roads with wide shoulders and few intersections, and few stop signs or stop lights. Casual bicyclists out for a family trip may prefer a quiet shared use path with adjacent parks, benches, and water fountains. Utilitarian bicyclists have needs that are more straightforward.

Commuter Trip Needs:

- Commuter routes should be direct, continuous, and connected
- Protected intersection crossing locations are needed for safe and efficient bicycle commuting
- Bicycle commuters must have secure places to store their bicycles at their destinations

The City of Dothan's neighborhoods do not have easy bicycle access to employment centers, schools and shopping. For the casual recreational rider, this may not be a serious deterrent, since they would be willing and able to drive their bicycle to the trailhead. However, this may not be an option for the experienced recreational rider or the commuter, as they generally would like to use their bicycle for the whole trip. Bicycle-friendly on-street connections between residential areas and the trails and between residential areas and shopping and commute centers would likely increase the prevalence of bicycle commuting, as well as increase the prevalence of recreational riding.

User Concerns Identified By Key Person Interviews, Survey Questionnaires and Public Meetings

Through citizen input at public meetings, discussions and/or specific interviews with key city staff and officials, written comments submitted by citizens and questionnaire results, the following bicycle and pedestrian concerns were identified. The concerns listed here are limited to only those expressed by citizens and officials in the above forums. They are not the result of the analysis of bicycle and pedestrian facilities, streets, sidewalks, land development, potential destinations and connectivity opportunities or of applying recognized standards to existing and projected population characteristics. Both of these tasks documented concerns that are identified throughout this report. However, they are every bit as important and are reflected in the Goals and Objectives of the bicycle and pedestrian program and in the recommended Plan. As of the date of this draft, user needs comments from a number of contacted key officials have not been received. Future responses will be documented when received and incorporated into the final draft.

Bicycle and Pedestrian User Concerns

- A defined bicycle / pedestrian trail system throughout Dothan.
- Connectivity between neighborhoods and schools, parks, shopping, etc. is important.
- James Oates Park connection.
- Connections to all parks.
- Streets designed with complete movement including bicycles and pedestrians.

Bicycle User Concerns

- Planned, designated on-street bicycle lanes.
- Bicycle routes that form a loop system.
- Adequate widths for bicycle lanes.
- Street safety and speed limit enforcement.
- Paved shoulders.
- Conversion of the bike trail at Westgate Park to all bike facility with no sharing of users.
- Westgate Park is the top bicycle destination in Dothan and the following streets could be used as bike routes to access the Park: Choctaw Street, Deerpath Road and Buena Vista Drive. Also, Choctaw Street's intersections with Ross Clark Circle and Westgate Parkway need to be more biker friendly.
- Proper bicycle related signage.
- Bicycle parking facilities at potential rider destinations.

Pedestrian User Concerns

- More off-street walking trails.
- Safer intersection crossings and better lighting.
- Concerns regarding safe pedestrian crossing of U. S. Highway 84 West within the John D. Odom Road / Grove Park Lane area to provide access between neighborhoods to the south and businesses on the north side of Highway 84.
- Pedestrian crossing at the intersection of Ross Clark Circle and Choctaw Street and at other key locations along Ross Clark Circle.
- Pedestrian safety at Westgate Park.
- Projects that will enhance walking to commercial areas, shopping and medical offices
- Sidewalks in neighborhoods.
- Improved sidewalk access in the vicinity of schools and parks.
- Landscaped separation between sidewalk and curb.
- Policy of building and maintaining streets as safe and pedestrian friendly as possible.

Existing Dothan Bicycle and Pedestrian Demand

When the Dothan Bicycle and Pedestrian Master Plan is implemented, more Dothan residents will have the opportunity to bicycle and walk, rather than driving for commuting, shopping and recreation. This shift can be directly translated into reduced vehicle miles traveled, and results in air quality benefits by reducing emissions. The pedestrian and bicycle demand model tables that are presented within this section (Tables 11 through 14), are provided as simply an order of magnitude to study and compare the number of people bicycling and walking in Dothan today to the potential numbers of bicycling and walking in the future (year 2035 used). Demand models are sometimes used to quantify usage of existing bicycle facilities, and to estimate the potential usage of new facilities. As is typical of models, the results show a range of accuracy that varies based on a number of assumptions and available data

The models used for this study incorporated information from existing publications as well as data from the *U.S. Census 2009 American Community Survey (ACS)*. All data assumptions and sources are noted in the "Source" column for each table. For modeling purposes, the study area included all residents within the City of Dothan according to the 2009 ACS. The year 2009 was used as the baseline for the demand analysis, as it was the most recent year for which data was available. For this analysis, population data for the existing labor force (including the number of workers and percentage of pedestrian and bicycle commuters) were obtained from the 2009 ACS findings for the City of Dothan. In addition to people commuting to the workplace via walking or by bicycle, the model also incorporates a portion of the labor force working from home.

The 2009 ACS was also used to estimate the number of school children in Dothan. This figure was combined with data from *National Safe Routes to School Travel Data Survey, 2010*, which found that approximately 12 percent of school children walk to and from school every day. College students constitute a third variable in the model due to the presence of Troy State University and Wallace Community College in Dothan (neither of which has on-campus dormitories). The enrollment information shown for the Dothan campus of Troy State University was obtained directly from Troy State University's Institutional Research department, via telephone. The enrollment information shown for Wallace Community College's Dothan campus was obtained directly from Wallace Community College's Director for Public Relations and Marketing, via telephone.

Troy State University, Dothan Campus Enrollment
(2011 Spring Semester enrollment figures shown) = 1,623 Total Students

Wallace Community College, Dothan Campus Enrollment
(2011 Spring Semester enrollment figures shown) = 3,500 Total Students

Data from the Federal Highway Administration regarding walking and bicycling indicates that the average number of students which bicycle to college is approximately 60 percent (for Universities with on-campus housing). However, since neither Troy State University nor Wallace Community College have on-campus dormitories at their Dothan locations, a much lower 5% figure was used. The FHWA's 2001 National Household Travel Survey found that commute trips (including work and school trips) only comprise approximately a third of total trips; trips for shopping, recreation and socializing are a significantly greater proportion of total trips than just commuting, as reported by the ACS.

The National Safe Routes to School surveys found that approximately two percent (2%) of school children bike to school and that twelve percent (12%) walk to school. The Existing Bicycle and Pedestrian Demand Estimates found in Tables 11 and 12 (which immediately follow) summarize these results and assumptions in the estimated existing daily bicycle and walking trips in Dothan.

Table 11

Existing Bicycle Demand Estimate

Variable	Quantity	Source
Study area population	67,162	2009 American Community Survey, City of Dothan population.
Employed population	27,191	2009 American Community Survey, City of Dothan population of workers ages 16+.
Percent of employed population that bicycle to work	0.3%	2009 American Community Survey, City of Dothan population of workers ages 16+ that bicycle to work.
Number of bike to work commuters	81	(Employed persons) x (% employees that bike to work)
Percent of employed population that work at home	1.2%	2009 American Community Survey, City of Dothan population of workers ages 16+ that work at home.
Number of work at home bicycle commuters	16	Assumes 5% of population working at home makes at least one daily bicycle trip
Percent of employed population that take public transit to work	0.2%	2009 American Community Survey, City of Dothan population of workers ages 16+ that take public transit to work.
Number of public transit to work commuters	5	Assumes 10% of transit riders access transit by bicycle
School children, ages 5-14 (K-8)	8,346	2009 American Community Survey, City of Dothan - school enrollment by level of school
Percent of school children that bicycle to school	2.0%	National Safe Routes to School Travel Data Surveys, January 2010
Number of school children bike commuters	166	(School children population) x (% school children that bike to school)
Number of college students	5,123	2011 Spring Semester Enrollment used for Troy State University and Wallace Community College, Dothan Campus locations.
Percent of college students that bicycle to campus	5.0%	National Bicycling & Walking Study, FHWA, Case Study No. 1, Publication FHWA-PD-92-041, 1991, Typical average is 60% (for on-campus dorms). Since there are no on-campus dorms at Dothan college campuses, a 5% factor is used.
Number of college student bike commuters	256	(College student population) x (% coll. students that bike to campus)
Total number of bicycle commuters	524	(Bike to work trips) + (School trips) + (College trips) + (Utilitarian trips)
Total daily bicycle trips subtotal	1,048	Total bicycle commuters x 2 (for round trips)
Other Utilitarian and Discretionary Trips:		
Ratio of “other” trips to commute trips	0.8%	2001 National Household Travel Survey, Appendix A, Table A-11, Page 21.
Estimated non-commute trips	8	Total daily bicycling trips x 0.8%
***Current Estimated Daily Bicycle Trips:**	**1,056**	(Total daily bicycle trips) + (Non-commute trips)

***Note:** This demand model is based on the standards (and assumptions) for estimating existing and future bicycle / walking demands, as developed by ALTA.

Table 12

Existing Pedestrian Demand Estimate

Variable	Quantity	Source
Study area population	67,162	2009 American Community Survey, City of Dothan population.
Employed population	27,191	2009 American Community Survey, City of Dothan population of workers ages 16+.
Percent of employed population that walk to work	0.3%	2009 American Community Survey, City of Dothan population of workers ages 16+ that walk to work.
Number of walk to work commuters	81	(Employed persons) x (% employees that walk to work)
Percent of employed population that work at home	1.2%	2009 American Community Survey, City of Dothan population of workers ages 16+ that work at home.
Number of work at home walk commuters	81	Assumes 25% of population working at home makes at least one daily walking trip
Percent of employed population that take public transit to work	0.2%	2009 American Community Survey, City of Dothan population of workers ages 16+ that take public transit to work.
Number of public transit to work commuters	40	Assumes 75% of transit riders access transit by foot
School children, ages 5-14 (K-8)	8,346	2009 American Community Survey, City of Dothan - school enrollment by level of school
Percent of school children that walk to school	12.0%	National Safe Routes to School Travel Data Surveys, January 2010
Number of school children walk commuters	1,001	(School children population) x (% school children that walk)
Number of college students	5,123	2011 Spring Semester Enrollment used for Troy State University and Wallace Community College, Dothan Campus locations.
Percent of college students that walk to campus	5.0%	National Bicycling & Walking Study, FHWA, Case Study No. 1, Publication FHWA-PD-92-041, 1991, Typical average is 60% (for on-campus dorms). Since there are no on-campus dorms at Dothan college campuses, a 5% factor is used.
Number of college student walk commuters	256	(College student population) x (% college students that walk)
Total number of walk commuters	1,459	(Walk to work trips) + (School trips) + (College trips) + (Utilitarian trips)
Total daily walking trips subtotal	2,918	Total walk commuters x 2 (for round trips)
Other Utilitarian and Discretionary Trips:		
Ratio of “other” trips to commute trips	0.8%	2001 National Household Travel Survey, Appendix A, Table A-11, Page 21.
Estimated non-commute trips	23	Total daily walking trips x 0.8%
***Current Estimated Daily Pedestrian Trips:**	**2,941**	(Total daily walking trips) + (Non-commute trips)

***Note:** This demand model is based on the standards (and assumptions) for estimating existing and future bicycle / walking demands, as developed by ALTA.

The previous Table 11 and Table 12 for existing bicycle and pedestrian demand estimate that approximately 703 bicycle trips and 2,778 walking trips occur in the Dothan area each day. These numbers are applicable to weekdays only and averaged over the course of the year.

Potential Future Walking and Biking Trips

Estimating future benefits requires additional assumptions regarding population and anticipated commuting patterns in 2035 for Dothan. The variables used in the future demand model generally resemble the variables used in the existing demand model (discussed earlier). Future population and employment projections found in the City of Dothan's Long Range Development Plan (3/2/2011), *A Sense of New Beginnings,* were also referenced in these models.

The City of Dothan's Long Range Development Plan, A Sense of New Beginnings (adopted March 16, 2011), projects Dothan's population to be at 81,290 in the year 2035. Employment in the City is predicted to increase to approximately 32,901 jobs as suburbs grow and commuting to the town increases. The population of school children is assumed to maintain its current 2011 proportion to city's total population, or 12.4 percent. The 2035 student enrollment figures for the Dothan locations of Troy State University and Wallace Community College were determined by assuming the same proportion of City population to college students that will attend both colleges in Dothan will remain at 7.6%, as in 2011. This assumes an enrollment growth of 1,055 college students.

The following Table 13 summarizes estimates for Future Bicycle Demand in the year 2035. Immediately after Table 13 is Table 14, an Estimate for Future Pedestrian Demand table. Both of these estimates for future bicycle and pedestrian demands assumes a more complete pedestrian and bicycle network and concurrent program development within the City of Dothan to encourage use. These future bicycle and pedestrian estimates predict that over 2,106 bicycle trips and 2,921 pedestrian trips will occur in Dothan each day by 2035.

Table 13

Estimate for Future Bicycle Demand, Year 2035

Variable	Quantity	Source
Future study area population	81,290	City of Dothan Long Range Development Plan, A Sense of New Beginnings (3/16/2011)
Future employed population	32,901	Assumes the same 21% growth of population from the current year of 2011, per the Dothan Long Range Development Plan.
Future percent of employed population that bicycle to work	1.3%	Assumes a 1% increase over 24 years due to trends and improvements in the bikeway network.
Future number of bike to work commuters	427	(Employed persons) x (% employees that bike to work)
Future percent of employed population that work at home	1.2%	Assumes that this factor will remain unchanged and stable from the current year of 2011.
Future number of work at home bicycle commuters	39	Assumes 10% of population working at home makes at least one daily bicycling trip
Future percent of employed population that take public transit to work	1.2%	Assumes a 1% increase over 24 years due to trends and improvements in public transit
Future number of public transit to work commuters	39	Assumes 10% of transit riders access transit by bicycle
Future school children, ages 5-14 (K-8)	9,380	Maintains the year 2011 proportion of total Dothan population who are school children at 12.4%
Future percent of school children that bicycle to school	3.0%	Assumes a 1% increase over 24 years due to trends and improvements in the bikeway network
Future number of school children bike commuters	281	(School children population) x (% School children that bike to school)
Future number of college students	6,178	Maintains the year 2011 proportion of total Dothan population who are college students within Dothan at 7.6%
Future percent of college students that bicycle to campus	6.0%	Assumes a 1% increase over 24 years due to trends and improvements in the bikeway network
Future number of college student bike commuters	370	(College student population) x (% coll. students that bike to campus)
Future total number of bicycle commuters	1,156	(Bike to work trips) + (School trips) + (College trips) + Utilitarian trips)
Future total daily bicycle trips	2,312	Total bike commuters X 2 (for round trips)
Other Utilitarian and Discretionary Trips:		
Ratio of "other" trips to commute trips	0.8%	2001 National Household Travel Survey, Appendix A, Table A-11, Page 21.
Future estimated non-commute trips	18	Total daily bicycling trips x 0.8%
***Future Estimated Daily Bicycle Trips:**	**2,330**	(Total daily bicycle trips) + (Non-commute trips)

***Note:** This demand model is based on the standards (and assumptions) for estimating existing and future bicycle / walking demands, as developed by ALTA.

Table 14

Estimate for Future Pedestrian Demand, Year 2035

Variable	Quantity	Source
Future study area population	81,290	City of Dothan Long Range Development Plan, A Sense of New Beginnings (3/16/2011)
Future employed population	32,901	Assumes the same 21% growth of population from the current year of 2011, per the Dothan Long Range Development Plan.
Future percent of employed population that walks to work	1.3%	Assumes a 1% increase over 24 years due to trends and improvements in the walkway network.
Future number of walk to work commuters	427	(Employed persons) x (% of employees that walk to work)
Future percent of employed population that work at home	1.2%	Assumes that this factor will remain unchanged and stable from the current year of 2011.
Future number of work at home walk commuters	39	Assumes 10% of population working at home makes at least one daily walking trip
Future percent of employed population that take public transit to work	1.2%	Assumes a 1% increase over 24 years due to trends and improvements in public transit
Future number of public transit to work commuters	296	Assumes 10% of transit riders access transit by walking
Future school children, ages 5-14 (K-8)	9,380	Maintains the year 2011 proportion of total Dothan population who are school children at 12.4%
Future percent of school children that walk to school	13.0%	Assumes a 1% increase over 24 years due to trends and improvements in the walkway network
Future number of school children walk commuters	1,219	(School children population) x (% school children that walk to school)
Future number of college students	6,178	Maintains the year 2011 proportion of total Dothan population who are college students within Dothan at 7.6%
Future percent of college students that walk to campus	6.0%	Assumes a 1% increase over 24 years due to trends and improvements in the walkway network
Future number of college student walk commuters	370	(College student population) x (% coll. students that walk to campus)
Future total number of walk commuters	2,351	(Walk to work trips) + (School trips) + (College trips) + (Utilitarian trips)
Future total daily walking trips	4,702	Total walk commuters X 2 (for round trips)
Other Utilitarian and Discretionary Trips:		
Ratio of "other" trips to commute trips	0.8%	2001 National Household Travel Survey, Appendix A, Table A-11, Page 21.
Future estimated non-commute trips	37	Total daily walking trips x 0.8%
***Future Estimated Daily Pedestrian Trips:**	**4,739**	(Total daily walking trips) + (Non-commute trips)

***Note:** This demand model is based on the standards (and assumptions) for estimating existing and future bicycle / walking demands, as developed by ALTA.

Summary of Findings

Dothan has both excellent assets that can contribute to potential bicycle and pedestrian facility improvements and some basic negatives that will require sound planning, especially prioritization of projects, and time to overcome. The negatives are, however, the kind for which feasible, strategic solutions can be proposed and implemented. Following are positives and negatives related to bicycle and pedestrian planning that were identified by the inventory and analysis of existing conditions.

Positives

Although this is the City's first attempt to prepare a bicycle and pedestrian plan, three previous planning reports have addressed bicycle and pedestrian issues and the need for planning. They are the City of Dothan Long Range Development Plan, the Southeast Wiregrass MPO 2035 Long Range Transportation Plan and the Master Plan for Parks and Recreation in Dothan.

The City of Dothan's commitment to the improvement of bicycle and pedestrian facilities, which is evident not only by the undertaking of this planning project but by the recent implementation of the first on-street bicycle lane on John D. Odom Road, the excellent off-street bicycle trail at Westgate Park and regulations requiring sidewalks in new subdivisions.

A street system that provides convenient accessibility throughout the City via nine Principal Arterials, thirty-four minor arterials and thirty-three collector streets. From the center of Dothan these streets radiate to all parts of the area as well as provide a beltway around the center of development.

Connecting sidewalks that provide pedestrian circulation throughout most of Downtown Dothan and to a lesser extent in the older, central areas that surround of downtown.

Paved, well developed off-street bicycle trail facility at Westgate Park that sets a precedent for quality bicycle related development.

Outstanding recreation facilities interspersed throughout the City that present resource opportunities for biking and walking facilities.

City, county and federal public facilities and utilities which generate a continuous flow of people into the Downtown Area.

Over 30% of roadways have conditions suitable for bicycling.

Negatives

An almost total lack of bicycle lanes with only 800 feet of marked, designated on-street bicycle lane in the entire City.

Lack of any off-street walking trails in the Department of Leisure Service's Region III, which is southwest Dothan.

Only 17% of Dothan's streets have a sidewalk on at least one side and 65% of the streets that do are classified as urban local streets.

The absence and/or inadequacies of sidewalk connections to provide access between most school and recreation facilities and the neighborhoods that surround them. This is particularly true in the outlying areas where sidewalks required in new subdivisions generally have no connection to schools or parks.

Only 7% of the crosswalks existing on major streets meet ADA accessibility standards.

A large number of sidewalks that are less than five feet in width, which is a desired standard and the width specified in the City's Subdivision Regulations.

Goals and Objectives

Goals

The primary goal is a sustainable Bicycle and Pedestrian Network and Program that will increase bicycling and walking and improve the safety of bicyclists and walkers in Dothan.

Related goals include:

- To encourage the use of bicycling and walking as legitimate modes of transportation.
- To improve the safety of bicyclists and pedestrians.
- To educate bicyclists, pedestrians, motorists, law enforcement officers, and others regarding traffic laws and safety measures.
- To encourage the development of bicycle and pedestrian resources.

Key Elements for Achieving Bicycle and Pedestrian Goals

The following Objectives were identified to assist in attaining the bicycle and pedestrian goals:

- Development of planning proposals that will encourage implementation of a bicycle and pedestrian network that provides convenient access to various destinations.
- Creating a successful program to encourage bicycle and walking.
- Promote high standards of design for the construction of bicycle and pedestrian facilities.
- Develop policies to incorporate bicycle and pedestrian facilities into transportation improvements by monitoring such improvements to ensure that projects have been scoped to include bicycle and pedestrian facilities, where appropriate.
- Encourage the creation of appropriate amenities, such as bicycle parking, to increase the convenience of bicycling or walking.
- Facilitate the publication of maps, such as a bicycle suitability map, that outline and promote the bicycle and pedestrian system, safety, and the appropriate use of available bicycle and pedestrian facilities.
- Encourage proper maintenance of bicycle and pedestrian infrastructure, including the use of volunteers for this task.
- Include bicycle and pedestrian facilities as components of the City's capital programs and site review approval processes.
- Identify safe and appropriate connections between various modes of transportation.
- Encourage the creation of specific education programs, tailored to children, adults, and motorists outlining the rules for safe travel.
- Develop a method to educate law enforcement officers to recognize bicycle and pedestrian rules and regulations for proper enforcement of laws to bicycle and pedestrian law offenders, and to motor vehicle offenders that negatively impact bicyclists and pedestrians.

- Identify necessary bicycle and pedestrian accommodations at tourist and business locations.
- Develop a method of collecting and updating data on bicycle and pedestrian activity.

2035 Long Range Transportation Plan Goals Relative to Bicycling / Walking

The Southwest Wiregrass Metropolitan Planning Organization established the goals and applicable planning factors in the process of developing the 2035 Long Range Transportation Plan. The following goals and/or applicable planning factors from the Transportation Plan are listed here because of their relevance to bicycle and pedestrian planning and their importance to overall transportation planning.

- Increase the accessibility and mobility options available to people.
- Increase the safety and security of the transportation system for motorized and non-motorized users.
- Enhance the integration and connectivity of the transportation system, across and between modes, for people.
- Create a framework for modal connectivity that enhances mobility options for the community.
- Encourage bicycling by providing safe and convenient places to park and store bicycles.
- Ensure adequate bicycle parking based on demand generated by various uses and level of security necessary to encourage use of bicycles for short and long term stays.
- Ensure that new development and road projects include pedestrian and bicycle facilities unless circumstances render such facilities infeasible.

Recommended Bicycle / Pedestrian Plan

This Dothan Bicycle and Pedestrian Plan envisions a comprehensive network of on- and off-street bicycle / pedestrian facilities, which provides convenient access to parks, schools, commercial areas, places of work, and other destinations as well as for recreational and physical fitness purposes. The Plan also recommends a structure to develop and maintain bicycle facilities, support bicycle and safety education, and encourage more people to bicycle for utilitarian and recreation reasons.

The Plan provides a vision for the future and a rational framework to guide the decisions of those responsible for public policy and improvements. It is designed to meet the needs for bicycle and pedestrian facilities with a variety of recommendations for improving bicycling and walking conditions and for interconnecting proposals with key activity destinations.

It is important to recognize that although the Plan provides a guide for influencing future development, actual implementation of proposed facilities will be the result of public policy, public roadway and park improvements, private development decisions and of major importance, money.

Many of the Bicycle and Pedestrian Plan recommendations can be implemented relatively easily by coordinating improvements with other street and development construction projects. Other recommendations will need to be stand-alone projects.

Proposed Bicycle Facilities Plan

The proposed bicycle facilities plan is provided on a 36”x 40” folded map titled “Proposed Bikeways, Large Map 2”, located in a map pocket within the appendix of this document.

Key features of the proposed bikeway plan are:

- Connectivity between major destinations is a major goal of the bikeway plan.
- A comprehensive network of on- and off-street bikeway lanes that provide access to all parks, major institutional uses and most schools.
- Bicycle lane access to future destinations such as the proposed James O. Oates Park on Campbellton Highway and College of Osteopathic Medicine on Cowarts Road.
- Does not use Principal Arterials with high traffic volumes.
- Proposes shared use lanes along streams and power line right-of-way in the western part of Dothan.
- Provides access to all parts of Dothan, although not necessarily by the most direct route in order to avoid streets with the City’s most heavy traffic volumes and highest degree of bicycle difficulty.
- Uses routes designated as suitable for bicycles.
- Outstanding bike ride provided by a loop with both on-street and off-street riding experience starting at Westgate Park with its 3.3 mile bicycle trail, then down Westgate Parkway to a proposed off-street stretch along a stream west to Brannon Strand Road and then north to another off-street stretch along a drainage way and power line right-of-

way taking the rider east to Westgate Parkway and back to Westgate Park. This approximately 12 mile loop consists of slightly over 6½ miles of on-street riding and some 5½ miles of off-street riding.

- A smaller loop involving Westgate Park would be an approximately 2½ mile on-street ride using Westgate Parkway south to Flowers Chapel Road, then west on Flowers Chapel to Woodburn Drive, then north on Woodburn Drive and Shady Lane to Whatley Drive and back to Westgate Park.

- Sufficient bike lanes in the Downtown area and throughout the central part of Dothan.

- Bikeway access is provided to every major recreation facility of the Dothan Recreation Department.

- Bicycle lane linkage with the Trojan Mountain Bike Trail Head.

- Bikeway access is provided to the majority of Dothan's public schools.

- The planned bike routes provide the rider with the possibility a loop ride without backtracking over the same route regardless of which part of the City the ride originates.

- Access is provided to all major destination points such as major shopping concentrations, governmental buildings, Peanut Festival site, etc.

- The proposed bikeways cover some 134 miles of on-street and 7 miles of off-street bikeways.

- Assumes that many of the recommended on-street bicycle lanes can be realized by painting bike lane markings, narrowing existing travel lanes, widening existing pavement to include paved shoulders or by removing existing travel lanes.

- An initial low cost way to educate motorists and bring attention to bicyclists would be to install "Share-The-Road" signs along roadways at high traffic areas and safety concern areas (reference Figure 4, "Shared-Use Roadway" design guideline graphic). All roadways are shared-use with bicyclists, unless prohibited by law.

- Many of the Bikeways Plan recommendations can be implemented relatively easily by coordinating improvements with other street and development construction projects.

- The proposed off-street facilities are shared use bicycle and pedestrian lanes. The proposed on-street bicycle lanes, when fully implemented, would cover 60 percent of the City's total street frontage.

- It is the intent of the bikeways plan that facilities should be identified with route signs, pavement markings, etc. to indicate that special accommodations have been made for bicycles.

Proposed Shared-Use Facilities

The AASHTO Guide for the Development of Bicycle Facilities states that, "shared use paths should not be used to preclude on-road bicycle facilities but rather to supplement a system of on-road bike lanes, wide outside lanes, paved shoulders and bike routes." The preliminary proposals attempt to do this with three significant off-street shared use trails that take advantage of utility and power line easements in the west part of Dothan. These proposed facilities include:

- A shared-use trail located along Beaver Creek south of Flowers Chapel Road that would extend from Westgate Parkway to a point near Flowers Chapel Road intersection with Brannon Stand Road. This paved 2.7 mile facility would be part of loop that originates and returns to Westgate Park as described in the description of proposed bicycle facilities.
- A shared-use trail located to the north of Whatley Drive along Rock Creek / Little Ch9octawahoc River extending between Westgate Parkway and Brannon Stand Road for a distance of 2.8 miles. This facility would also be part of the loop indicated above.
- A small 0.6 mile shared-use facility would be located along a power line right-of-way to the north of Murphy Mill Road and extend between John D. Odom Road and North Brannon Stand Road.
- Two of these facilities would be an important part of a loop ride originating in Westgate Park. These proposals are shown on Large Map 2, Proposed Bikeways and the Large Map 3, Proposed Walkways.

Proposed Pedestrian Facilities

The proposed pedestrian facilities plan is provided on a 36"x 40" folded map titled "Proposed Walkways, Large Map 3", located in a map pocket within the appendix of this document.

Key features of the proposed walkway plan are:

- A major goal of the walkway improvements is connectivity between potential destinations.
- Proposed walkways are limited to major arterials, minor arterials and collectors.
- Plan provides for walkways in the vicinity of all schools and recreation facilities.
- Walkway access is proposed in the vicinity of future developments such as the proposed College of Osteopathic Medicine and the James O. Oates Park.
- Existing walkways provide good access throughout the downtown area; however, the Plan provides for improvements to in-fill gaps in the existing sidewalk system to provide continuity.
- The Plan also provides for in-fill gaps in existing sidewalks in the central areas that surround Downtown Dothan.
- Walkways are proposed in the vicinity of major shopping areas.
- Plan assumes that all existing walkways will be brought up to standard by the City.
- Plan assumes that all walkways and crossings will be complaint with ADA requirements through the construction of new facilities or improvements to existing facilities.
- Many of the walkway recommendations can be implemented relatively easily by coordinating improvements with other street and development construction projects.

- The Plan proposes 86 miles of new walkways to be combined with the 81 miles of existing walkways.

Facility Design Guidelines

These guidelines will provide Dothan's staff with guidance on pedestrian and bicycle facility design. The guidelines will serve as the basis for reviewing development plans and making decisions for design elements.

The design guidelines and facility recommendations were developed in accordance with the *Manual on Uniform Traffic Control Devices* and the following ASSHTO documents: *Guide for the Planning, Design and Operation of Bicycle Facilities; Guide for the Development of Pedestrian Facilities; and A Policy on the Geometric Design of Highways and Streets*.

The guide for the development of bicycle facilities is described by AASHTO as follows:

"The guide is designed to provide information on the development of facilities to enhance and encourage safe bicycle travel. The majority of bicycling will take place on ordinary roads with no dedicated space for bicyclists. Bicyclists can be expected to ride on almost all roadways as well as separated shared use paths and even sidewalks, where permitted to meet special conditions. This guide provides information to help accommodate bicycle traffic in most riding environments. It is not intended to set forth strict standards, but, rather, to present sound guidelines that will be valuable in attaining good design sensitive to the needs of both bicyclists and other highway users."

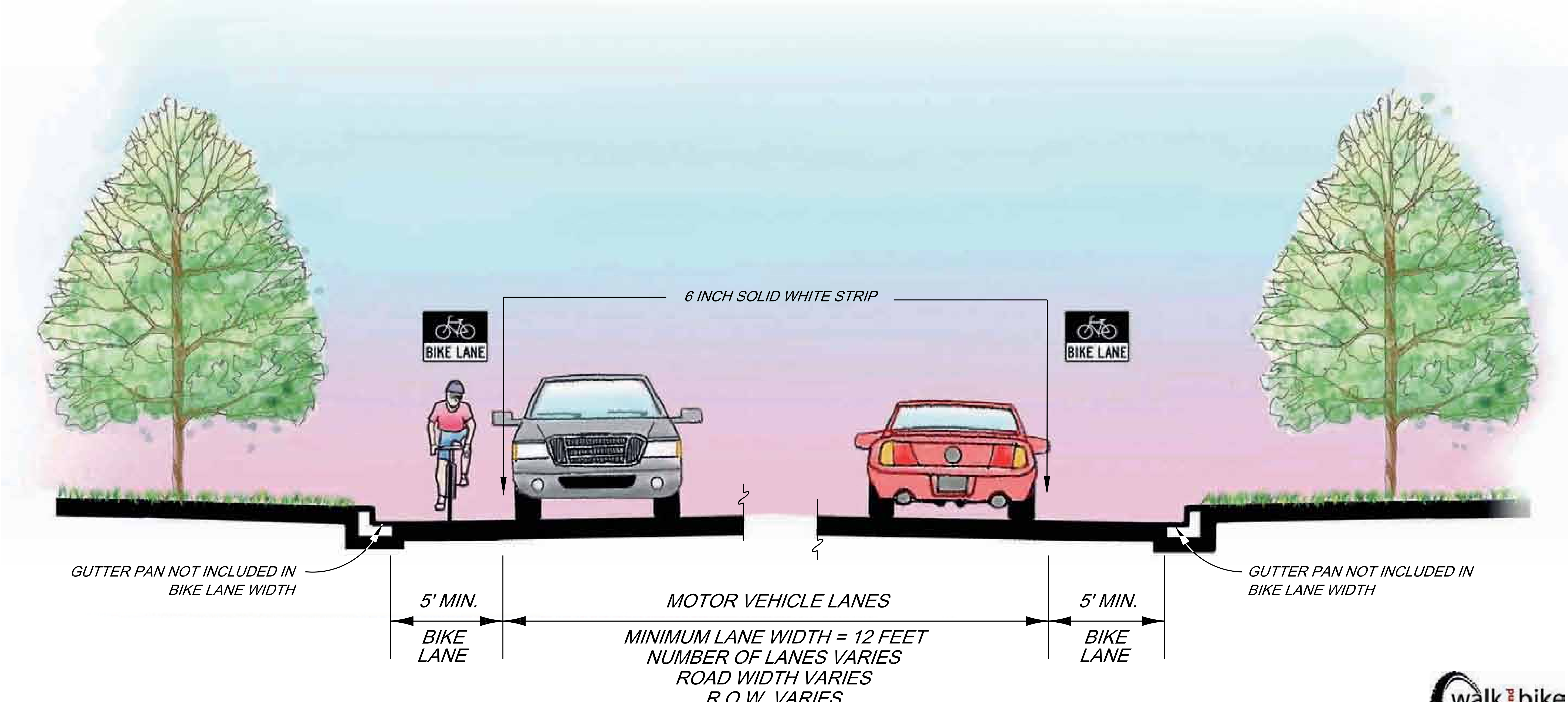
The pedestrian guide is described by AASHTO as follows:

"The purpose of this guide is to provide guidance on the planning, design, and operation of pedestrian facilities along streets and highways. Specifically, the guide focuses on identifying effective measures for accommodating pedestrians on public rights-of-way. Appropriate methods for accommodating pedestrians, which vary among roadway and facility types, are described in this guide. The primary audiences for this manual are planners, roadway designers, and transportation engineers, whether at the state or local level, the majority of whom make decisions on a daily basis that affect pedestrians. This guide also recognizes the profound effect that land use planning and site design have on pedestrian mobility and addresses these topics as well."

The graphic illustrations of pedestrian, bicycle and trail facilities presented in this report are minimum standards that the City should use when installing facilities. There will always be exceptions and modified solutions to certain issues such as difficult terrain or lack of right-of-way. For example, a 4-foot wide sidewalk may have to be installed in lieu of a more desirable 5-foot wide sidewalk because of available space.

Both on-road and off-road graphic design guidelines have been provided within the Dothan Bicycle and Pedestrian Master Plan. The graphic design guidelines are represented in the following list of figures:

FIGURES 1 THROUGH 13
IMMEDIATELY FOLLOW THIS PAGE



APPLICABLE ROADWAYS:

URBAN PRINCIPAL ARTERIALS:

1. AL HWY 53 (E. COTTONWOOD)
   - ROSS CLARK CIRCLE TO CITY LIMITS
2. E. MAIN STREET (U.S. 84E)
   - SO. OATES TO CITY LIMITS
3. W. MAIN STREET (U.S. 84W)
   - SO. OATES TO ROSS CLARK CIRCLE
4. U.S. 231 (NORTH & SOUTH)
   - INSIDE ROSS CLARK CIRCLE
5. REEVES STREET (U.S. 431N)
   - U.S. 231 BUS. TO ROSS CLARK CIRCLE

URBAN MINOR ARTERIALS:

1. ALICE STREET SOUTH
2. BURDESHAW STREET (EAST & WEST)
4. CHOCTAW
5. DENTON ROAD
   - OUTSIDE ROSS CLARK CIRCLE

URBAN MINOR ARTERIALS, CONT'D.:

4. HEADLAND AVE.
   - NORTH OF HARTFORD HWY.
7. HONEYSUCKEL ROAD
   - NORTH OF HARTFORD HWY.
8. PARK AVE. (NORTH & SOUTH)
9. RANGE STREET
   - ADAMS TO ROSS CLARK CIRCLE
10. ST. ANDREWS STREET
   - SOUTH OF U.S. 84
11. ST. ANDREWS STREET
   - NORTH OF U.S. 84
12. ST. ANDREWS STREET
   - SOUTH OF U.S. 84
13. SELMA STREET (EAST & WEST)
14. THIRD AVE.
   - LAFAYETTE TO ROSS CLARK CIRCLE
15. WEBB ROAD

URBAN MINOR ARTERIALS, CONT'D.:

16. WESTGATE PARKWAY

COLLECTOR STREETS:

1. BAYSHORE AVE.
2. CHICKASAW
3. DEXTER STREET
4. LAKE STREET
5. RANGE STREET
   - SOUTH OF EAST ADAMS
6. ROCKY BRANCH ROAD (PORTION)
7. TIMBERS DRIVE
8. WHATLEY DRIVE (PORTION)

LOCAL STREETS:

1. BUENA VISTA DRIVE
2. BURBANK STREET

LOCAL STREETS, CONT'D.:

3. BROOKSIDE DRIVE
4. CARROLL STREET (EAST)
5. COE DAIRY ROAD
6. COLLEGE STREET (NORTH)
7. HEDSTROM DRIVE
8. LENA STREET
9. MONTANA STREET
10. NORTHVIEW HIGH SCHOOL ROAD
11. MOSS ST.
12. PRYOR STREET (PORTION)
13. REID ST.
18. ROLLINS AVE.
19. TECHNOLOGY DRIVE
20. WILSON STREET (EAST)
21. WOODBURN DRIVE (NORTH)
22. SHADY LANE (NORTH)

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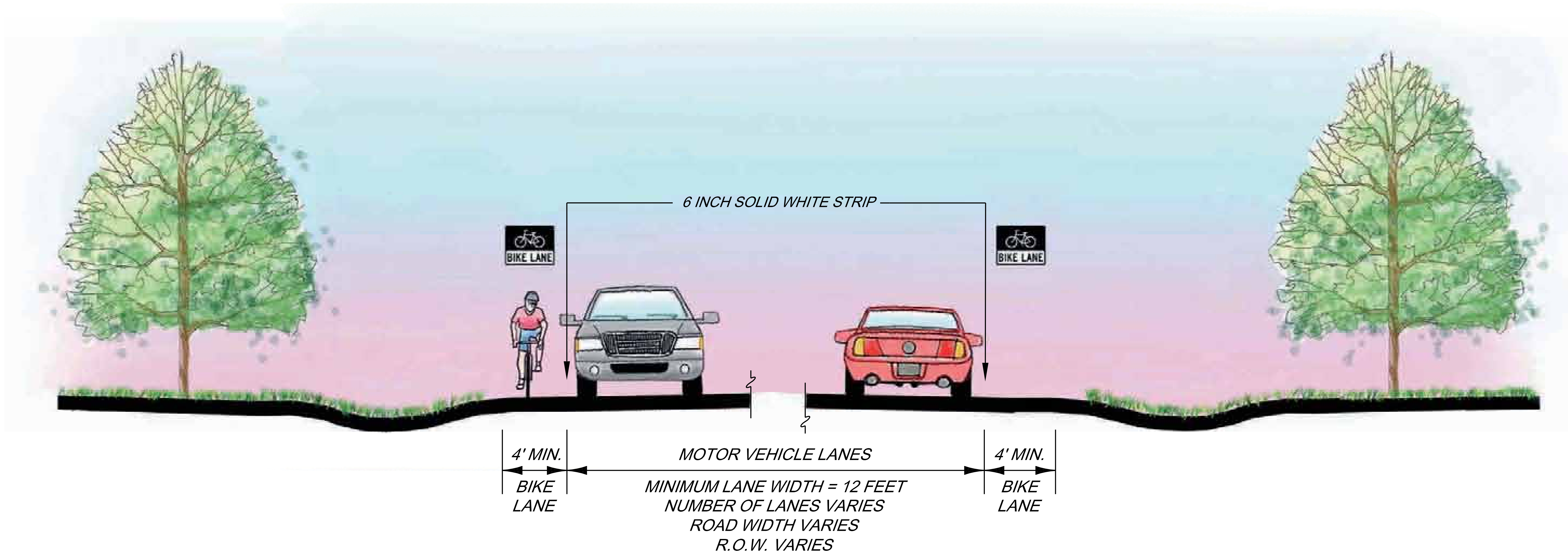
FIGURE 1

BIKE LANE ON STREET WITH CURB & GUTTER (STREET PARKING PROHIBITED)

NOT TO SCALE

Source: Guide for the Development of Bicycle Facilities, AASHTO, 1999



APPLICABLE ROADWAYS:

URBAN PRINCIPAL ARTERIALS:

1. COLUMBIA HWY. (AL 52E)
   - ROSS CLARK CIRCLE TO CITY LIMITS
2. W. MAIN STREET (U.S. 84W)
   - ROSS CLARK CIRCLE TO CITY LIMITS
3. REEVES STREET (U.S. 431N)
   - ROSS CLARK CIRCLE TO CITY LIMITS

URBAN MINOR ARTERIALS:

1. BRANNON STAND ROAD (NORTH & SOUTH)
2. CAMPBELLTON HWY.
3. FORRESTER ROAD
4. FORTNER STREET (W. & E. LAFAYETTE)
   - 6TH AVE. TO ROSS CLARK CIRCLE
5. FORTNER STREET
   - ROSS CLARK CIRCLE TO CITY LIMITS
6. HEADLAND AVE.
   - OUTSIDE ROSS CLARK CIRCLE

URBAN MINOR ARTERIALS, CONT'D.:

7. J. D. ODOM ROAD
   - U.S. 84 TO MURPHY MILL ROAD
8. J. D. ODOM ROAD
   - MURPHY MILL ROAD TO U.S. 231
9. KINSEY ROAD
10. MANCE NEWTON ROAD
11. NAPIER FIELD ROAD
12. OMUSSEE ROAD
13. PREVATT ROAD
14. RONEY ROAD
15. SAUNDERS ROAD (EAST)
16. THIRD AVE.
    - ROSS CLARK CIRCLE TO CITY LIMITS

COLLECTOR STREETS:

1. BEVERLYE ROAD (NORTH & SOUTH)
2. BOB HALL ROAD

COLLECTOR STREETS, CONT'D.:

3. FLOWERS CHAPEL ROAD
4. FLYNN ROAD
5. GREY HODGES ROAD (EAST & WEST)
6. HATTON ROAD
7. HONEYSUCKLE ROAD
   - SOUTH OF HARTFORD HWY.
8. LUCY GRADE ROAD
9. MURPHY MILL ROAD
10. ROCKY BRANCH ROAD (PORTION)
11. TAYLOR ROAD
12. TRAWICK ROAD
13. WHATLEY DRIVE (PORTION)

LOCAL STREETS:

1. BRUNER ROAD
2. BLACKMAN ROAD
3. COWARTS ROAD
4. DREW ROAD

LOCAL STREETS, CONT'D.:

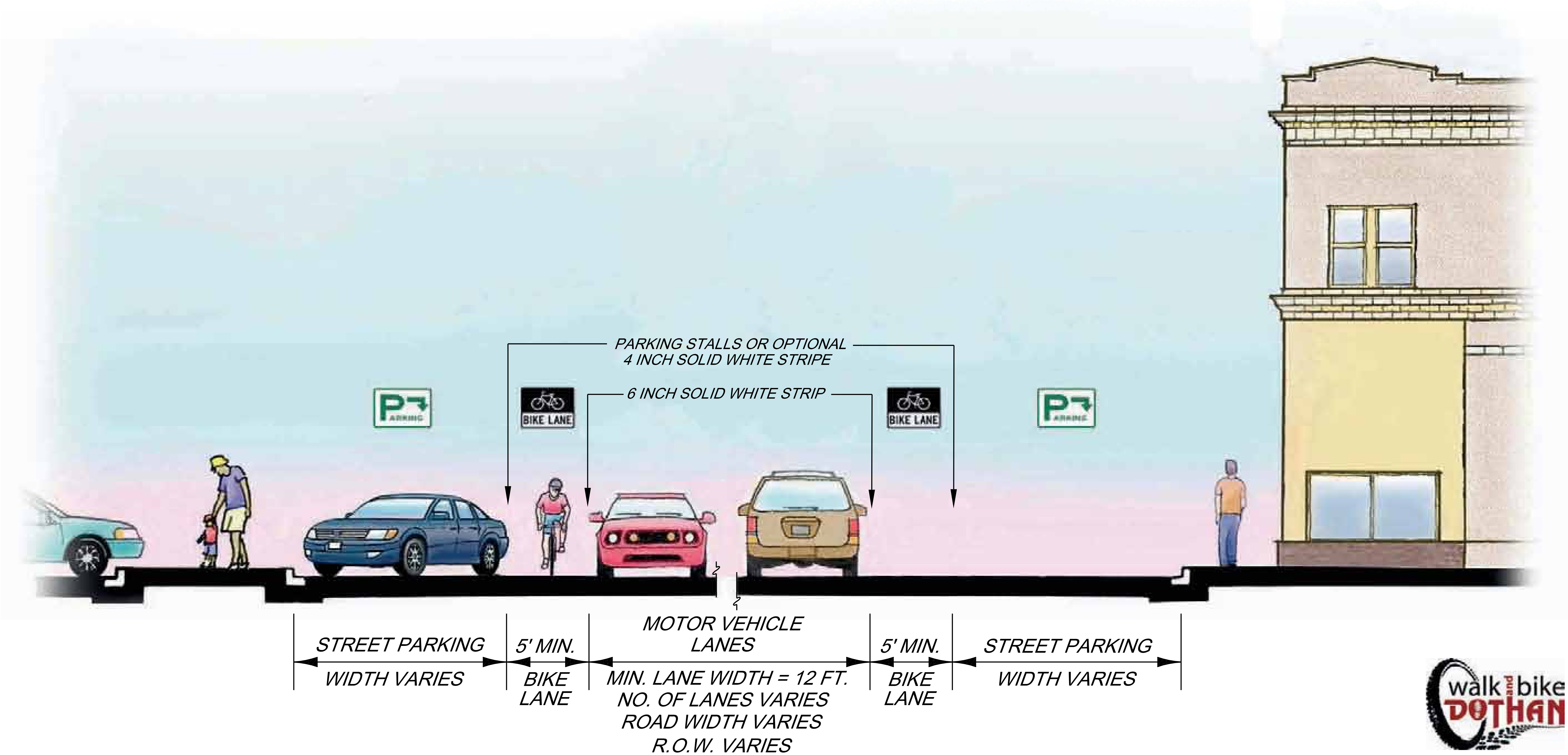
5. DUNN ROAD
6. ENNIS ROAD
7. KELLY SPRINGS ROAD
8. PRYOR STEET (PORTION)
9. ROWLAND ROAD
10. SANITARY DAIRY ROAD
11. WESTGATE PARK ENTRANCE
    - EXTENSION OF CHOCTAW STREET

FIGURE 2

BIKE LANE ON STREET WITHOUT CURB & GUTTER (STREET PARKING PROHIBITED)

NOT TO SCALE

Source: Guide for the Development of Bicycle Facilities, AASHTO, 1999



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APPLICABLE ROADWAYS:

URBAN MINOR ARTERIALS:

1. TROY STREET
   - PORTIONS
2. BURDESHAW STREET (WEST)
   - PORTIONS
3. ST. ANDREWS (NORTH)
   - RAILROAD DEPOT AREA (SMALL PORTION)

LOCAL STREETS:

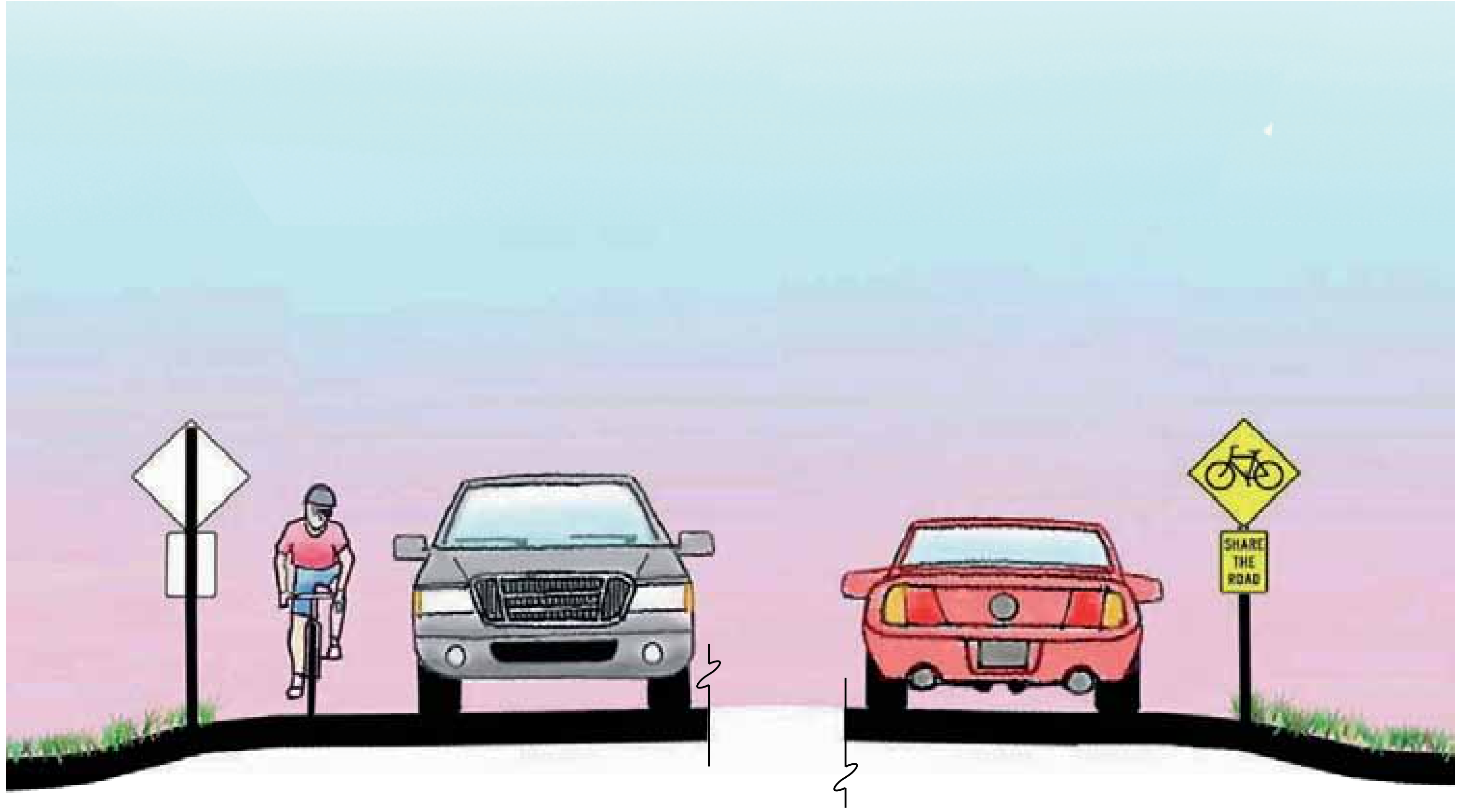
1. PRYOR STREET
   - PORTIONS

FIGURE 3

BIKE LANE ON STREET WITH CURB & GUTTER (STREET PARKING ALLOWED)

NOT TO SCALE

Source: Guide for the Development of Bicycle Facilities, AASHTO, 1999



NO PAVEMENT MARKINGS ARE REQUIRED FOR SHARED ROADWAYS

SHARED-USE ROADWAYS
(ROADWAY WITH REGULAR LANE WIDTH)

- **SHARED-USE ROADWAYS CONSIST OF NEARLY ALL ROADS (EXCEPT ROADWAYS WHERE BICYCLING IS PROHIBITED BY LAW)**
- **"SHARE THE ROAD" SIGNS CAN HELP EDUCATE MOTORISTS TO THE FACT THAT BICYCLISTS HAVE AS MUCH RIGHT TO THE ROADWAYS AS MOTORISTS**
- **NOTE THAT ALL ROADWAYS EITHER SIGNED OR UNSIGNED ARE KNOWN AS A "SHARED ROADWAY"**

SIGN LOCATION CRITERIA:

Since there are no national or local standards for the placement of the Share the Road signs, the following items are suggestions that might be considered when deciding on a location for these signs:

- High bicyclist / motorist collision rate or number
- High bicycle and automobile traffic
- High bicyclist / motorist speed differential
- Bicyclists' perceived need
- Lanes with narrow shoulder
- Conflict points, including intersections and interchanges
- Known bicycle routes (whether signed or not signed)
- City / County borders, or other transition areas

GETTING SIGNS INSTALLED:

- Volunteers or bicycle groups may be sought to help with sign placement and/or donations for purchase, if inadequate funding is available at the local city and county levels.
- Even though a donor's name would not be listed on the sign, the donor names could be listed on the bicycle & pedestrian web site.

W11-1 / W16-1P SIGNS
"SHARE THE ROAD" WITH BICYCLISTS, SIGN ASSEMBLY. YELLOW BACKGROUND SHOWN. (A FLOURESCENT YELLOW-GREEN BACKGROUND COLOR IS ALSO AVAILABLE)
Source: 2009 Edition of the Manual for Uniform Traffic Control Devices for Streets & Highways, FHWA

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FIGURE 4

THE FOLLOWING INFORMATION IS OBTAINED FROM THE FHWA'S UNIVERSITY COURSE ON BICYCLE & PEDESTRIAN TRANSPORTATION, LESSON 14, SHARED ROADWAYS, JULY 2006, Page 2, Section 14.2, Starting at Paragraph 2:

In the United States, most shared roadways have no provisions for bicycle travel and are perceived by many bicyclists to be unsafe or at least uninviting. However, there are some design measures that can be taken to ensure that shared roadways accommodate bicyclists safely and efficiently.

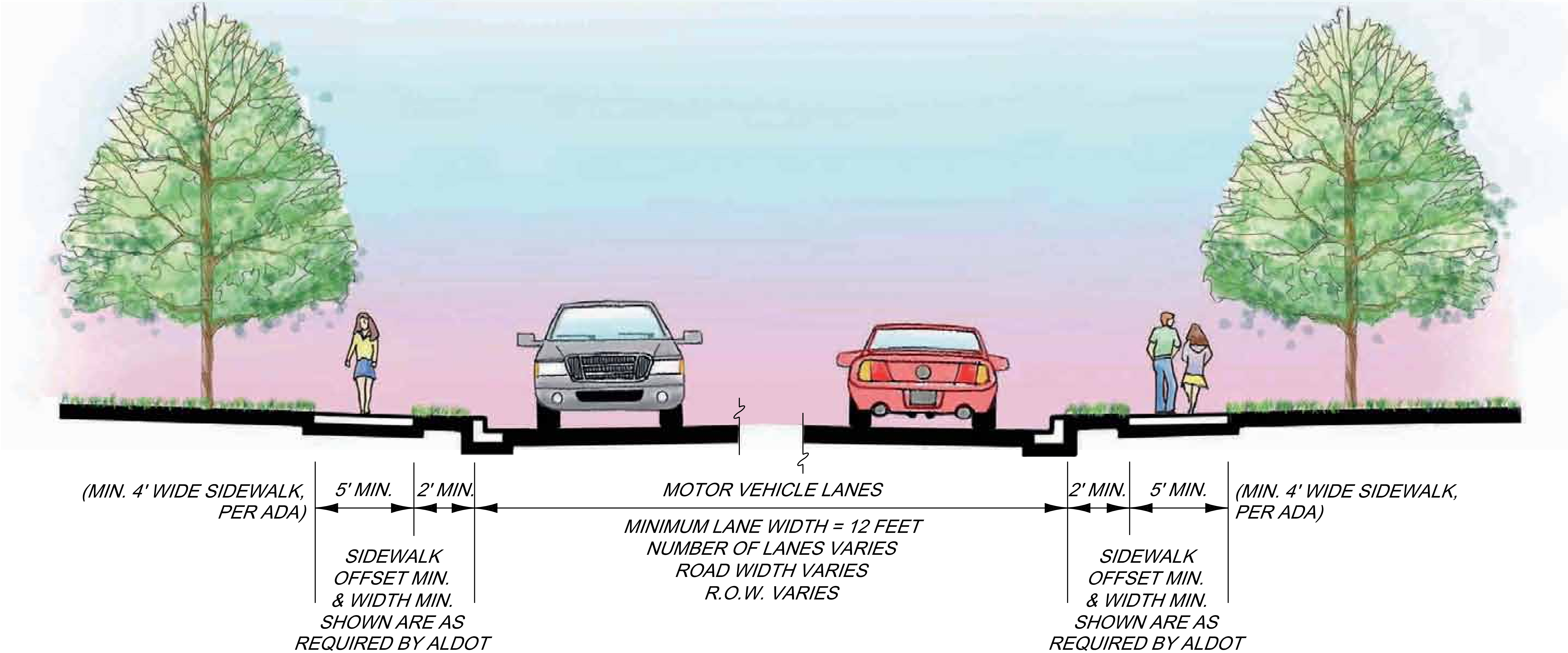
There are no specific bicycle standards for most shared roadways; they are simply the roads that currently exist as local urban or rural roads and highways. Mile for mile, shared roadways are the most common bikeway type. Shared roadways are suitable in urban areas on streets with low speeds—40 kilometers per hour (km/h) (25 miles per hour (mi/h)) or less - or low traffic volumes (3,000 vehicles per day or less, depending on speed and land use). In rural areas, the suitability of a shared roadway decreases as traffic speeds and volumes increase, especially on roads with poor sight distances.

Where bicycle use or demand is potentially high, roads should be widened to include paved shoulders or shoulder bikeways if the travel speeds and volumes on the roadway are high. Many urban local streets carry excessive traffic volumes at speeds higher than they were designed to carry. These can function as shared roadways if traffic speeds and volumes are reduced.

SHARED-USE ROADWAY (BIKING ALLOWED WITH REGULAR ROAD LANE WIDTH)

NOT TO SCALE

Sources:
- The Oregon Bicycle & Pedestrian Plan, Oregon Dept. of Transportation, 1995
- FHWA University Course on Bicycle & Pedestrian Transportation, Lesson 14: Shared Roadways, July 2006
- A "Share-The-Road Program" for Sacramento, California, Proposed By SABA, August 2004



APPLICABLE ROADWAYS:

URBAN PRINCIPAL ARTERIALS:

1. AL HWY 52W (HARTFORD HWY.)
   - ROSS CLARK CIRCLE TO CITY LIMITS
2. E. MAIN STREET (U.S. 84E)
   - SOUTH OATES TO CITY LIMITS
3. W. MAIN STREET (U.S. 84W)
   - ROSS CLARK CIRCLE TO ROSS CLARK CIRCLE
4. U.S. 231 (NORTH & SOUTH)
   - INSIDE ROSS CLARK CIRCLE
5. REEVES STREET (U.S. 431N)
   - U.S. 231 BUS. TO ROSS CLARK CIRCLE

URBAN MINOR ARTERIALS:

1. BURDESHAW STREET (EAST)
2. CHEROKEE (NORTH)
3. CHOCTAW
4. DENTON ROAD
   - INSIDE ROSS CLARK CIRCLE

URBAN MINOR ARTERIALS, CONT'D.:

5. HONEYSUCKLE ROAD
   - NORTH OF HARTFORD HWY.
6. THIRD AVE.
   - LAFAYETTE TO ROSS CLARK CIRCLE
7. WESTGATE PARKWAY

COLLECTOR STREETS:

1. 6TH AVE.
2. ALEXANDER DRIVE
3. ROCKY BRANCH ROAD
4. ROLLINS AVE.
5. STADIUM STREET

LOCAL STREETS:

1. ALLEN ROAD
2. BASIN AVE.

LOCAL STREETS, CONT'D.:

3. BAYSHORE AVE.
4. BROOKSIDE DRIVE
5. BUENA VISTA DRIVE
6. BURBANK STREET
7. CANARY STREET
8. CARROLL STREET
9. COE DAIRY ROAD
10. COMER STREET
11. DEXTER STREET
12. GARLAND STREET
13. GRANT STREET
14. HAISTEN DRIVE
15. HEDSTROM DRIVE
16. HODGESVILLE ROAD
17. LAKE STREET
18. LINDEN STREET
19. MENDHEIM DRIVE
20. MOSS STREET

LOCAL STREETS, CONT'D.:

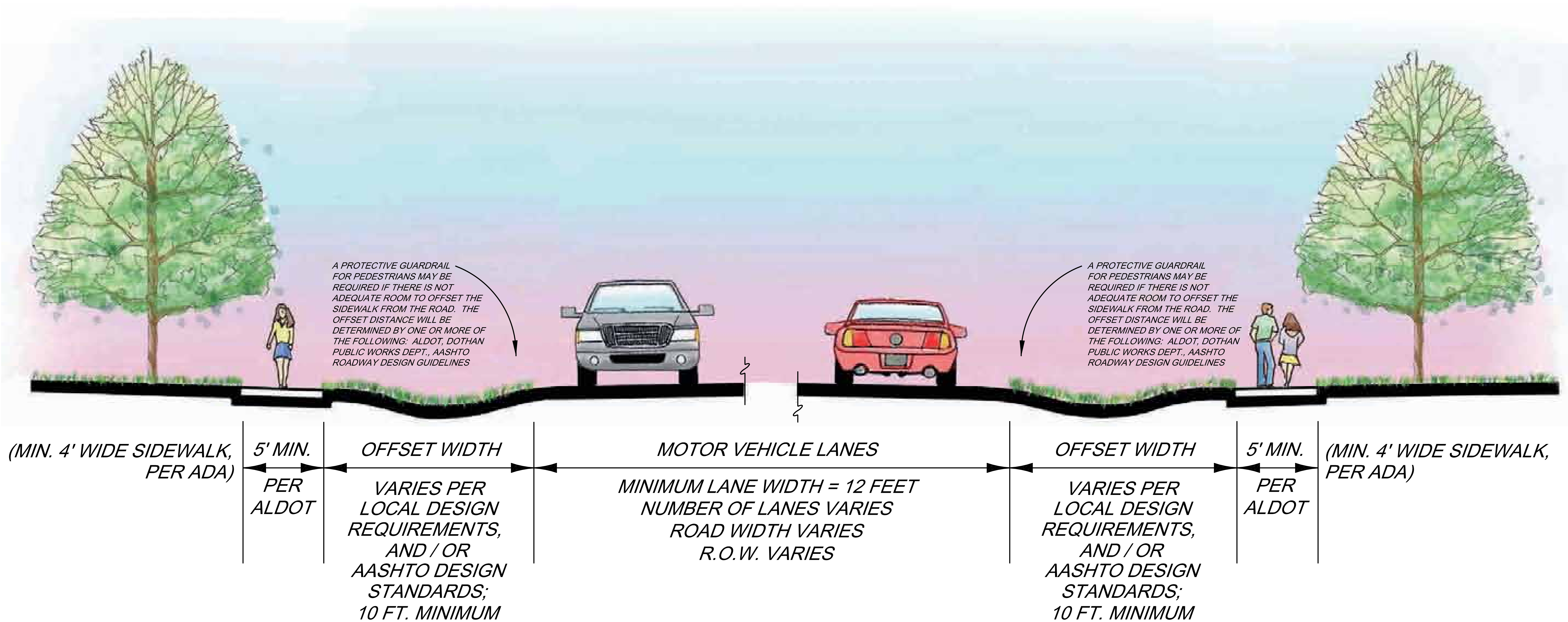
21. NORTHVIEW HIGH SCHOOL ROAD
22. PRYOR STREET (PORTION)
23. ROLLINS AVE.
24. SEQUOYAH DRIVE
25. STADIUM STREET
26. STRINGER STREET
27. SUNSET DRIVE
28. STATE AVE.
29. TATE DRIVE
30. TECHNOLOGY DRIVE
31. WILDER AVE.
32. WOODBURN DRIVE
33. WOODLAND DRIVE

walk and bike DOTHAN

FIGURE 5

SIDEWALK ON STREET WITH CURB & GUTTER (PARKING PROHIBITED)

NOT TO SCALE



APPLICABLE ROADWAYS:

URBAN PRINCIPAL ARTERIALS:

1. AL HWY 53W (EAST COTTONWOOD)
   - SOUTH OATES TO ROSS CLARK CIRCLE
2. W. MAIN STREET (U.S. 84W)
   - ROSS CLARK CIRCLE TO CITY LIMITS
3. U.S. 231 (NORTH & SOUTH)
   - ROSS CLARK CIRCLE TO CITY LIMITS
4. ROSS CLARK CIRCLE
   - ALL AREAS

URBAN MINOR ARTERIALS:

1. BRANNON STAND ROAD (NORTH & SOUTH)
2. CAMPBELLTON HWY.
3. FORTNER STREET
   - OATES TO ROSS CLARK CIRCLE
4. FORTNER STREET
   - ROSS CLARK CIRCLE TO CITY LIMITS

URBAN MINOR ARTERIALS, CONT'D.:

5. J. D. ODOM ROAD
   - U.S. 84 TO MURPHY MILL ROAD
6. J. D. ODOM ROAD
   - MURPHY MILL ROAD TO U.S. 231
7. KINSEY ROAD
8. PARK AVE. (SOUTH)
9. PREVATT ROAD

COLLECTOR STREETS:

1. BEVERLYE ROAD (NORTH & SOUTH)
2. BRACEWELL AVE.
3. COWARTS ROAD
4. FLOWERS CHAPEL ROAD
5. HONEYSUCKLE ROAD
   - SOUTH OF HARTFORD HWY
6. LUCY GRADE ROAD

COLLECTOR STREETS, CONT'D.:

7. MURPHY MILL ROAD
8. TRAWICK ROAD
9. TIMBERS ROAD
10. TAYLOR ROAD

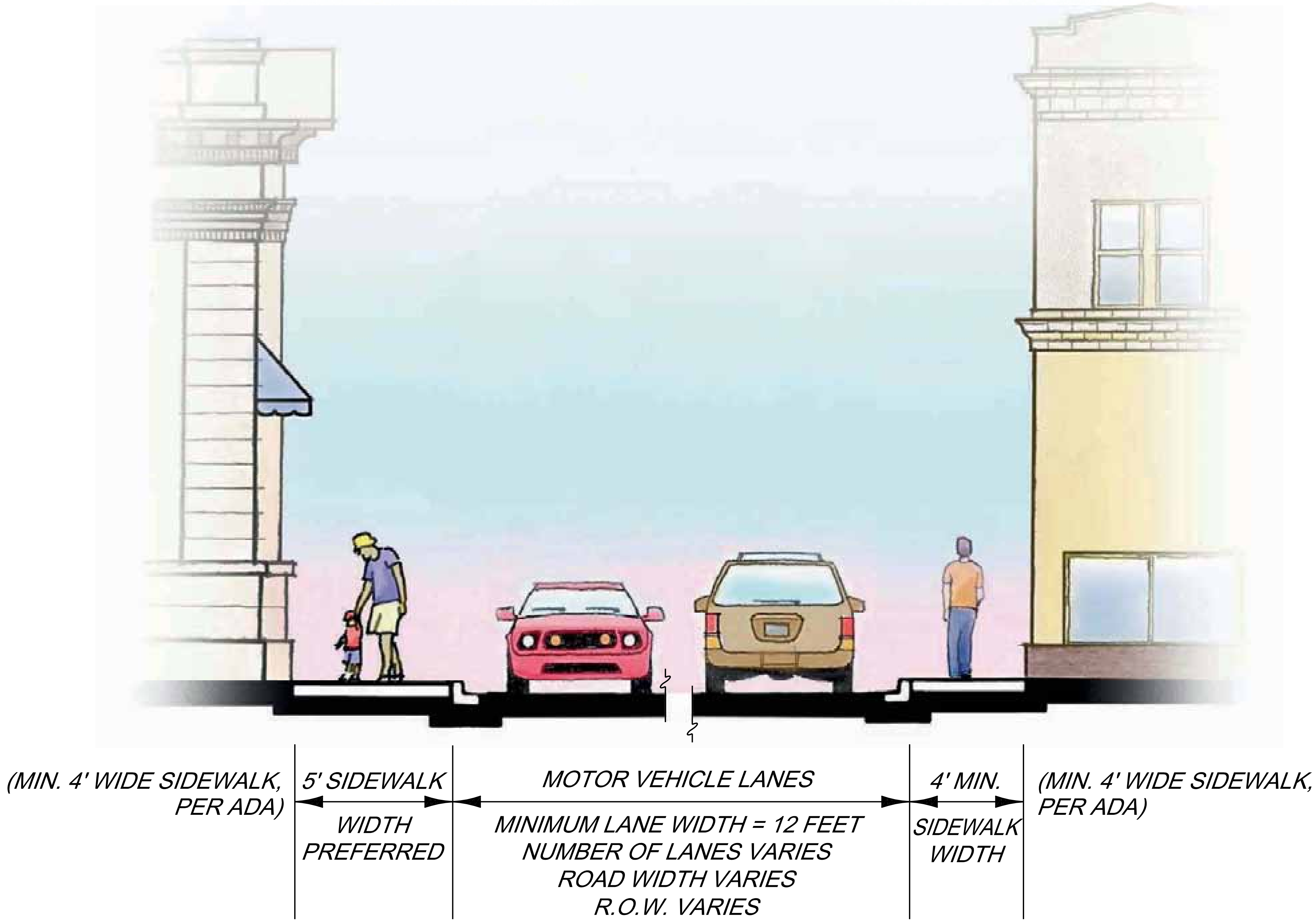
LOCAL STREETS:

1. BOB HALL ROAD
2. EARLINE DRIVE
3. KELLY SPRINGS ROAD
4. SANITARY DAIRY ROAD
5. WESTGATE PARK ENTRANCE
   - EXTENSION OF CHOCTAW STREET

FIGURE 6

SIDEWALK ON STREET WITHOUT CURB & GUTTER (PARKING PROHIBITED)

NOT TO SCALE



APPLICABLE ROADWAYS:

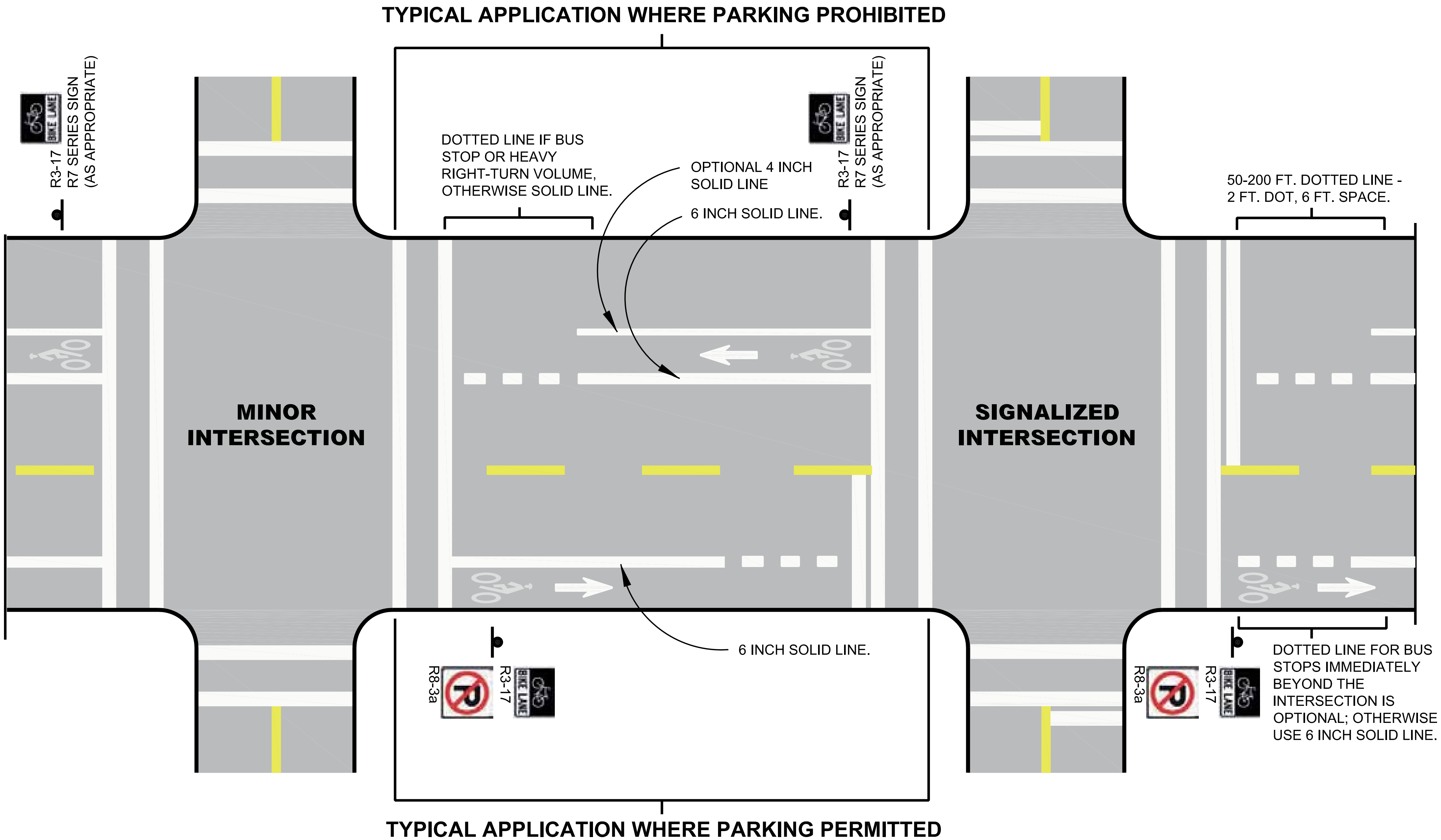
URBAN PRINCIPAL ARTERIALS:

1. EAST & WEST MAIN STREET (U.S. 84)
   - PORTIONS INSIDE ROSS CLARK CIRCLE
2. U.S. 231 (NORTH & SOUTH)
   - PORTIONS INSIDE ROSS CLARK CIRCLE
3. REEVES HEADLAND HWY. (U.S. 431)
   - PORTIONS INSIDE ROSS CLARK CIRCLE

FIGURE 7

URBAN SIDEWALK ON STREET WITH NARROW WIDTH R.O.W. (PARKING PROHIBITED)

NOT TO SCALE



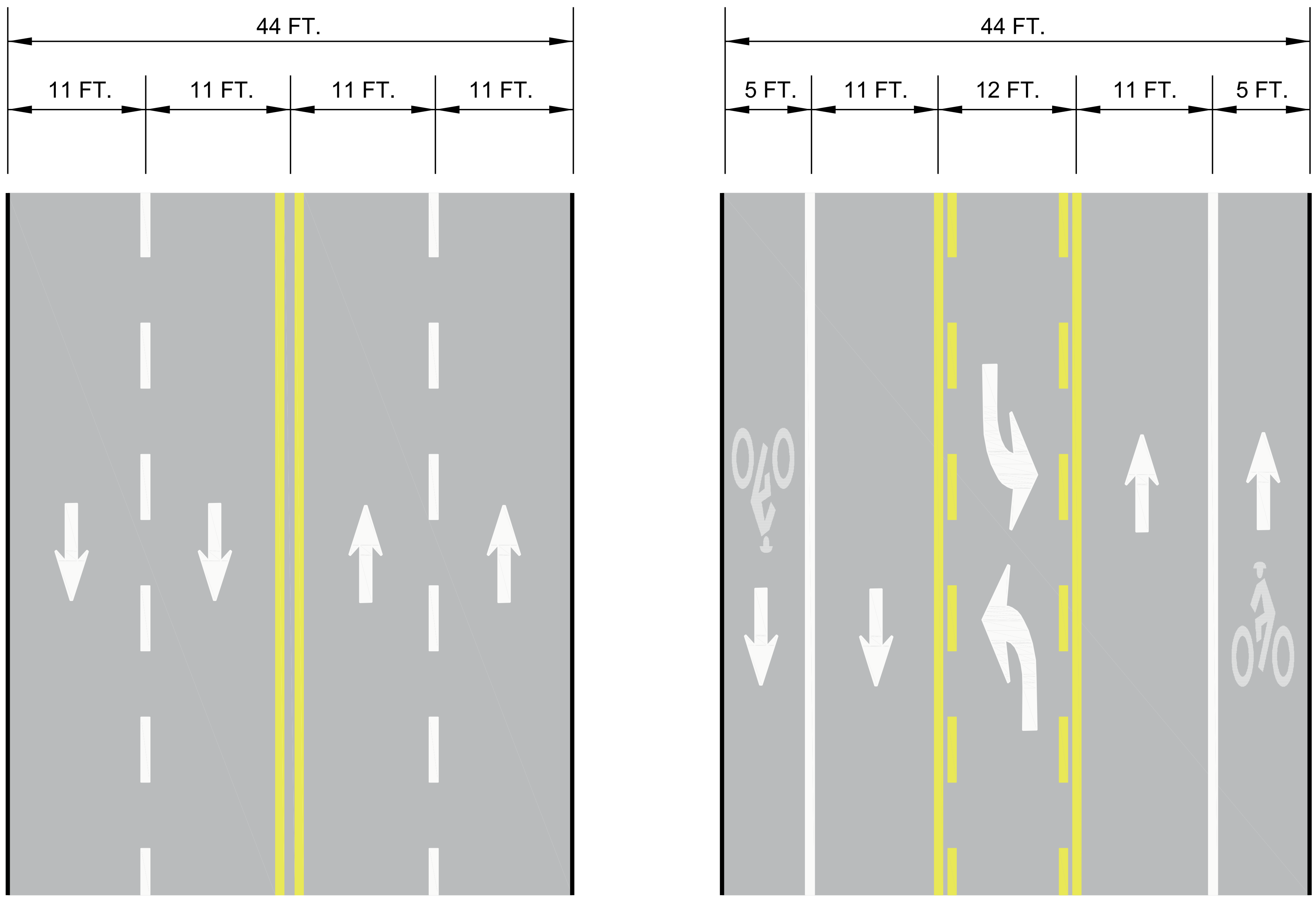
TYPICAL MUTCD R7 SERIES SIGNS:

FIGURE 8

TYPICAL BIKE LANE PAVEMENT MARKINGS (FOR TWO-WAY STREET)

NOT TO SCALE

Source: Guide for the Development of Bicycle Facilities, AASHTO, 1999



BEFORE CONVERSION TO ROAD DIET

AFTER CONVERSION TO ROAD DIET

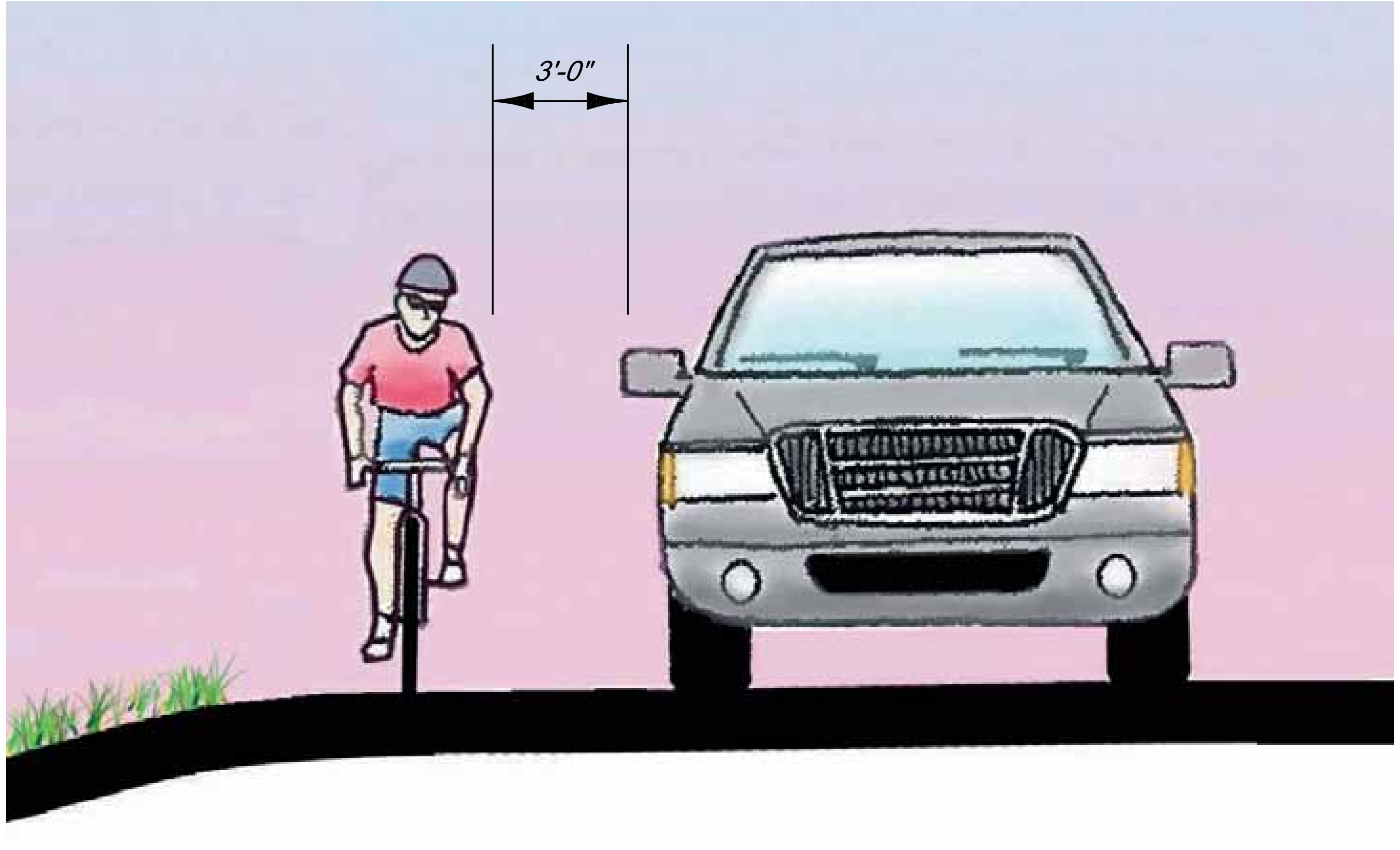
NOTE:
EVEN THOUGH A "ROAD DIET" IS NOT RECOMMENDED FOR ANY OF THE PROPOSED BIKE LANE ROUTES WITHIN DOTHAN, IT IS SHOWN HERE FOR INFORMATION PURPOSES. FOR A ROADWAY DIET TO WORK WITHOUT CONGESTION, TRAFFIC STUDIES PERFORMED BY THE FHWA HAVE SHOWN THAT TRAFFIC VOLUMES SHOULD BE LESS THAN 20,000 VEHICLES PER DAY.

FIGURE 9

ROAD DIET BICYCLE LANE CONVERSION (FOR AVERAGE & LOW TRAFFIC VOLUME ROADWAYS)

NOT TO SCALE

Source: FHWA Highway Safety Information System; Evaluation of Lane Reduction "Road Diet" Measures and Their Effects on Crashes and Injuries.



"3-FEET OF DISTANCE WHEN PASSING"

- **THE "3-FEET RULE" HAS BECOME A STATE LAW IN PARTS OF THE UNITED STATES.**
- **A "3-FEET" PASSING DISTANCE REQUIRED BETWEEN MOTORIST AND BICYCLIST IS CURRENTLY NOT A STATE LAW IN ALABAMA, ALTHOUGH ALABAMA DOES HAVE A "SAFE DISTANCE OVERTAKING" LAW. (PLEASE SEE BELOW)**
- **IF DESIRED, LAW COULD BE PASSED LOCALLY IN CITIES AND TOWNS**
- **LAW HAS PROVEN TO DECREASE BICYCLE FATALITIES**

ARTICLE 4: DRIVING ON AND USE OF ROADWAYS GENERALLY; OVERTAKING AND PASSING.

ALABAMA SAFE DISTANCE OVERTAKING LAW:

Section 32-5A-82

Overtaking vehicle on left.

The following rules shall govern the overtaking and passing of vehicles proceeding in the same direction, subject to those limitations, exceptions and special rules hereinafter stated:

(1) The driver of a vehicle overtaking another vehicle proceeding in the same direction shall pass to the left thereof at a safe distance and shall not again drive to the right side of the roadway until safely clear of the overtaken vehicle.

(2) Except when overtaking and passing on the right is permitted, the driver of an overtaken vehicle shall give way to the right in favor of the overtaking vehicle on audible signal and shall not increase the speed of his vehicle until completely passed by the overtaking vehicle.

(Acts 1980, No. 80-434, p. 604, §3-103.)

STATES THAT ADVOCATE THE "3-FEET RULE" THROUGH STATE LAW (as of June 2011):

- **ARIZONA**
- **ARKANSAS**
- **COLORADO**
- **FLORIDA**
- **GEORGIA**
- **ILLINOIS**
- **KANSAS**
- **LOUISIANA**
- **MAINE**
- **MARYLAND**
- **MASSACHUSETTS**
- **MINNESOTA**
- **MISSISSIPPI**
- **NEVADA**
- **NEW HAMPSHIRE**
- **OKLAHOMA**
- **TENNESSEE**
- **UTAH**
- **WISCONSIN**

Source: 3-Feet Please @ www.3feetplease.com

FIGURE 10

3-FEET SAFE DISTANCE PASSING

NOT TO SCALE

Sources:

- State Code of Alabama: Article 4, Section 32-5A-82, Overtaking Vehicle on Left
- 3-Feet Please @ www.3feetplease.com

TYPICAL GREENWAY, SHARED-USE OFF-ROAD TRAIL SECTION

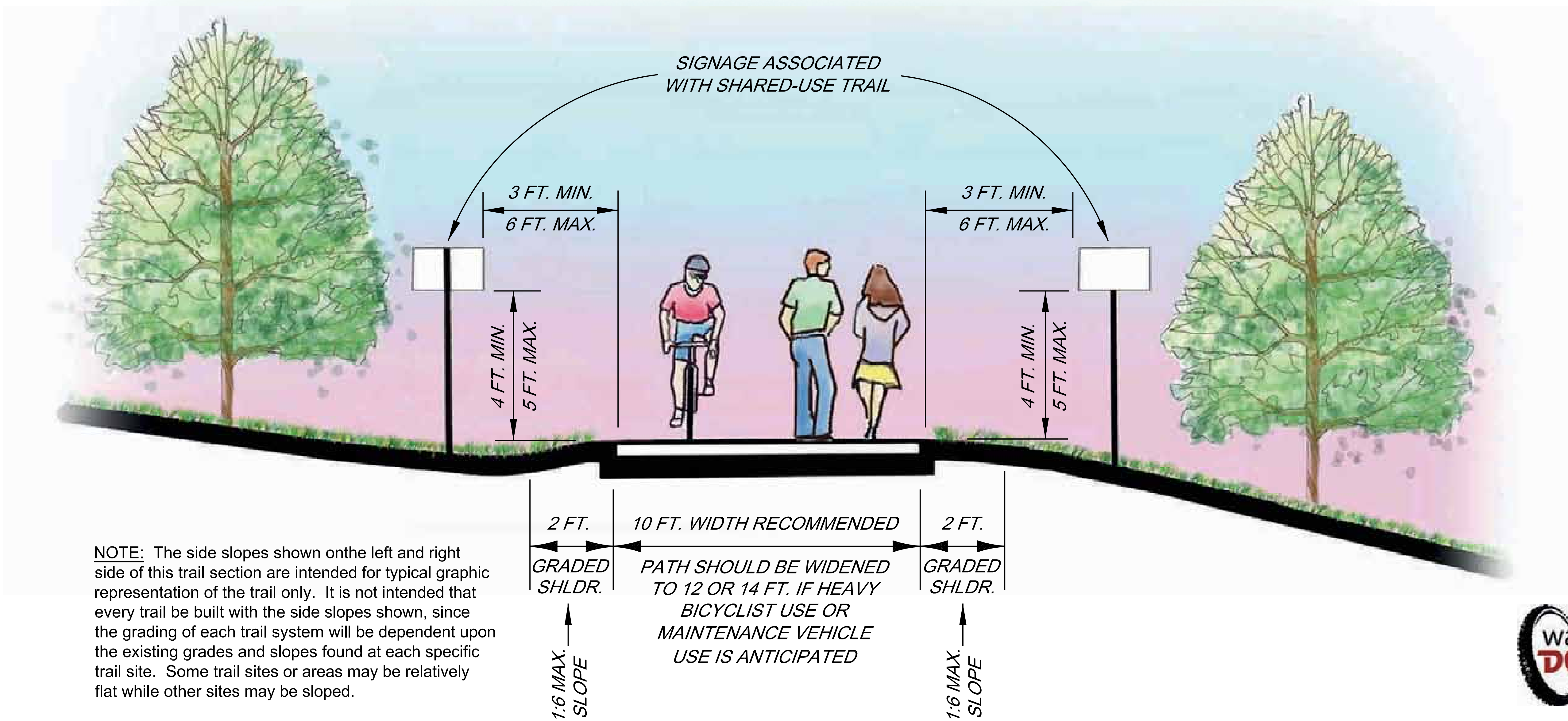


FIGURE 11

SHARED-USE TRAIL / GREENWAY (TRAIL SHARED BY BICYCLISTS & PEDESTRIANS)

NOT TO SCALE

Source: Guide for the Development of Bicycle Facilities, AASHTO, 1999

NOTE:
THREE (3) OFF ROAD / SHARED-USE TRAILS (FOR BOTH BICYCLING & WALKING) ARE PROPOSED ON THE WEST SIDE OF DOTHAN. TWO (2) SHARED-USE TRAILS ARE PROPOSED ALONGSIDE CREEKS / RIVERS, WHILE THE THIRD TRAIL IS PROPOSED WITHIN A WIREGRASS ELECTRIC COOPERATIVE TRANSMISSION LINE R.O.W. THE SOUTHERN-MOST SHARED-USE TRAIL IS PROPOSED ALONGSIDE BEAVER CREEK, WITHIN THE ALREADY CLEARED SANITARY SEWER R.O.W. THAT SERVES THE SEWAGE TREATMENT PLANT LOCATED ON FLOWERS CHAPEL ROAD. THE BEAVER CREEK TRAIL IS PROPOSED TO START AT HONEYSUCKLE ROAD AND END AT FLOWERS CHAPEL ROAD TO THE WEST. NORTH OF U.S. HWY 84W IS THE SECOND PROPOSED SHARED-USE TRAIL. THIS TRAIL RUNS ALONGSIDE ROCK CREEK WHICH FLOWS INTO LITTLE CHOCTAWHATCHEE CREEK, WHICH FLOWS INTO THE CHOCTAWHATCHEE RIVER (THE CHOCTAWHATCHEE / ROCK CREEK TRAIL). THE CHOCTAWHATCHEE / ROCK CREEK TRAIL IS PROPOSED TO START AT WESTGATE PARKWAY AND END AT NORTH BRANNON STAND ROAD TO THE WEST. THE THIRD PROPOSED SHARED-USE TRAIL IS LOCATED SLIGHTLY SOUTH-EAST OF KELLY SPRINGS ELEMENTARY SCHOOL, WITHIN AN ELECTRICAL TRANSMISSION LINE R.O.W. THE KELLY SPRINGS TRAIL IS PROPOSED TO START AT THE WESTERN BOUNDARY OF THE DOTHAN PAVILION MALL AND END AT NORTH BRANNON STAND ROAD TO THE WEST.

FIGURE 12:

BIKEWAYS LOCATED ON ROADWAYS:

ROADWAY TYPE AND NAME:	APPLICABLE DESIGN GUIDELINE FIGURE:		
	1	2	3
URBAN PRINCIPAL ARTERIALS:			
AL HWY 52W (HARTFORD HWY): - ROSS CLARK CIRCLE TO CITY LIMITS	●		
BURDESHAW STREET (WEST) - PORTIONS			●
EAST MAIN STREET (US 84E) - SOUTH OATES TO CITY LIMITS	●		
WEST MAIN STREET (US 84W) - SOUTH OATES TO ROSS CLARK CIRCLE	●		
WEST MAIN STREET (US 84W) - ROSS CLARK CIRCLE TO CITY LIMITS		●	
REEVES STREET / HEADLAND HWY. (US 431N) - ROSS CLARK CIRCLE TO CITY LIMITS		●	
REEVES STREET / HEADLAND HWY. (US 431N) - US 231 BUS. TO ROSS CLARK CIRCLE	●		
ST. ANDREWS STREET (NORTH) - RAILROAD DEPOT AREA (SMALL PORTION)			●
TROY STREET - PORTIONS			●
URBAN MINOR ARTERIALS:			
ALICE STREET SOUTH	●		
BURDESHAW STREET (EAST AND WEST)	●		
BRANNON STAND ROAD (NORTH AND SOUTH)		●	
CAMPBELLTON HWY.		●	
CHOCTAW	●		
DENTON ROAD - OUTSIDE ROSS CLARK CIRCLE	●		
FORRESTER ROAD		●	
FORTNER STREET (WEST AND EAST LAFAYETTE) - 8TH AVE. TO ROSS CLARK CIRCLE		●	
FORTNER STREET - ROSS CLARK CIRCLE TO CITY LIMITS		●	

FIGURE 12, CONTINUED:

BIKEWAYS LOCATED ON ROADWAYS:

ROADWAY TYPE AND NAME:	APPLICABLE DESIGN GUIDELINE FIGURE:		
	1	2	3
URBAN PRINCIPAL ARTERIALS, CONTINUED:			
HEADLAND AVE. - NORTH OF HARTFORD HWY.	●		
HEADLAND AVE. - OUTSIDE ROSS CLARK CIRCLE		●	
HONEYSUCKLE ROAD - NORTH OF HARTFORD HWY.	●		
J.D. ODOM ROAD - US 84 TO MURPHY MILL ROAD		●	
J.D. ODOM ROAD - MURPHY MILL ROAD TO US 231		●	
KINSEY ROAD		●	
MANCE NEWTON ROAD		●	
NAPIER FIELD ROAD		●	
OMUSEE ROAD		●	
PARK AVE. (NORTH AND SOUTH)	●		
PREVATT ROAD		●	
RANGE STREET - ADAMS TO ROSS CLARK CIRCLE	●		
RONEY ROAD		●	
SAUNDERS ROAD (EAST)		●	
ST. ANDREWS STREET - SOUTH OF US 84	●		
ST. ANDREWS STREET - NORTH OF US 84	●		
SELMA STREET (EAST AND WEST)	●		
THIRD AVE. - LAFAYETTE TO ROSS CLARK CIRCLE	●		
THIRD AVE. - ROSS CLARK CIRCLE TO CITY LIMITS		●	

FIGURE 12, CONTINUED:

BIKEWAYS LOCATED ON ROADWAYS:

ROADWAY TYPE AND NAME:	APPLICABLE DESIGN GUIDELINE FIGURE:		
	1	2	3
URBAN PRINCIPAL ARTERIALS, CONTINUED:			
WEBB ROAD	●		
WESTGATE PARKWAY	●		
COLLECTOR STREETS:			
BAYSHORE AVE.	●		
BEVERLYE ROAD (NORTH AND SOUTH)		●	
BOB HALL ROAD		●	
CHICKASAW	●		
DEXTER STREET	●		
FLOWERS CHAPEL ROAD		●	
FLYNN ROAD		●	
GREY HODGES ROAD (EAST AND WEST)		●	
HATTON ROAD		●	
HONEYSUCKLE ROAD - SOUTH OF HARTFORD HWY.		●	
LUCY GRADE ROAD		●	
MURPHY MILL ROAD		●	
RANGE STREET - SOUTH OF EAST ADAMS	●		
ROCKY BRANCH ROAD (PORTION)	●		
ROCKY BRANCH ROAD (PORTION)		●	
TAYLOR ROAD		●	

FIGURE 12, CONTINUED:

BIKEWAYS LOCATED ON ROADWAYS:

ROADWAY TYPE AND NAME:	APPLICABLE DESIGN GUIDELINE FIGURE:		
	1	2	3
COLLECTOR STREETS, CONTINUED:			
TIMBERS DRIVE	●		
TRAWICK ROAD		●	
WHATLEY DRIVE (PORTION)		●	
WHATLEY DRIVE (PORTION)	●		
LOCAL STREETS:			
BRUNER ROAD		●	
BUENA VISTA DRIVE	●		
BURBANK STREET	●		
BLACKMAN ROAD		●	
BROOKSIDE DRIVE	●		
CARROLL DRIVE (EAST)	●		
COE DAIRY ROAD	●		
COLLEGE STREET (NORTH)	●		
COWARTS ROAD		●	
DREW ROAD		●	
DUNN ROAD		●	
ENNIS ROAD		●	
HEDSTROM DRIVE	●		
KELLY SPRINGS ROAD		●	

FIGURE 12, CONTINUED:

BIKEWAYS LOCATED ON ROADWAYS:

ROADWAY TYPE AND NAME:	APPLICABLE DESIGN GUIDELINE FIGURE:		
	1	2	3
LOCAL STREETS, CONTINUED:			
LENA STREET	●		
MONTANA STREET	●		
MOSS STREET	●		
NORTHVIEW HIGH SCHOOL ROAD	●		
PRYOR STREET (PORTION)	●		
PRYOR STREET (PORTION)		●	
PRYOR STREET (PORTION)			●
REID STREET	●		
ROLLINS AVE.	●		
ROWLAND ROAD		●	
SANITARY DAIRY ROAD		●	
SHADY LANE (NORTH)	●		
TECHNOLOGY DRIVE	●		
WESTGATE PARK ENTRANCE - EXTENSION OF CHOCTAW STREET		●	
WILSON STREET (EAST)	●		
WOODBURN DRIVE (NORTH)	●		

FIGURE 13:

WALKWAYS LOCATED ON ROADWAYS:

ROADWAY TYPE AND NAME:	APPLICABLE DESIGN GUIDELINE FIGURE:		
	5	6	7
URBAN PRINCIPAL ARTERIALS:			
AL HWY. 52W (HARTFORD HWY) - ROSS CLARK CIRCLE TO CITY LIMITS	●		
EAST MAIN STREET (US 84E) - SOUTH OATES TO CITY LIMITS	●		
WEST MAIN STREET (US 84W) - ROSS CLARK CIRCLE TO ROSS CLARK CIRCLE	●		
WEST MAIN STREET (US 84W) - ROSS CLARK CIRCLE TO CITY LIMITS		●	
EAST AND WEST MAIN STREET - PORTIONS INSIDE ROSS CLARK CIRCLE			●
AL HWY. 53W (EAST COTTONWOOD) - SOUTH OATES TO ROSS CLARK CIRCLE		●	
US 231 (NORTH AND SOUTH) - INSIDE ROSS CLARK CIRCLE	●		
US 231 (NORTH AND SOUTH) - ROSS CLARK CIRCLE TO CITY LIMITS		●	
US 231 (NORTH AND SOUTH) - PORTIONS INSIDE ROSS CLARK CIRCLE			●
REEVES STREET / HEADLAND HWY. (US 431) - PORTIONS INSIDE ROSS CLARK CIRCLE			●
REEVES STREET (US 431N) - US 231 BUS. TO ROSS CLARK CIRCLE	●		
ROSS CLARK CIRCLE - ALL AREAS		●	
URBAN MINOR ARTERIALS:			
BURDESHAW STREET (EAST)	●		
BRANNON STAND ROAD (NORTH AND SOUTH)		●	
CAMPBELLTON HWY.		●	
CHEROKEE (NORTH)	●		
CHOCTAW	●		
DENTON ROAD - INSIDE ROSS CLARK CIRCLE	●		

FIGURE 13, CONTINUED:

WALKWAYS LOCATED ON ROADWAYS:

ROADWAY TYPE AND NAME:	APPLICABLE DESIGN GUIDELINE FIGURE:		
	5	6	7
URBAN MINOR ARTERIALS, CONTINUED:			
FORTNER STREET - OATES TO ROSS CLARK CIRCLE		●	
FORTNER STREET - ROSS CLARK CIRCLE TO CITY LIMITS		●	
HONEYSUCKLE ROAD - NORTH OF HARTFORD HWY.	●		
J.D. ODOM ROAD - US 84 TO MURPHY MILL ROAD		●	
J.D. ODOM ROAD - MURPHY MILL ROAD TO US 231		●	
KINSEY ROAD		●	
PARK AVE. (SOUTH)		●	
PREVATT ROAD		●	
THIRD AVE. - LAFAYETTE TO ROSS CLAEK CIRCLE	●		
WESTGATE PARKWAY	●		
COLLECTOR STREETS:			
6TH AVE.	●		
ALEXANDER DRIVE	●		
BEVERLYE ROAD (NORTH AND SOUTH)		●	
BRACEWELL AVE.		●	
COWARTS ROAD		●	
FLOWERS CHAPEL ROAD		●	
HONEYSUCKLE ROAD - SOUTH OF HARTFORD HWY.		●	
LUCY GRADE ROAD		●	

FIGURE 13, CONTINUED:

WALKWAYS LOCATED ON ROADWAYS:

ROADWAY TYPE AND NAME:	APPLICABLE DESIGN GUIDELINE FIGURE:		
	5	6	7
COLLECTOR STREETS, CONTINUED:			
MURPHY MILL ROAD		●	
ROCKY BRANCH ROAD	●		
ROLLINS AVE.	●		
STADIUM STREET	●		
TAYLOR ROAD		●	
TIMBERS ROAD		●	
TRAWICK ROAD		●	
LOCAL STREETS:			
ALLEN ROAD	●		
BASIN AVE.	●		
BAYSHORE AVE.	●		
BOB HALL ROAD		●	
BROOKSIDE DRIVE	●		
BUENA VISTA DRIVE	●		
BURBANK STREET	●		
CANARY STREET	●		
CARROLL STREET	●		
COE DAIRY ROAD	●		
COMER STREET	●		

FIGURE 13, CONTINUED:

WALKWAYS LOCATED ON ROADWAYS:

ROADWAY TYPE AND NAME:	APPLICABLE DESIGN GUIDELINE FIGURE:		
	5	6	7
LOCAL STREETS, CONTINUED:			
DEXTER STREET	●		
EARLINE DRIVE		●	
GARLAND STREET	●		
GRANT STREET	●		
HAISTEN DRIVE	●		
HEDSTROM DRIVE	●		
HODGESVILLE ROAD	●		
KELLY SPRINGS ROAD		●	
LAKE STREET	●		
LINDEN STREET	●		
MENDHEIM DRIVE	●		
MOSS STREET	●		
NORTHVIEW HIGH SCHOOL ROAD	●		
PRYOR STREET (PORTION)	●		
ROLLINS AVE.	●		
SANITARY DAIRY ROAD		●	
SEQUOYAH DRIVE	●		
STADIUM STREET	●		

FIGURE 13, CONTINUED:

WALKWAYS LOCATED ON ROADWAYS:

ROADWAY TYPE AND NAME:	APPLICABLE DESIGN GUIDELINE FIGURE: 5	6	7
LOCAL STREETS, CONTINUED:			
SUNSET DRIVE	●		
STATE AVE.	●		
TATE DRIVE	●		
TECHNOLOGY DRIVE	●		
WESTGATE PARK ENTRANCE - EXTENSION OF CHOCTAW STREET		●	
WILDER AVE.	●		
WOODBURN DRIVE	●		
WOODLAND DRIVE	●		

Education and Outreach Strategies

Existing Bicycle Education Programs

While no formal bicycle education programs currently exist in Dothan, The League of American Bicyclists (LAB) is an active organization that provides information, maps, and safety education. The organization has developed a wide array of educational safety programs and educational seminars to help develop local programs. This information is continuously updated by the LAB, on their website that can be accessed for the most current educational materials available at: www.bikeleague.org/programs/education

Education and Encouragement Strategies

As with any community activity, public support and involvement will be critical to the successful implementation of an active bicycle and pedestrian program. To this end, the following strategies are proposed.

1. Make the Bicycle and Pedestrian Advisory Committee a permanent committee and expand its membership to include more citizen members. Charge the Committee with promoting bicycle and pedestrian initiatives and assisting in implementation of the Bicycle and Pedestrian Plan.
2. Designate a bicycle / pedestrian coordinator.
3. Create a school education / encouragement program addressing all of the 5-E's of the Safe Routes to School Program (SRTS):
   - Encouragement - uses events and contests to entice students, teachers, parents and the community to try walking and biking. This will require coordination and cooperation between the City, the School Board and individual schools to undertake such events as walk and bike day promotions, contests and activities that encourage biking and walking to school and incentives to students for participation in SRTS activities.
   - Education - teaches students and the community important safety skills and launches neighborhood safety campaign. This program will involve teachers, planners, engineers and law enforcement and could involve bicycle and walking presentations, safety training, preparation of maps showing biking and walking routes between schools and neighborhoods and driver safety programs.
   - Engineering - focuses on creating physical improvements to the infrastructure surrounding schools, reducing speeds and establishing safer crosswalks and pathways. The City's planning and public works staff would assume responsible roles in assuring proper design and construction.
   - Enforcement - uses law enforcement to strengthen neighborhood roadway safety concerns and activities. Activities might include increased patrols, special traffic direction during biking and walking events and crossing guard programs.
   - Evaluation - measures project activities to assure that they remain on time, on target and in demand. Parent surveys could be an adequate way to measure the program.
4. In addition, to the SRTS program, pursue education and outreach programs designed to promote bicycling and walking by explaining existing resources and future proposals. The

program could focus on drivers; current and potential cyclists and pedestrians; students; children and families; school personnel; and employees.

5. Establish a Saturday ride to engage residents of all ages by closing motorized travel on a group of streets to enable people to bike, walk and run in the streets without automobile traffic. Streets could be selected to create a loop ride linking neighborhoods with a popular destination. Many cities have similar events as a way to increase bicycling and walking, promote healthy activity and enhance community involvement.

6. Develop and promote programs to emphasize the need for bicycle and pedestrian safety in Dothan. Education, design and enforcement are major considerations for bicycle and pedestrian safety. The safety program should address critical components for making roadways safer such as helmet use, training children to ride bicycles safely, need for reflective material at night and an overall awareness of roadway dangers by bicyclists, pedestrians and motorists.

7. Conduct periodic surveys to monitor bicycling and walking activity and issues.

Safety

A sense of safety and security is very important to a successful increase in biking and walking. Proper safety revolves around design, interaction between motorized and non-motorized users, education and enforcement. Following are some actions that will help achieve a level of safety and security for bicyclists and pedestrians:

- Increase public awareness of traffic rules for bicyclists, pedestrians and motorists through educational programs.
- Develop a “Share the Road” campaign.
- Request that bicycle and pedestrian safety information be included in driver tests and be distributed with driver license renewals.
- Ensure that city regulations require standards for safe and accessible pedestrian and bicycle facilities.
- Design and construct all facilities to meet standards established by the American Association of State Highway Transportation Officials.
- Provide pedestrian friendly street lighting.
- Make sure that the police department is fully aware of bicycle and pedestrian traffic laws.
- Strictly enforce traffic laws in high bicycle and pedestrian activity areas such as schools and recreation areas.
- Maintain proper maintenance of all streets, sidewalks and trails.
- Provide information to inform property owners of sidewalk maintenance responsibilities.
- Maintain crosswalk striping at the same frequency as roadway striping.

- Develop a program of traffic calming.

Complete Streets

The following principles regarding complete streets are provided as guidance from the National Complete Streets Coalition:

- Complete streets are designed and operated to enable safe access users. Pedestrians, bicyclists, motorists and transit riders of all ages and abilities must be able to safely move along and across a complete street.

- Creating complete streets means changing the policies and practices of transportation planning and construction.

- A Complete Streets policy ensures that the entire right-of-way is routinely designed and operated to enable safe access for all users.

- Transportation agencies must ensure that all road projects result in a complete street appropriate to local context and needs.

The National complete Street Coalition has identified ten elements of a comprehensive complete streets policy. They are:

- VISION: Includes a vision of how and why the community wants to complete its streets.

- SPECIFIES ALL USERS: Specifies that 'all users' includes pedestrians, bicyclists and transit passengers of all ages and abilities, as well as trucks, buses, emergency vehicles and automobiles.

- ALL AGENCIES AND ALL ROADS: Is understood by all those responsible for transportation to cover all roads.

- ALL PROJECTS: Applies to both new and retrofit projects, including design, planning, maintenance and operations for the entire right-of-way.

- EXCEPTIONS: Makes any exceptions specific and sets a clear procedure that requires high-level approval of exceptions.

- DESIGN CRITERIA: Directs the use of the latest and best design criteria and guidelines while recognizing the need for flexibility in balancing user needs.

- CONTEXT SENSITIVE: Directs that Complete Streets solutions will complement the context of the community.

- PERFORMANCE MEASURES: Establishes performance standards with measurable outcomes.

- IMPLEMENTATION: Includes specific next steps for implementation of the policy.

Source: The above guidance principles and policy statements are from the National Complete Streets Coalition.

The City of Dothan Long Range Development Plan, A Sense of New Beginnings provides a long-range guide for the development of Dothan. This Plan was recently adopted on March 16, 2011 and contains a section on complete streets with the intent of making it easier to travel in Dothan by walking and bicycling and implementation recommendations related to complete streets. These sections of the Plan are incorporated into the Bicycle and Pedestrian Plan as the complete streets policy that is set forth is an appropriate component of planning for bicycling and walking. The following is from the Long Range Development Plan:

"*As our community grows, so does the most basic component of our infrastructure; streets. Streets are a significant component of the public realm, making up a majority of the total land use of our City. They contribute in a major way to the livability of our community. For many years, streets were designed and constructed primarily to move cars rather than people. The result can be seen in the sprawl of our communities, in traffic congestion and in the fact that there are few places that are safe and convenient for pedestrians, bicyclists, those dependent on a wheelchair or transit riders. Our City streets should be designed for everyone regardless of age or mode of transportation and not be mean and hostile.*

Many feel that streets should be designed with the complete movement in mind, especially as our City sprawls out into the countryside leaving limited opportunity for other modes of travel. Street design should focus on being safer, more livable, and welcoming to everyone. A complete street is one that is designed and operated for all users. Instituting a complete streets policy ensures that transportation planners and engineers consistently design and operate the entire roadway with all users in mind - including bicyclists, public transportation vehicles and riders, and pedestrians of all ages and abilities.

A recent federal survey found that seventy-five percent (75%) of walking trips take place on roads without sidewalks or shoulders, and only about five percent (5%) of bicycle trips occur on bike lanes. The survey also revealed that the percentage of accidents involving pedestrians and bicyclists is disproportionately high compared to the percentage of actual trips taken. Those accidents occur on roads that lack sidewalks or crosswalks, where the lanes are too narrow to share with bicyclists, where there is little or no room for transit riders, and where the sidewalks were not designed for people with disabilities; essentially an incomplete street design.

A Complete Streets policy is a change in the traditional road construction philosophy of a project-by-project consideration of bicycle and pedestrian-friendly design practices. A Complete Streets policy requires designers of all road construction and improvement projects to begin by evaluating how the right-of-way serves all who use it. Although the Federal Highway Administration has endorsed this approach since 2000, it has yet to be widely implemented."

The Dothan Long Range Development Plan ranked sidewalks, pedestrian ways and bike trails second in importance regarding concerns related to implementation recommendations. The following is from the Implementation section of the Plan and is related to a complete streets policy.

"2. SIDEWALKS, PEDESTRIAN WAYS and BIKE TRAILS

A recent revision to the Dothan subdivision regulations establishes a clear formula for developers of land to determine when and where sidewalks are required in new subdivisions. Section 90-141 addresses in detail the instances when, the location of, and the dimensions for new sidewalks within new residential neighborhoods.

The opportunity that is overlooked in many cases involves providing a link between commercial development and adjacent residential areas that would support pedestrian and bicycle trips. Such a link would extend the opportunity for surrounding neighborhood residents to walk or ride to and from the development and their homes rather than having to get into their automobiles for the short drive to the center. Pedestrian links between residential communities, work centers and shopping or entertainment centers is an important component of the multi-modal transportation system of a city.

Recommendations:

2a. *Enforce sidewalk requirements established in the subdivision regulations. Revise as appropriate.*

2b. *Participate fully in the development of the Bike/Ped Plan for the City and implement as funding becomes available.*

2c. *Encourage pedestrian and bicycle links between shopping and entertainment destinations in the development plan approval process.*

2d. *Use incentives such as reduced street width or development density to encourage sidewalk design and construction in excess of the minimum required.*

2e. *Promote design and construction of streets and walkways to be safe and pedestrian friendly and incorporate in-line public spaces throughout the network.*

2f. *Develop streetscape plans and overlay districts for highly visible major roadways in the City that address issues such as safety, trees and landscaping, lighting, pedestrian amenities, sidewalks, crosswalks and medians to enhance the walkability of our City."*

Road Diet

Road diet is a reconfiguration of existing roadway right-of-way that reduces the number of traffic lanes to better serve bicycles, pedestrians and transit while continuing to maintain adequate accommodation for motor vehicles. This is accomplished by creating center-turn lanes, on-street parking, bike lanes, transit lanes or a combination of these type facilities. It is a relatively inexpensive means of reallocating the same space in a manner that benefits all modes of transportation: motorists, bicyclists and pedestrians. Reference is made to Figure 9 for a graphic example of road diet improvements.

Functional Improvements

Road diet conversion may potentially create space within an existing right-of-way for:

- Bicycle lanes;
- New and/or wider sidewalks for pedestrians;
- On-street parking;
- Street furniture (e.g., streetscape patios);
- Landscaping buffers between the sidewalk and travel way;
- Turn-outs at transit stops; and/or
- Transit stop amenities such as shelters and benches.

Appropriate Conditions for Road Diet

As a general rule, under average daily traffic (ADT) conditions, road diets have minimal effects on vehicle capacity as two-way left-turn lanes move left-turning vehicles out of the main traffic lane. However, road diet in above average daily traffic conditions (approximately 20,000 vehicles or above) will likely increase traffic congestion.

Road diet improvements should be considered as potentially desirable given the following traffic conditions:

- Might be feasible and works best with moderate volumes of 10,000 to 20,000 ADT.
- Highly likely to be feasible with ADT of under 10,000.

Road diet improvements might be considered as potentially beneficial given the following:

- Existing 4-lane roadway with an inadequate lane width of less than 12 feet.
- Existing development that has created a high number of turning movements.
- When traffic accidents is higher than the average for roadways with a similar classification.
- The need to implement bike lane recommendations.
- When traffic calming is needed because of safety issues.
- A need exists for on-street parking.
- Additional or wider sidewalks are needed and pedestrian safety is an issue.

The cost of implementing a road diet can vary widely depending on the treatments used in reallocating the existing right-of-way such as painted or raised median, the degree of streetscaping and landscaping enhancements, color treatment of bike lanes and crosswalks and other activities incorporated into the project such as transit stops, intersection turnouts, utility relocation.

Road Diet Benefits

Following is a brief summary of the benefits that can be realized from road diet conversions.

Motor Vehicle Safety

The *Highway Safety Manual* indicates that converting a 4-lane undivided road to a 3-lane road (two lanes with a center turn lane) reduces crashes by approximately 29%. Reasons for this includes the removal of left-turn movements from the through lanes, which reduces head-on left turn and rear end accidents; less lanes slow motorists speeds to desired levels; one traffic lane each direction eliminates lane changing and side swipe accidents. A road diet project in Athens, Georgia decreased total crashes by 53 percent.

Traffic Calming

Road diet improvements such as fewer lanes, medians, on-street parking and turn outs create a traffic calming effect that benefits all modes of transportation: vehicles, bicycles and pedestrians. These changes eliminate the merge and weave movements that occur on four-lane roadways and results in all vehicles travelling at about the same speed. A Vancouver, Washington road diet project decreased vehicle speeds by 18 percent. In Clear Lake, Iowa aggressive speeding was decreased by 52 percent and vehicles over the 45 mph limits was decreased by 32 percent.

Improved Traffic Flow

Case studies have shown that implementing road diet improvements can actually improve traffic, especially on streets with numerous curb cuts which create excessive left turn situations. On roadways where average daily traffic is feasible for road diet improvements, there is a minimal effect on vehicle capacity primarily because left turning vehicles are moved into a common turning lane. Case studies have shown no significant changes in traffic volumes and no traffic diversion impacts. Also, reducing the number of vehicle travel lanes in the same direction eliminates lane changes and weaving, which improves vehicle flow along the corridor. On existing streets with lanes that are too narrow the ability to improve lane width to standard 12 foot wide lanes provides improve traffic flow.

Bicycle Facilities

Road diet improvements are an important tool for creating first class bike lanes. Removal of a traffic lane can provide room for bike lanes on the outside of the remaining travel lane. The addition of a bike lane to a street with road diet improvements creates space dedicated exclusively to bicyclists, makes drives more cognizant of bicyclists and can encourage more bicycle use. It provides a greatly increased attractive environment for bicyclists. Road diet is a simple, relatively low cost way to create bicycle facilities for the community.

Pedestrian Facilities

Road diet is also an important tool for creating improved pedestrian facilities through the removal of traffic lanes thereby providing room for sidewalks and/or wider sidewalks. Pedestrian benefits include reduced motor vehicle speeds, reduced crossing distance, medians to break crossing and possible sidewalk buffer from travel lanes through parking, bike lanes or landscaping. Of all the benefits to pedestrians, easier, safer street crossing is a major factor in encouraging pedestrian activity including walking for exercise purposes. As is true for biking, road diet provides a much more attractive environment for walkers.

Parking

Some commercial areas are in need of on-street parking. Where feasible, the eliminated travel lane can be used to accommodate on-street parking, such as in shopping areas, commercial corridors, school areas and near churches. On-street parking serves two purposes, it provides needed parking spaces and it serves as a buffer between pedestrians and moving traffic.

Other Benefits

Road diet offers the potential to improve the attractiveness and livability of a community through streetscape and landscape improvements in medians and intersection turnouts. This combined with safety traffic conditions, more pleasant driving experiences, increased mobility and accessibility for bicyclists and pedestrians improves the overall quality of life. Road diets also make streets more pleasant for the people who live along them, lowering street noise, discouraging speeding, and making their yards safer. Also, commercial areas benefit through slower traffic, more on-street parking and pedestrian activity.

Management, Operation and Policy Recommendations

Proper management and maintenance are crucial to the long-term success of bicycle and pedestrian facilities and the continued use of such facilities. Along with the development of a pedestrian and bicycle network, Dothan should develop an ongoing management program which ensures that facilities are maintained in good condition.

Equally important will be the development and adoption of policies which support the continued development of a pedestrian and bicycle-friendly community. The recent provision of sidewalk requirements in the Dothan Subdivision Regulations is a policy that will ensure the coordination of new subdivisions into the overall walkway network. A casual review of Map 4, Existing Bicycle, Pedestrian Facilities / Potential Biking, Walking Destinations shows some ten relatively new subdivisions in the western part of Dothan that have sidewalks as a result of this policy.

Operational Considerations

Sidewalks require little in the way of operational policies; however, on-street bicycle facilities are governed by State traffic law. The following operational considerations should be adopted and efforts made to familiarize them to bicyclists and pedestrians.

1. <u>On-street bicycle and pedestrian facilities use public right-of-way and are open at all times</u>. During periods of construction or road closures, clear provision should be made to

accommodate pedestrians and bicycles. After hours lighting, where provided, should be designed to adequately meet pedestrian and bicycle needs, and be properly maintained.

2. Off-street facilities should be open from dawn to dusk, unless other hours are specifically designated. Off-road trails will not be lit, and should be closed after dark. Use of these facilities after dark is unlikely to be sufficient to maintain adequate trail safety, or to justify extended security patrolling. Where feasible, parking lots at trail heads should be gated and locked when the facility is closed. Should after-hours demand increase in the future, this policy could be revisited.

3. Off-street trails are open only for non-motorized transportation except limited access is provided for emergency and maintenance vehicles.

4. Shared-use trails are only suitable for non-motorized modes of transportation. The Bicycle and Pedestrian Plan recommends off-street shared-use facilities for several locations. Physical barriers to discourage motorized trail use have been incorporated into the design standards. Pavement design and barriers should be designed to accommodate occasional access by maintenance vehicles and/or emergency vehicle access, where appropriate.

5. Trail user rules should be adopted and promoted. Design standards have been developed to maximize safety and security benefits, and to minimize user conflicts on trails, especially shared-use trails. In addition, it will be critical to ensure that trail users follow certain basic rules in order to permit safe use by all trail users. User rules, which should be clearly posted and publicized may include:

    a. Stay to the right except when passing.

    b. Yield when entering and crossing a trail.

    c. No pets permitted on trails.

    d. Park only in designated areas.

    e. No motorized vehicles.

    f. No destruction of vegetation.

    g. Clear, easy to read signage stating time period in which trails are open to the public.

    h. Alcoholic beverages, weapons, fireworks and fires prohibited.

6. Provide adequate warning of risk to ensure adequate user safety. Type and location of needed individual warning signs should be determined during design.

7. Emergency procedures should be established for off-street pedestrian and bicycle facilities. While current emergency procedures will generally be sufficient to respond to on-street incidents, the Dothan Police, Recreation and Fire Departments should be consulted to ensure adequate emergency procedures are in place for off-street facilities. Considerations include CPR training for park personnel, emergency vehicle access, the need for patrolling, and the possible need for call boxes.

8. Traffic law enforcement should explicitly address laws relating to bicycle and pedestrians. Existing traffic law already establishes basic protocol for pedestrians and bicycles in on-street environments. Often these laws are not fully understood, either by cyclists and pedestrians or by motorists. User education, accompanied by the strategic use of warnings or enforcement action, should be offered to ensure that existing laws are obeyed. The most critical areas to focus include:

    a. Bicycles riding the wrong way, against traffic or ignoring traffic control devices.

b. Bicyclists riding at night without lights.

c. Pedestrians failing to yield to motorist in roadways.

d. Motorists failing to yield to pedestrians in crosswalks or failing to yield to bicycles at intersections.

e. Motorists speeding on local roads or ignoring traffic control devices.

Maintenance

Once developed, pedestrian and bicycle facilities will require on-going maintenance. Proper maintenance can contribute significantly to residents' perception of the facilities and significantly encourage use. Furthermore, in many instances facility maintenance is essential to maintain safety. An un-swept bicycle lane or wide shoulder, for example, is a direct hazard; as can be badly cracked sidewalk pavement. Maintenance procedures should include periodic inspection, voluntary notification of problems by users, and a mechanism for addressing hazardous conditions in a timely manner.

1. Clearly identify city departments responsible for facility maintenance. Off-street facilities should be managed and maintained by the Leisure Services Department. On-street facilities by the Public Works Department or adjacent property owners.

2. Establish routine maintenance practices. Maintenance needs will vary by facility type, but should include the following:

   a. Liter and debris removal. On-road bikeways, sidewalks, and trails all require regular cleaning and sweeping. Particular attention should be paid to sweeping the shoulder and edge of pavement on designated bike lanes, since these areas often accumulate litter and debris, creating a hazard for cyclists.

   b. Emptying trash receptacles. Public trash receptacles, whether adjacent to sidewalks or trails, need to be emptied regularly to avoid littering problems.

   c. Trim and maintain vegetation in trail shoulders and landscape strips. Properly maintained vegetation can prevent pavement deterioration, and will ensure that safe sight distances are preserved.

   d. Remove graffiti and make minor facility repairs as needed. Graffiti removal and minor repairs should be effected as quickly as possible to deter additional vandalism.

3. Establish periodic facility inspection and occasional maintenance practices. In addition to the above routine maintenance, facilities should be subject to periodic inspection and, as needed, occasional maintenance or facility repair. The following practices should be adopted:

   a. Inspect pavement surfaces regularly. Urgent repairs should be completed promptly. Major repair and replacement should be infrequent, and should be scheduled as needed.

   b. Inspect bridges, underpasses and other structures carefully to ensure that they remain in safe condition.

   c. Drainage systems should be inspected seasonally to ensure that they remain functioning and unblocked. This applies equally to trail drainage and to street drainage.

   d. Light fixtures, where provided, should be periodically cleaned and inspected. Where necessary, bulbs should be changed to ensure that safe levels of illumination are maintained.

e. Signs and markings should be periodically inspected, to ensure that they are in good condition and remain legible. Signs that are missing or in poor condition should be replaced promptly.

4. Develop public reporting system for maintenance needs or safety concerns. Often, facility users will notice problems with trail, sidewalk or bicycle facilities before a scheduled inspection or routine maintenance occurs. A reporting system should be developed, whereby facility users can report issues and concerns to the appropriate city department. The same forum could allow residents or users to request additional facilities or facility modifications; this would give the City ongoing input into the future development of its pedestrian and bicycle facilities and program.

   A name and phone number should be provided at all trail heads and at other convenient public locations, particularly those linked into the network. Suitable locations might include the library, the recreation center, and bicycle or sports shops.

Supportive Policies

As new development occurs an opportunity is presented to incorporate pedestrian and bicycle considerations, in an effective and cost-efficient manner compared to retrofit projects. The overall size and value of the facility network will be considerably enhanced if facilities are provided in public-private partnership, with residents, developers and the City all contributing to the network development. The intent of these policies is to ensure the continued consideration of pedestrian and bicycle facilities in Dothan.

1. Incorporate pedestrian and bicycle facilities in new roadway design. As a new street is planned and designed consideration should be given to the inclusion of pedestrian and bicycle facilities. Maps 6 and 7 show bicycle and pedestrian facilities along known planned roadways. At a minimum, pedestrian and bicycle facilities shown on these plans should be provided, although the detailed layout and facility specification has been left to the design phase. Any additional new roadways, even if not specifically included in the Bicycle and Pedestrian Plan, should be considered for pedestrian and bicycle facilities in keeping with the overall concepts of the Plan.

2. Incorporate pedestrian and bicycle facilities in major roadway repair / replacement or redesign projects. As existing roads and intersections are repaired, repaved, or reconfigured, pedestrian and bicycle facilities should be incorporated wherever feasible. As with new roadways, the Bicycle and Pedestrian Plan should be consulted to determine the significance of the individual roadway within the city. Facilities included in the Plan should be incorporated into the roadway re-design. For roadways not included in the Plan, consideration should still be given to the provision of pedestrian and/or bicycle facilities, wherever these facilities might complement or enhance the overall bicycle and pedestrian network.

3. Enforce Section 90-141 of the Subdivision Regulations to require sidewalks in new subdivisions. As indicated in the City's Long Range Development Plan, opportunities should be made to provide a link between neighborhoods and shopping areas, schools, parks and other destinations. And consideration should be given to eliminating the 400 vehicle per day exclusion in the R-4 District.

4. Systematically retrofit key areas of existing development and street corridors (on-street or off-street) to provide pedestrian and bicycle facilities in accordance with the Plan. The Plan shown on Large Maps 2 and 3 identifies routes which should be developed as either pedestrian facilities (generally sidewalks) or bicycle facilities (generally a signed bike lanes), including intersection improvements.

5. Educate residents particularly children, about the benefits of walking and bicycling as well as basic safety training. Walking and bicycling can be extremely safe, pleasant activities if conducted properly. As levels of activity increase, it becomes increasingly important to follow certain basic safety precautions and rules of common courtesy. Specific educational actions should include:

   a. Work with other area agencies to provide bicycle safety training to school-age children, and to actively participate in other regional educational initiatives.

   b. Target schools, church groups, and athletic centers to distribute literature about the benefits of walking and bicycling; available and planned facilities; key safety messages; special events flyers; and other relevant messages.

   c. Clarify with motorists, pedestrians, cyclists and law enforcement officials the expectations in terms of traffic and pedestrian rules, and enforcement policies. Activities which become or are expected to become problematic (e.g. cyclists failing to obey traffic laws; motorists failing to yield to pedestrians at crosswalks) should be the focus of target outreach efforts, followed by enforcement activity as appropriate.

6. Identify Dothan Pedestrian / Bicycle Coordinator to administer overall program and coordinate responsibilities of various departments. The development, management, and implementation of facilities and programs recommended in the Bicycle and Pedestrian Plan will be the responsibility of several City departments, including Planning and Development, Leisure Services, Public Works and Police. A city pedestrian / bicycle coordinator would provide a single point of contact for the public, and would help ensure that all aspects of this plan are implemented in a coordinated, complementary fashion.

7. Establish ongoing public participation strategy. Preparation of the Bicycle and Pedestrian Plan included public information meetings, public hearings, an informative web site and meetings and coordination with the Bicycle and Pedestrian Advisory Committee. The public meetings and web site presented findings and proposals at various stages of development, and allowed citizens to raise a variety of issues including timing of the proposed projects, typical facilities anticipated, and policies to ensure that future development is pedestrian and bicycle friendly. All comments and suggestions were given serious consideration, and many suggestions have been incorporated in the plan.

   As individual projects are identified and brought forward, the immediate neighborhoods and affected institutions (such as schools, churches and retail centers) should be consulted for input in the facility design process.

Implementation Strategy

Implementation of the Plan will include a local funding commitment, acquiring grant funding, the inclusion of bicycle and pedestrian recommendation into City policies and regulations, coordination with all future transportation projects and the designation of City staff responsibilities.

Plan Prioritization and Estimated Cost

The City of Dothan is committed to implementing the proposed Bicycle and Pedestrian Plan; however, because of the large scope of the recommendations included in the Plan, all proposed activities cannot be carried out immediately. The priorities should, therefore, be considered a flexible sequence of actions that can be successfully implemented through a planned, systematic approach which takes into account need, priority and financing. In this manner, the recommendations can be successfully realized in an incremental manner over a period of years.

Successful implementation will require a coordinated effort between departments and agencies of the City of Dothan as well as an ability to respond to Federal and State grant opportunities. Priorities are shown on Large Map 4 Bikeway Route Prioritization and on Large Map 5 Walkway Route Prioritization.

It is important to recognize that the planning proposals are a guide and there will be, and should be, flexibility in their implementation. Therefore, individual projects and their priority may be modified to take advantage of funding opportunities and roadway improvement projects. The objective is that implementation remains within the overall framework of the Plan.

Priorities other than specific bike and walkway projects include the following ongoing initiatives:

- Start the public hearing process required to adopt the Plan as an official part of the City of Dothan Comprehensive Plan and adopt a policy of updating the Plan, as needed, in future years.
- Designate a staff member to be responsible for managing and promoting the City's bicycle and pedestrian program.
- Prepare design drawings and specifications for individual improvements in coordination with implementation priorities.
- Actively seek funding, on a continuous basis, for implementation of the recommended bicycle and pedestrian improvements.
- Coordination of transportation projects and roadway improvements to incorporate bicycle and sidewalk projects into public works project. For example, re-striping a street for bike lanes when it is repaved regardless of the proposed bicycle and pedestrian recommendations priorities.
- Be prepared for quick action to integrate bicycle and pedestrian proposals when a fast-track roadway improvement project develops on short notice.

Immediate (1 to 5 Year) Bikeway Initiatives

Immediate bikeway initiatives are based on projected high travel routes, public engagement comments, access to downtown offices / destinations and major retail areas such as Dothan Pavilion Mall. The following table identifies individual bikeway projects considered to be an immediate initiative along with a general cost estimate for each project:

Please Note: The bikeway costs which follow are based on the following criteria:

- Assumes bikeways on both sides of road
- Assumes no disturbances to existing utilities
- Assumes private contractor selected by competitive bid
- Assumes no retaining or fill conditions
- Assumes average site accessibility
- No engineering design fees, geotechnical exploratory fees, right-of-way acquisition, legal deed research, surveying, environmental studies, archaeological studies, or other "soft costs" have been included.
- Clear & grub shoulders, 6' wide
- Remove & replace curb & gutter (c & g) where appropriate
- Excavation
- Fine grade, compact shoulders
- Regrass disturbed areas
- Bituminous concrete pavement (5' wide per lane), with aggregate base
- Paint lane stripes
- Paint bicycle icons
- Bicycle signage (assumes 1 sign per 1,000 ft., both sides of road; i.e. 10 signs per mile)

Table 15

Immediate (1 to 5 Year) Bikeway Initiatives and Estimated Cost

Project Area Description:	See Map:	Associated Graphic Design Guideline:	Miles:	Est. Cost:
Kelly Springs Elementary School / Pavilion Mall Area Streets:	Bike-1			**$770,000**
Kelly Springs Rd.		Figure 2	1.2	336,000
John D. Odom Rd.		Figure 2	0.6	168,000
Napier Field Rd.		Figure 2	0.2	56,000
Shared-Use Off-Road Trail (Behind Kelly Springs Elem. School)		Figure 11	0.6	210,000
Walton Park Recreation Center Area Streets:	Bike-2			**$427,500**
Rocky Branch Rd. (w/ c & g)		Figure 1	0.5	337,500
Rocky Branch Rd. (w/o c & g		Figure 2	0.3	90,000
Andrew Belle Recreation Center Area Streets:	Bike-3			**$337,500**
North Range St.		Figure 1	0.5	337,500
Westgate Recreation Center Area Streets:	Bike-4			**$2,340,000**
North Woodburn Dr.		Figure 1	0.6	405,000
West Main St. - US 84		Figure 2	0.4	120,000
John D. Odom Rd.		Figure 2	0.4	120,000
Whatley Dr. (w/ c & g)		Figure 1	1.0	675,000
Whatley Dr. (w/o c & g)		Figure 2	0.5	150,000
Westgate Pkwy.		Figure 1	1.0	675,000
Choctaw St.		Figure 1	0.2	135,000
East Entrance Road to Westgate Park		Figure 2	0.2	60,000
Grandview Elementary School Area Streets	Bike-5			**$1,552,500**
E. Selma St.		Figure 1	0.6	405,000
Third Ave.		Figure 1	1.7	1,147,500
Girard / Heard / Selma Street Elementary School Area Streets:	Bike-6			**$2,092,500**
Choctaw St.		Figure 1	1.3	877,500
No. Park Ave.		Figure 1	1.4	945,000
Chickasaw St.		Figure 1	0.4	270,000
Beverlye Middle & Hidden Lakes Elementary School Area Streets:	Bike-7			**$1,200,000**
So. Beverlye Rd.		Figure 2	1.0	300,000
No. Beverlye Rd.		Figure 2	0.7	210,000
Prevatt Rd.		Figure 2	2.3	690,000

Table 15 - Immediate (1 to 5 Year) Bikeway Initiatives, Continued

Project Area Description:	See Map:	Associated Graphic Design Guideline:	Miles:	Est. Cost:
Dothan High School / Doug Tew Recreation Center Area Streets:	Bike-8			**$1,957,500**
West Selma St.		Figure 1	1.7	1,147,500
So. Park Ave.		Figure 1	1.2	810,000
East Lafayette Street / St. Andrews Area Streets:	Bike-9			**$1,417,500**
South St. Andrews St.		Figure 1	1.4	945,000
East Lafayette St.		Figure 1	0.7	472,500

Immediate (1 to 5 Year) Walkway Initiatives

Immediate walkway initiatives will provide safe pedestrian access to all public elementary and middle schools. The following table identifies individual walkway projects considered to be an immediate initiative along with a general cost estimate for each project:

Please Note: The walkway costs which follow are based on the following criteria:

- Assumes walkways on both sides of road
- Assumes no disturbances to existing utilities
- Assumes private contractor selected by competitive bid
- Assumes no retaining or fill conditions
- Assumes average site accessibility
- No engineering design fees, geotechnical exploratory fees, right-of-way acquisition, legal deed research, surveying, environmental studies, archaeological studies, or other "soft costs" have been included.
- Clear & grub shoulders, 6' wide
- Remove & replace curb & gutter (c & g) where appropriate
- Excavation
- Fine grade, compact areas beneath sidewalks
- Regrass disturbed areas
- 5' wide, 4" thick reinforced concrete sidewalk, with aggregate base
- Concrete handicapped ramps at crosswalk areas
- Pedestrian signal improvements located at major intersections

Table 16

Immediate (1 to 5 Year) Walkway Initiatives and Estimated Cost

Project Area Description:	See Map:	Associated Graphic Design Guideline:	Miles:	Est. Cost:
Kelly Springs Elementary School / Pavilion Mall Area Streets:	Walk-1			**$1,586,900**
Kelly Springs Rd.		Figure 6	0.8	413,840
John D. Odom Rd.		Figure 6	0.6	285,380
Murphy Mill Rd. (2 Routes)		Figure 6	0.6	285,380
North Brannon Stand Rd.		Figure 6	1.0	392,300
Shared-Use Off-Road Trail (Behind Kelly Springs Elem. School)		Figure 11	0.6	210,000

Table 16 - Immediate (1 to 5 Year) Walkway Initiatives, Continued

Area Description:	See Map:	Associated Graphic Design Guideline:	Miles:	Est. Cost:
Wiregrass Mall / Westgate Parkway Area Streets:	Walk-2			**$709,990**
Westgate Pkwy. (2 Routes)		Figure 5	1.3	709,990
Flowers Hospital Area Streets:	Walk-3			**$916,910**
West Main St.- US 84 (2 Routes)		Figure 5	1.1	631,530
No. Woodburn Dr.		Figure 5	0.6	285,380
Selma Street Elementary School Area Streets:	Walk-4			**$2,311,890**
Hartford Hwy.		Figure 5	0.8	438,840
Timbers Dr.		Figure 5	0.5	296,150
West Selma St.		Figure 5	0.4	206,920
Woodland Dr.		Figure 5	0.5	246,150
South Park Ave.		Figure 5	0.8	413,840
Mendheim Dr.		Figure 5	0.4	206,920
Stadium St.		Figure 5	0.9	503,070
Beverlye Middle & Hidden Lakes Elementary School Area Streets	Walk-5			**$1,566,130**
Prevatt Rd.		Figure 6	1.5	738,450
South Beverlye Rd.		Figure 6	1.2	620,760
North Beverlye Rd.		Figure 6	0.4	206,920
Highlands Elementary School Area Streets:	Walk-6			**$167,690**
Flowers Chapel Rd.		Figure 6	0.3	167,690
Pavilion Mall Area Streets:	Walk-7			**$1,259,210**
Flynn Rd.		Figure 6	1.0	442,300
Montgomery Hwy. (US 231)		Figure 6	1.1	531,530
Murphy Mill Rd.		Figure 6	0.6	285,380
Carver Middle & Jerry Lee Faine Elementary School Area Streets:	Walk-8			**$2,336,890**
Comer St.		Figure 5	0.2	128,460
Canary St.		Figure 5	0.3	217,690
Lake St.		Figure 5	0.3	167,690
Allen Rd.		Figure 5	0.1	39,230
Pryor St.		Figure 5	0.2	78,460
Bayshore Ave.		Figure 5	0.4	306,920
East Burdeshaw St.		Figure 5	1.2	620,760
Sunset Dr.		Figure 5	0.1	89,230
Basin Ave.		Figure 5	0.2	78,460
Wilder Ave.		Figure 5	0.4	206,920
State Ave.		Figure 5	0.4	206,920
Stringer St.		Figure 5	0.5	196,150

Table 16 - Immediate (1 to 5 Year) Walkway Initiatives, Continued

Area Description:	See Map:	Associated Graphic Design Guideline:	Miles:	Est. Cost:
James O. Oates Park Area:	Walk-9			**$770,000**
Off Road, Creek Trail		Figure 11	1.3	455,000
Off Road, Park Trail		Figure 11	0.9	315,000
Westgate Park Area Streets:	Walk-10			**$631,530**
Whatley Dr.		Figures 5 & 6	0.9	503,070
Deer Path Rd.		Figure 5	0.2	128,460
Grandview Elementary School Area Streets:	Walk-11			**$2,051,510**
Grant St.		Figure 5	0.2	178,460
6th Ave.		Figure 5	0.5	296,150
Alexander Dr.		Figure 5	0.5	146,150
East Selma St.		Figure 5	0.7	374,610
Haven Dr.		Figure 5	0.7	374,610
3rd Ave.		Figure 5	0.5	296,150
Hedstrom Dr.		Figure 5	0.6	285,380
Montana Street Elementary Area Streets:	Walk-12			**$1,459,210**
Denton Dr.		Figure 5	0.9	503,070
Sequoyah Dr.		Figure 5	0.5	246,150
Choctaw St.		Figure 5	0.9	453,070
Greentree Ave.		Figure 5	0.1	89,230
Montana St.		Figure 5	0.3	167,690
Girard Middle & Girard Elementary School Area Streets:	Walk-13			**$1,776,900**
Choctaw St.		Figure 5	1.0	592,300
Westgate Park East Entrance Rd.		Figure 6	0.2	178,460
North Cherokee Ave.		Figure 5	1.4	749,220
West Main St.		Figure 5	0.4	256,920
Cloverdale Elementary School Area Streets:	Walk-14			**$2,358,430**
Hodgesville Rd.		Figure 5	0.4	256,920
Ross Clark Circle (US 431)		Figure 6	0.1	89,230
Bus. US 231		Figure 5	0.2	128,460
Pinecrest Dr.		Figure 5	0.1	39,230
COE Dairy Rd.		Figure 5	1.0	542,300
East Carroll St.		Figure 5	0.3	167,690
Rollins Ave.		Figure 5	0.2	128,460
Moss St.		Figure 5	0.2	128,460
Dexter St.		Figure 5	0.2	78,460
Third Ave.		Figure 5	0.5	296,150
East Cottonwood Rd.		Figure 5	0.9	503,070

Table 16 - Immediate (1 to 5 Year) Walkway Initiatives, Continued

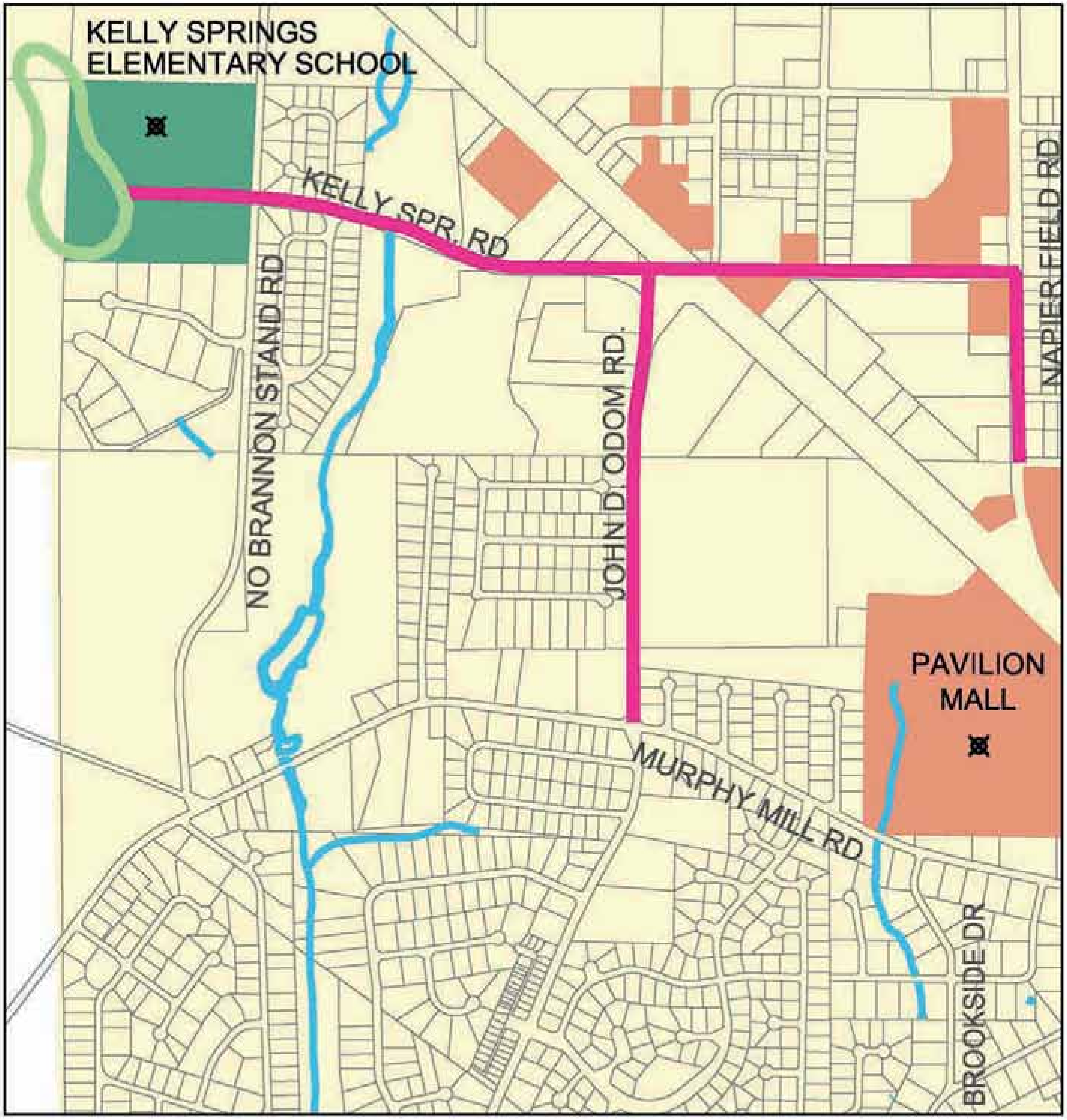
Area Description:	See Map:	Associated Graphic Design Guideline:	Miles:	Est. Cost:
Landmark Elementary & Northview High School Area Streets:	Walk-15			**$1,302,290**
Westgate Pkwy.		Figure 5	1.0	492,300
Northview High School Road		Figure 5	0.3	217,690
Roney Rd.		Figure 6	0.1	139,230
Rocky Branch Rd. (w/ c & g)		Figure 5	0.3	167,690
Rocky Branch Rd. (w/o c & g)		Figure 6	0.2	128,460
Kinsey Rd.		Figure 6	0.4	156,920
Honeysuckle Middle School Area Streets:	Walk-16			**$2,361,500**
Fortner St.		Figure 6	2.1	1,023,830
Earline Rd.		Figure 6	1.2	470,760
Hartford Hwy.		Figure 6	0.2	178,460
Honeysuckle Rd. (2 Routes)		Figure 5	1.5	688,450
Heard Elementary School Area Streets:	Walk-17			**$2,836,110**
Flowers Chapel Rd.		Figure 6	1.0	492,300
West Main St. – US 84 (w/ c & g)		Figure 6	0.5	296,150
West Main St. – US 84 (w/o c & g)		Figure 5	0.8	463,840
Bracewell Ave.		Figure 5	0.5	246,150
Haisten Dr.		Figure 5	0.8	363,840
Heard Dr.		Figure 5	0.2	128,460
Sheila Dr.		Figure 5	0.2	78,460
Stonebridge Rd.		Figure 5	0.5	246,150
Fortner St.		Figure 5	0.7	324,610
Woodland Dr.		Figure 5	0.5	196,150

BIKE-1 THROUGH BIKE-9 MAPS

AND

WALK-1 THROUGH WALK-17 MAPS

IMMEDIATELY FOLLOW THIS PAGE



NORTH

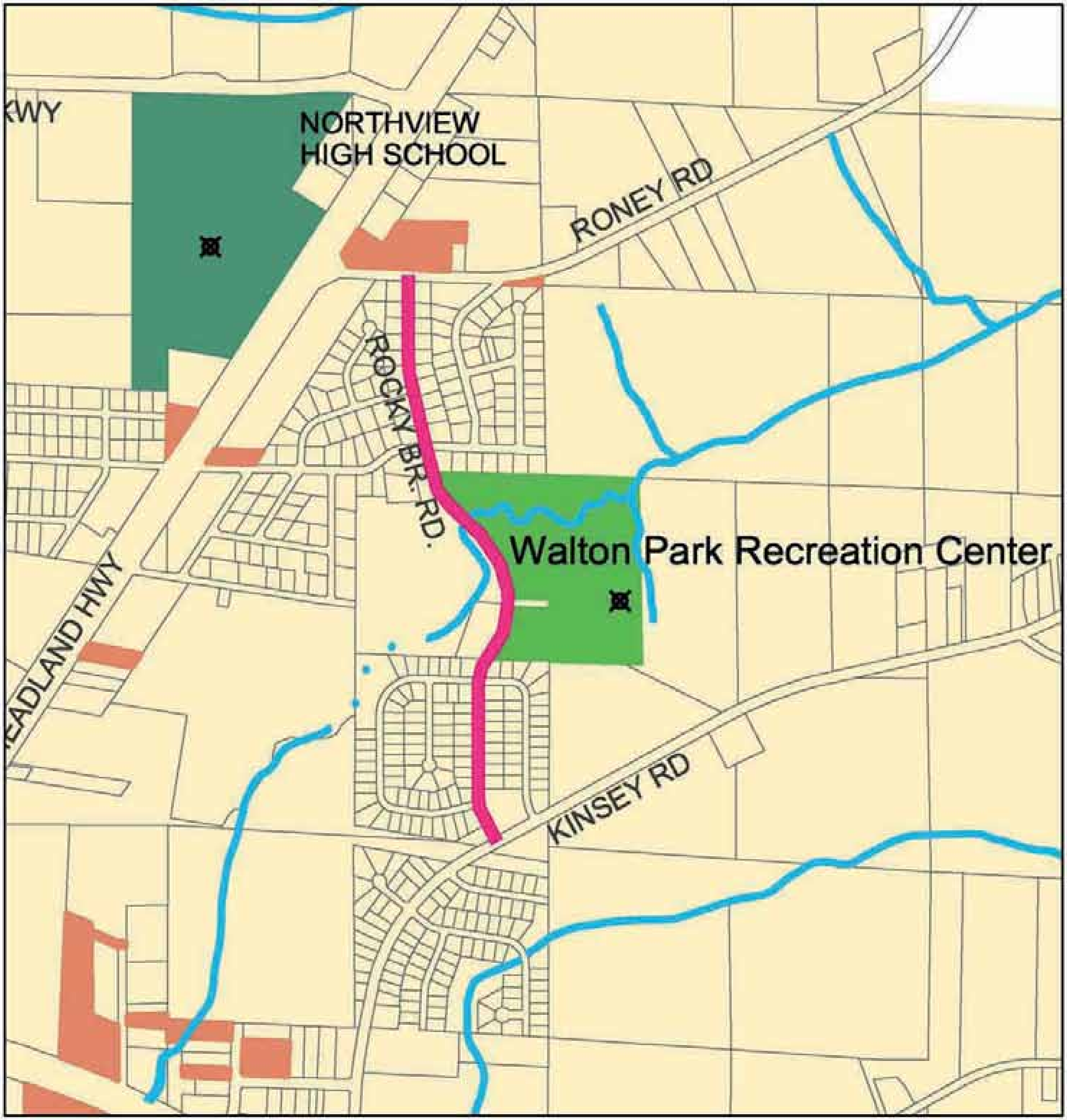
"IMMEDIATE" BIKEWAY ROUTE (POTENTIAL PROJECT AREA)
KELLY SPRINGS ELEMENTARY SCHOOL / PAVILION MALL AREA

MAP: BIKE-1

LEGEND:
- ON ROAD BIKEWAY
- SHARED-USE OFF-ROAD TRAIL

1,000' 500' 0 1,000'
GRAPHIC SCALE (FEET)

walk and bike DOTHAN



"IMMEDIATE" BIKEWAY ROUTE (POTENTIAL PROJECT AREA)
WALTON PARK RECREATION CENTER AREA

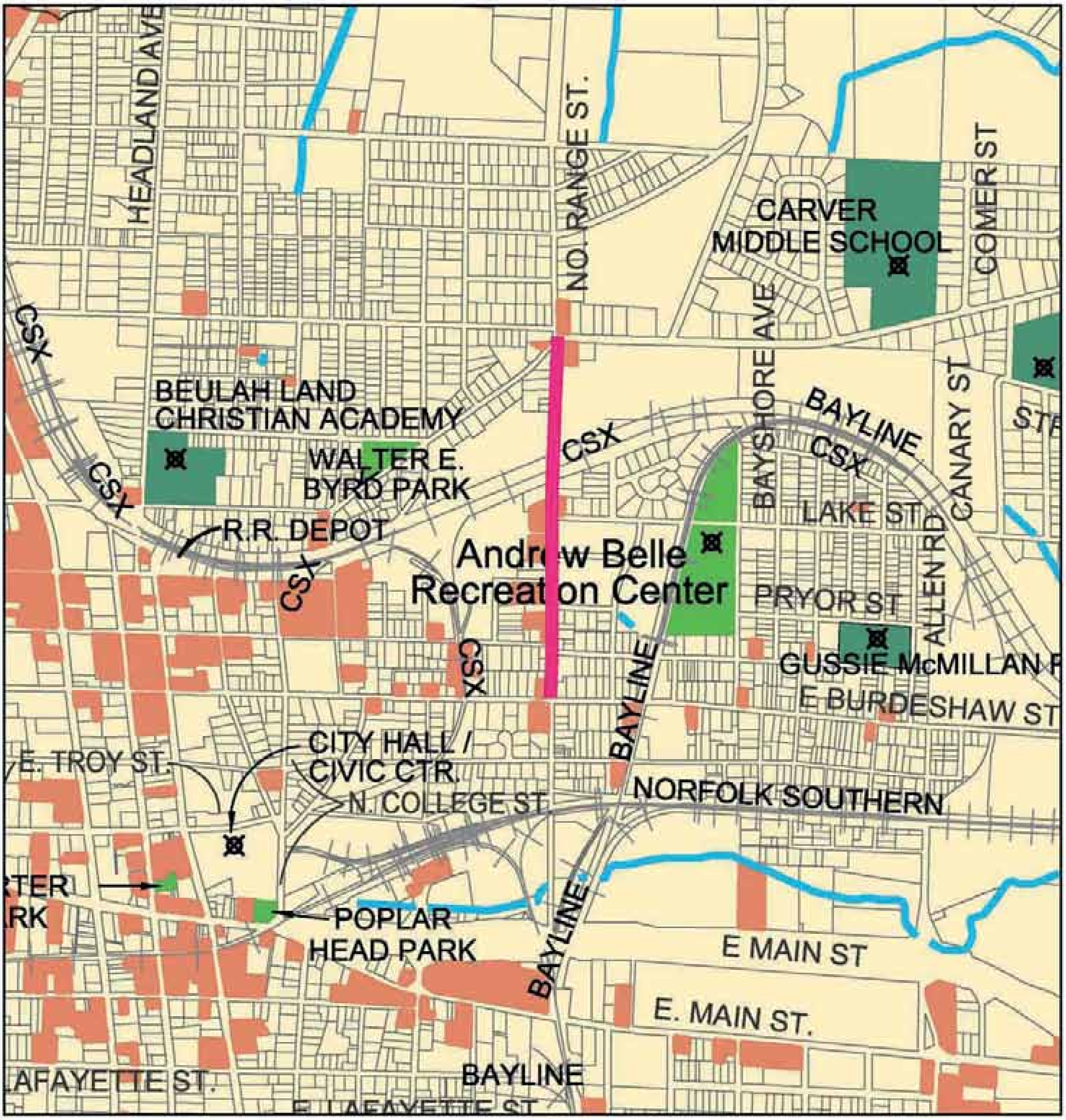
MAP: BIKE-2

LEGEND:

ON ROAD BIKEWAY

1,000' 500' 0 1,000'

GRAPHIC SCALE (FEET)



NORTH

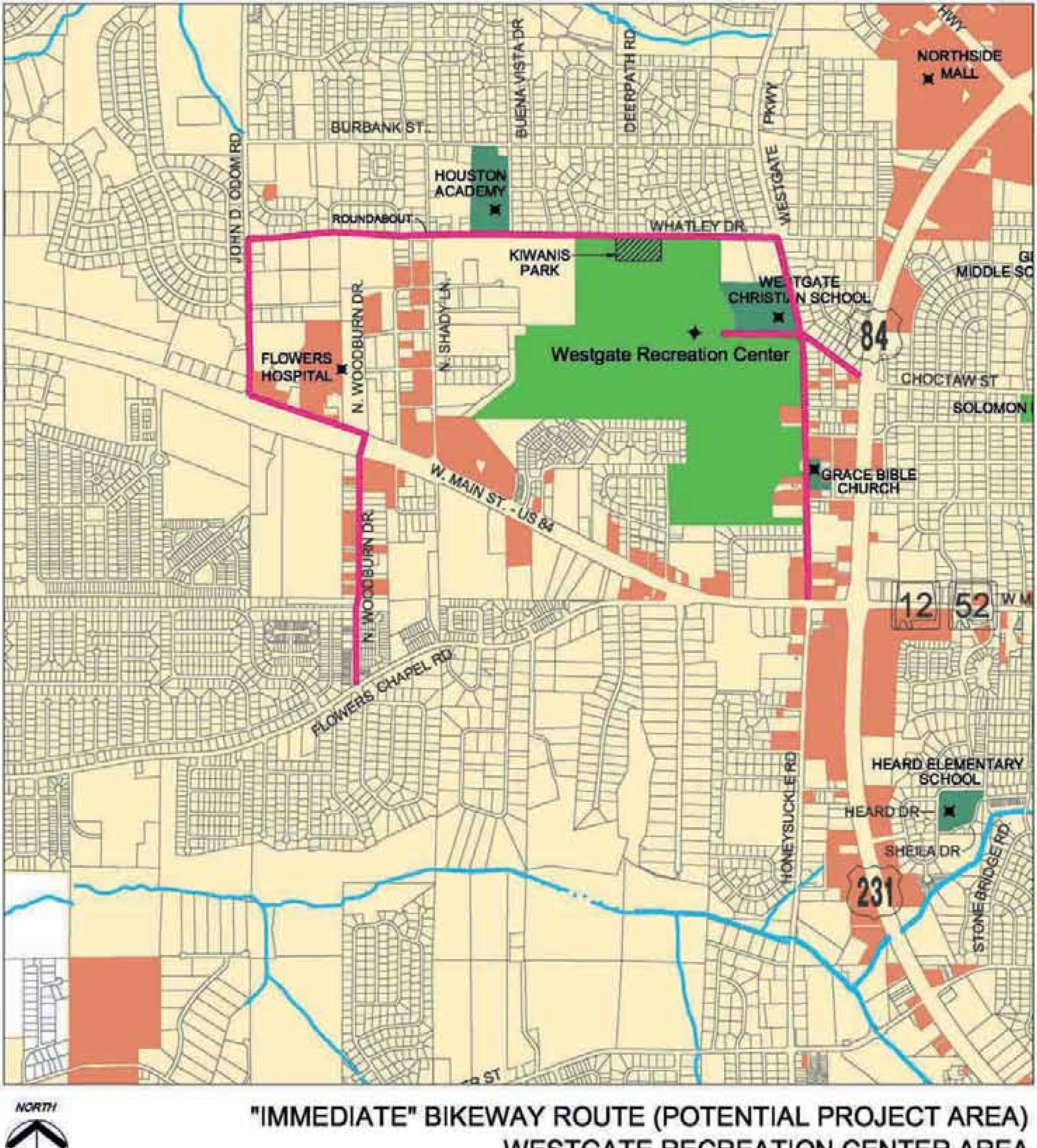
"IMMEDIATE" BIKEWAY ROUTE (POTENTIAL PROJECT AREA)
ANDREW BELLE RECREATION CENTER AREA

MAP: BIKE-3

LEGEND:
ON ROAD BIKEWAY

1,000' 500' 0 1,000'
GRAPHIC SCALE (FEET)

walk and bike DOTHAN



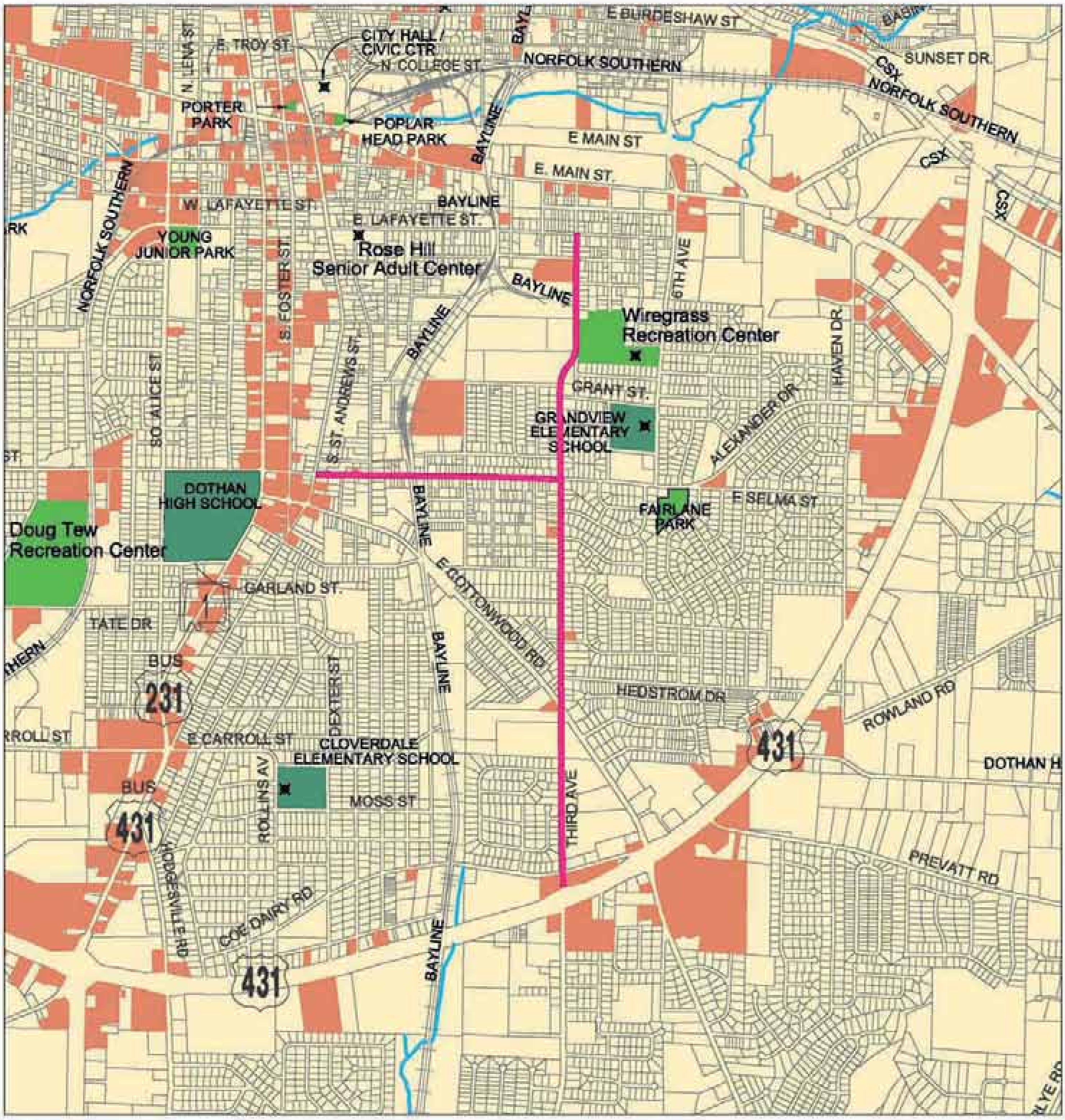
"IMMEDIATE" BIKEWAY ROUTE (POTENTIAL PROJECT AREA)
WESTGATE RECREATION CENTER AREA

MAP: BIKE-4

LEGEND:
ON ROAD BIKEWAY

2,000' 1,000' 0 2,000'
GRAPHIC SCALE (FEET)

walk and bike DOTHAN



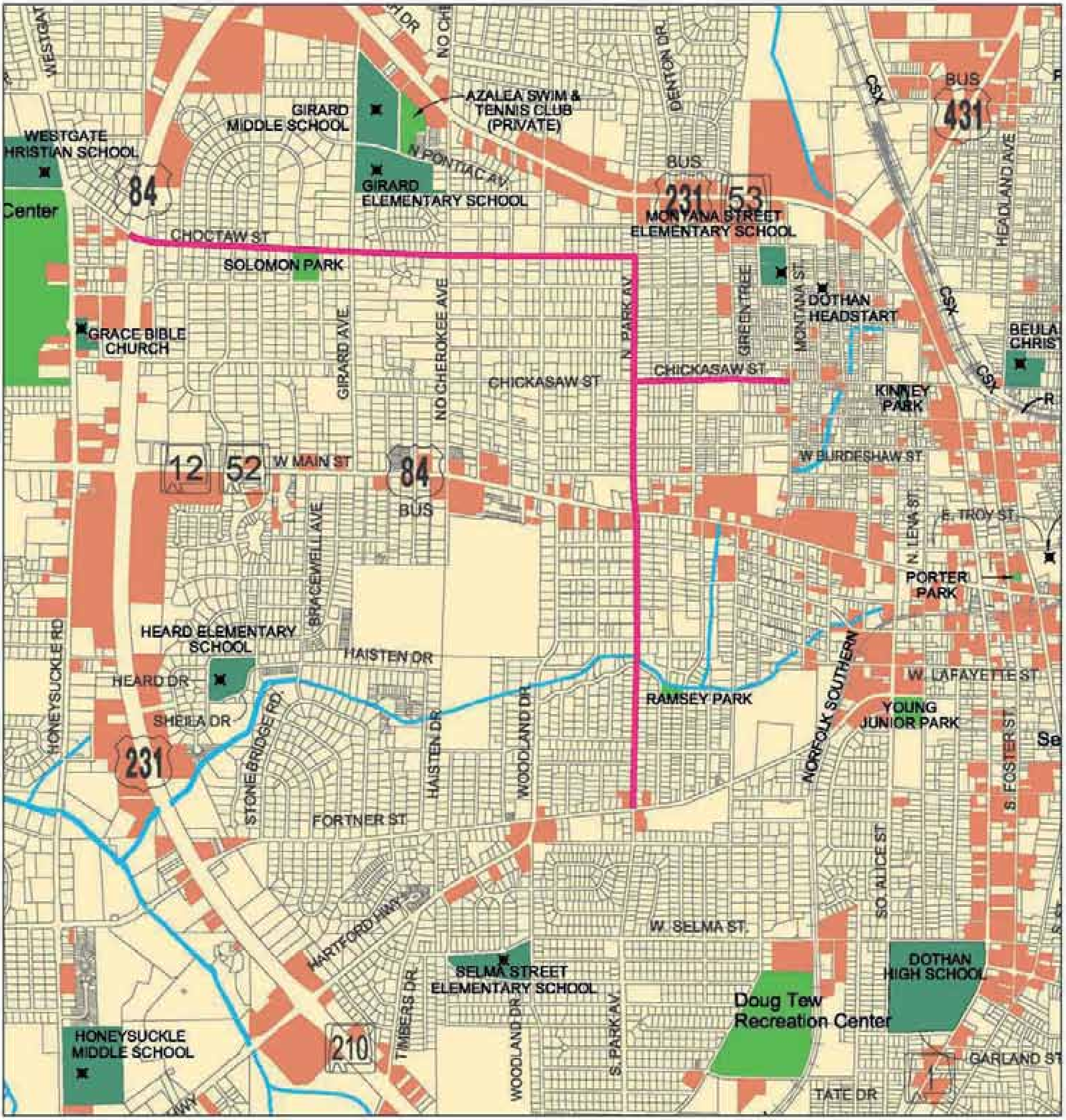
NORTH

"IMMEDIATE" BIKEWAY ROUTE (POTENTIAL PROJECT AREA)
GRANDVIEW ELEMENTARY SCHOOL AREA

MAP: BIKE-5

LEGEND:
ON ROAD BIKEWAY

2,000' 1,000' 0 2,000'
GRAPHIC SCALE (FEET)



NORTH

"IMMEDIATE" BIKEWAY ROUTE (POTENTIAL PROJECT AREA)
GIRARD / HEARD / SELMA STREET ELEMENTARY SCHOOL AREAS

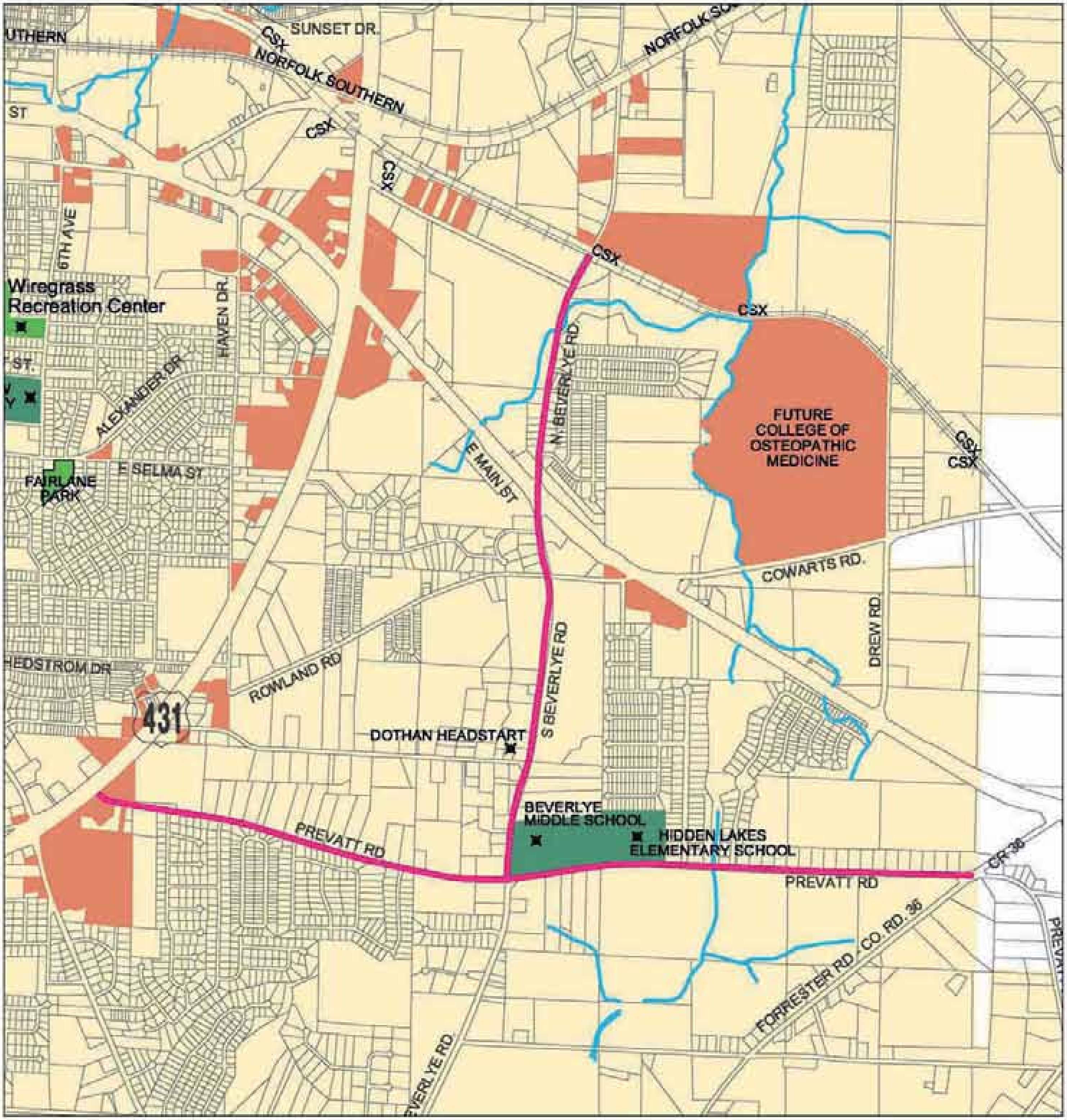
MAP: BIKE-6

LEGEND:

ON ROAD BIKEWAY

2,000' 1,000' 0 2,000'

GRAPHIC SCALE (FEET)



NORTH

"IMMEDIATE" BIKEWAY ROUTE (POTENTIAL PROJECT AREA)
BEVERLYE MIDDLE & HIDDEN LAKES ELEMENTARY SCHOOL AREA

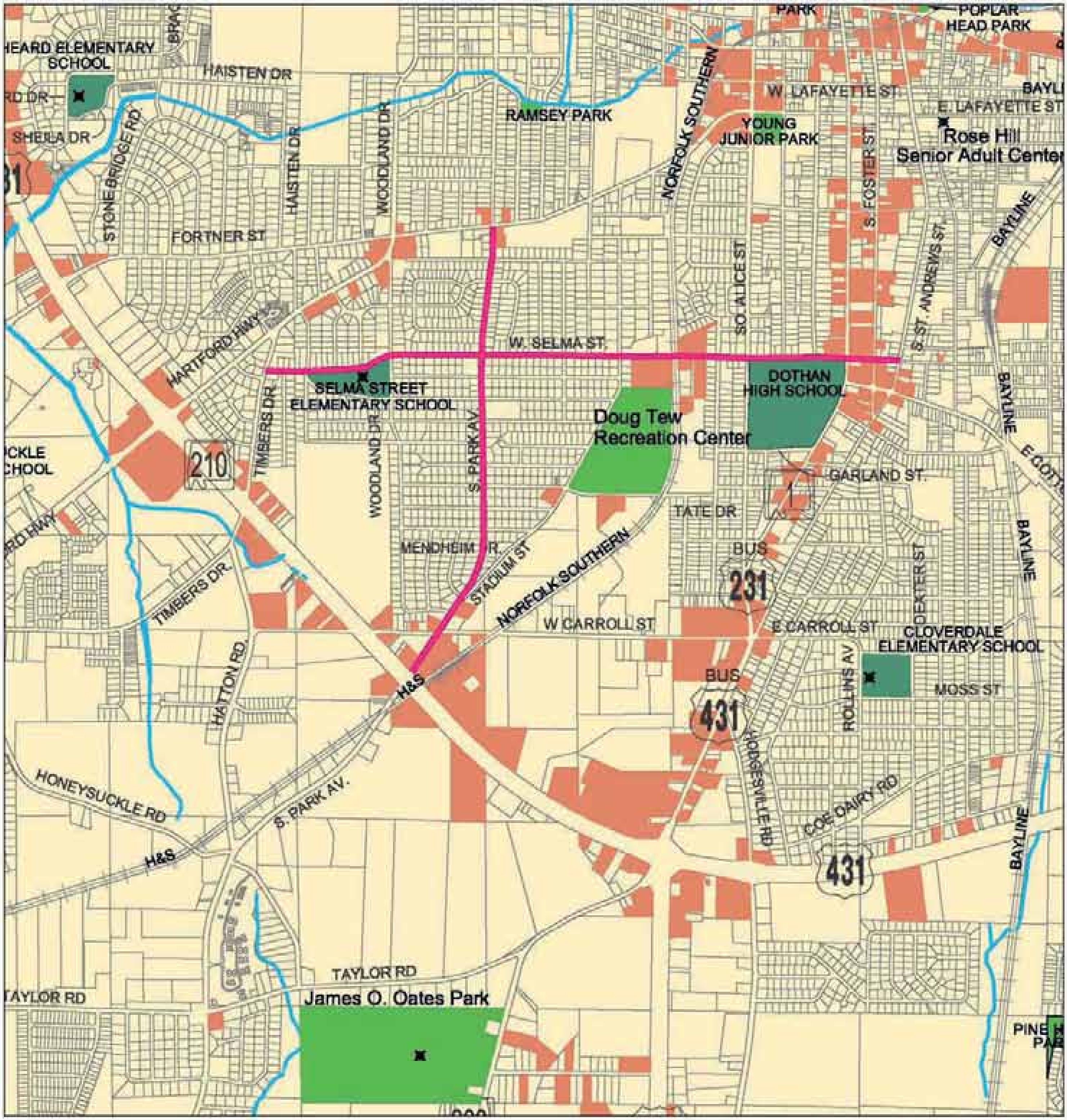
MAP: BIKE-7

LEGEND:

ON ROAD BIKEWAY

2,000' 1,000' 0 2,000'

GRAPHIC SCALE (FEET)



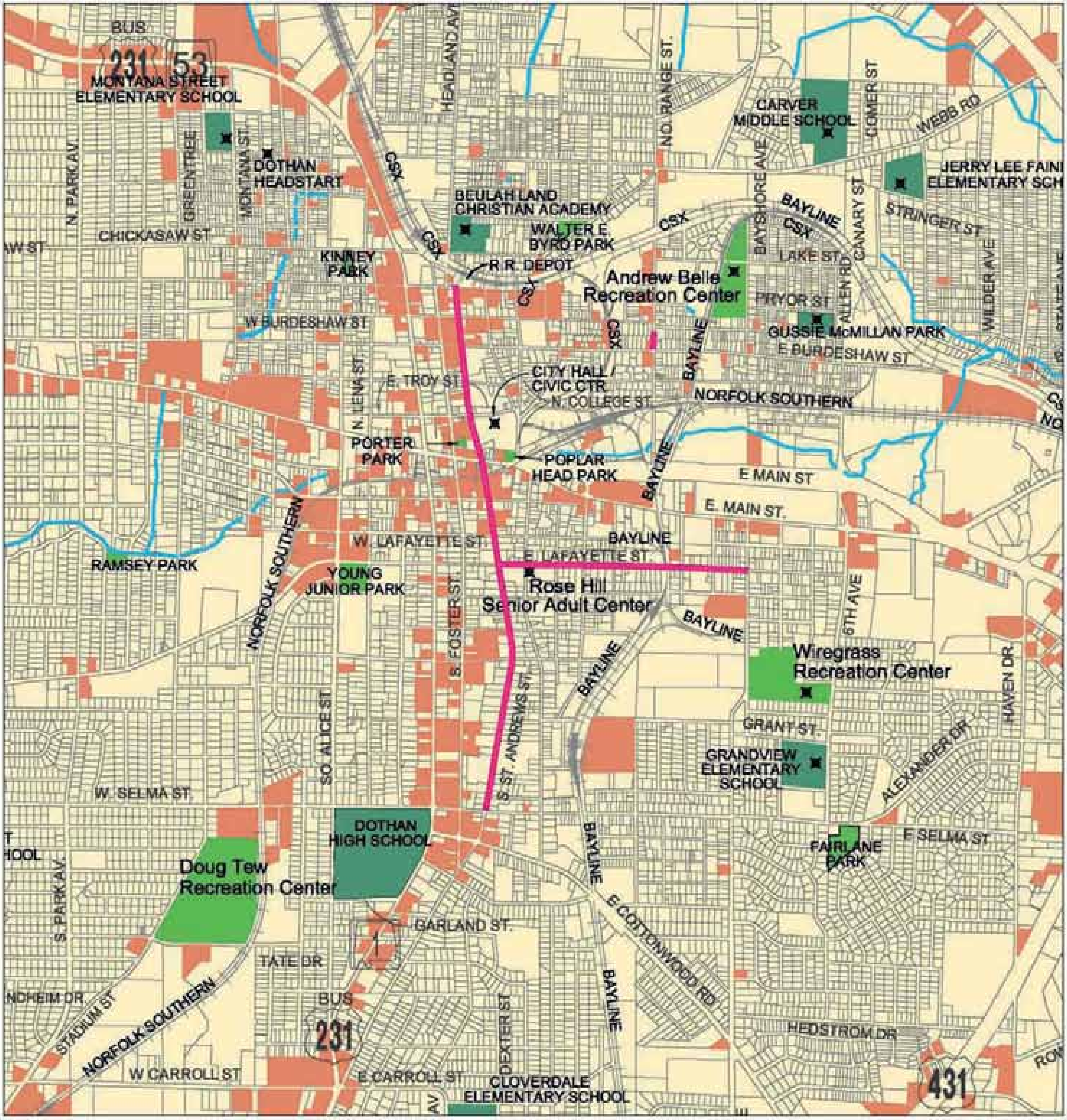
"IMMEDIATE" BIKEWAY ROUTE (POTENTIAL PROJECT AREA)
SELMA STREET ELEMENTARY SCHOOL AREA

MAP: BIKE-8

LEGEND:
ON ROAD BIKEWAY

2,000' 1,000' 0 2,000'
GRAPHIC SCALE (FEET)

walk and bike DOTHAN



NORTH

"IMMEDIATE" BIKEWAY ROUTE (POTENTIAL PROJECT AREA)
EAST LAFAYETTE STREET / ST. ANDREWS STREET AREA

MAP: BIKE-9

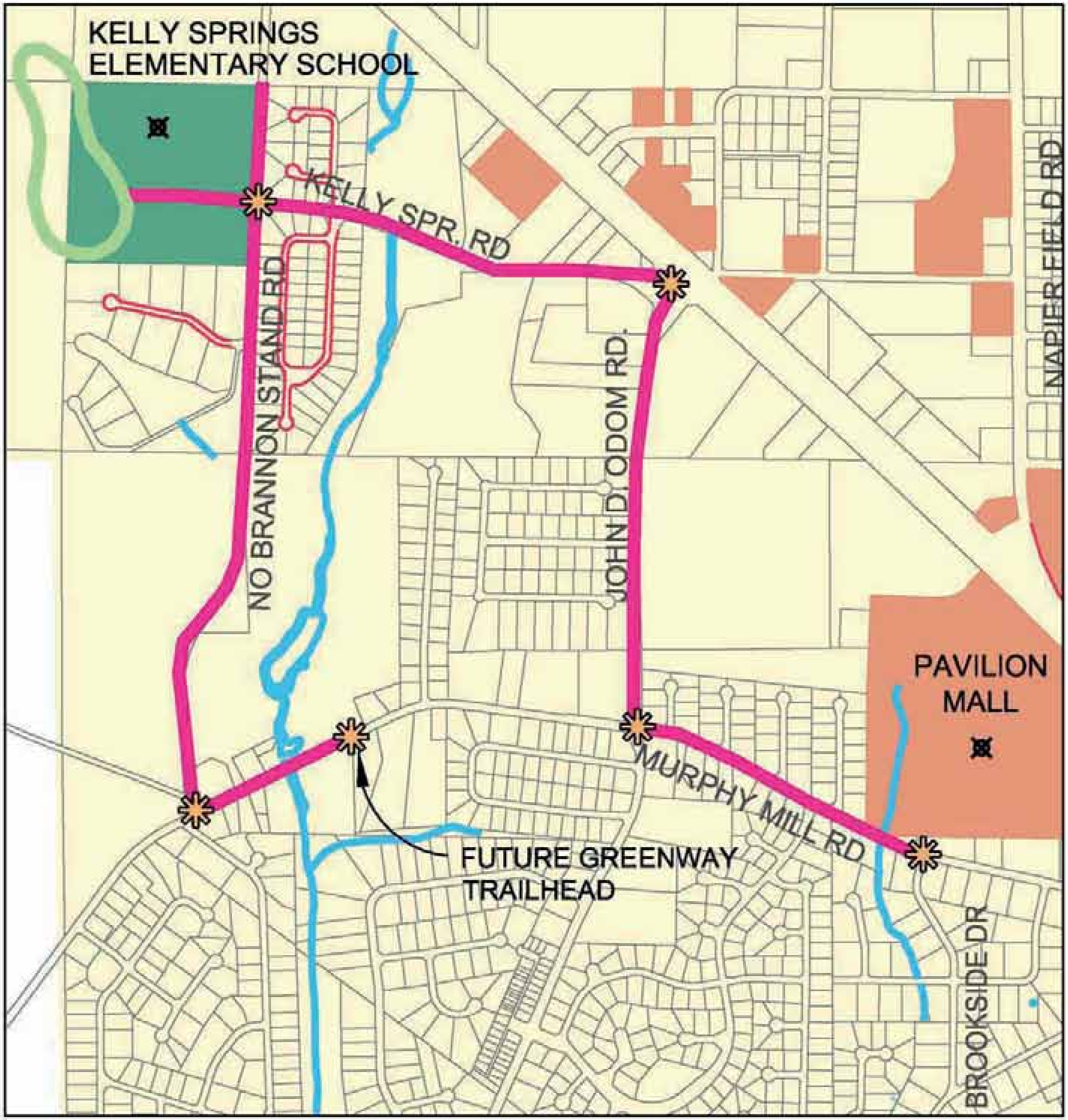
LEGEND:

ON ROAD BIKEWAY

2,000' 1,000' 0 2,000'

GRAPHIC SCALE (FEET)

walk and bike DOTHAN



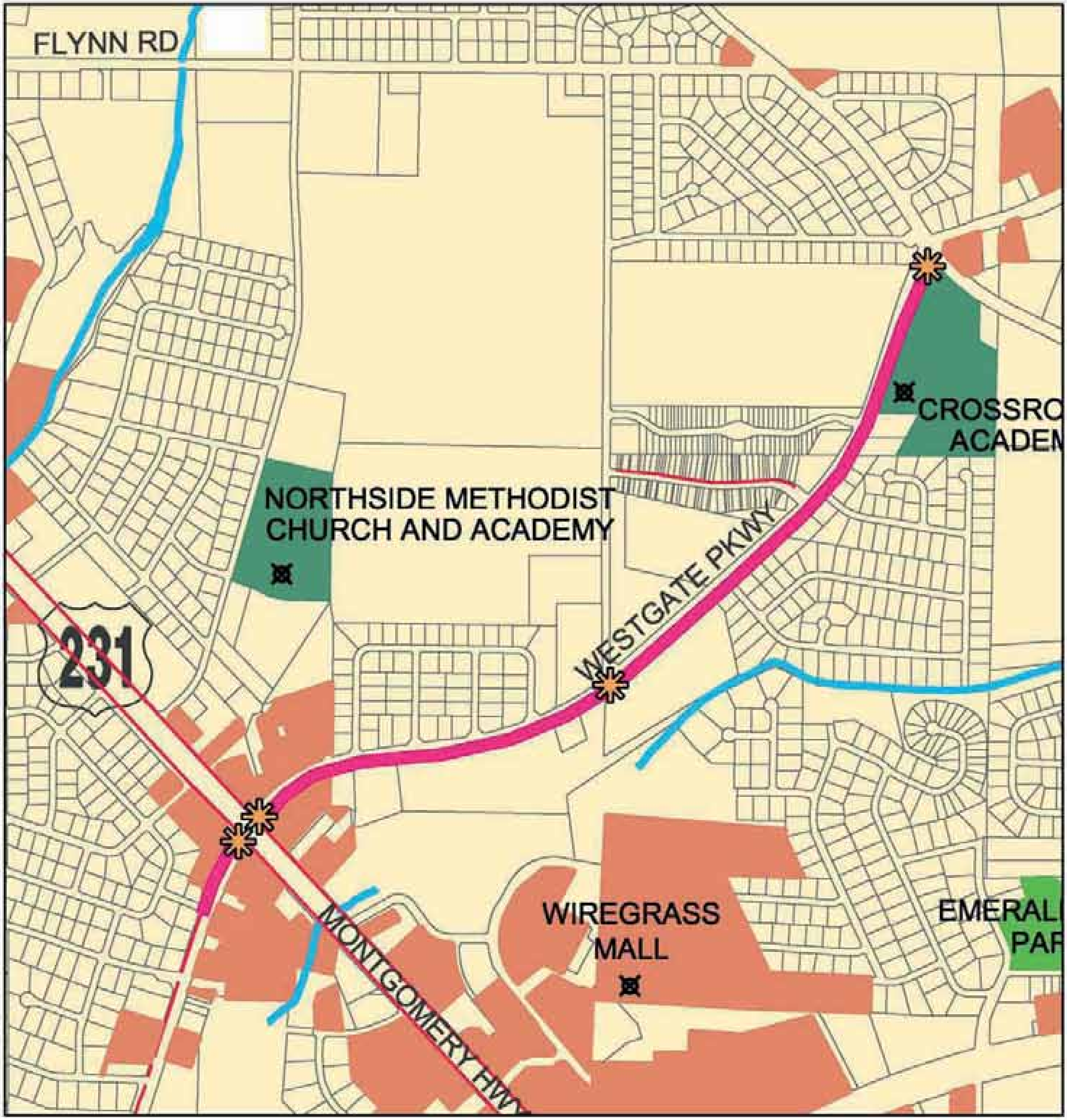
"IMMEDIATE" WALKWAY ROUTE (POTENTIAL PROJECT AREA)
KELLY SPRINGS ELEMENTARY SCHOOL AREA

MAP: WALK-1

NORTH

LEGEND:
- ON ROAD WALKWAY
- SHARED-USE OFF-ROAD TRAIL
- INTERSECTION IMPROVEMENTS

1,000' 500' 0 1,000'
GRAPHIC SCALE (FEET)



NORTH

"IMMEDIATE" WALKWAY ROUTE (POTENTIAL PROJECT AREA)
WIREGRASS MALL / WESTGATE PARKWAY AREA

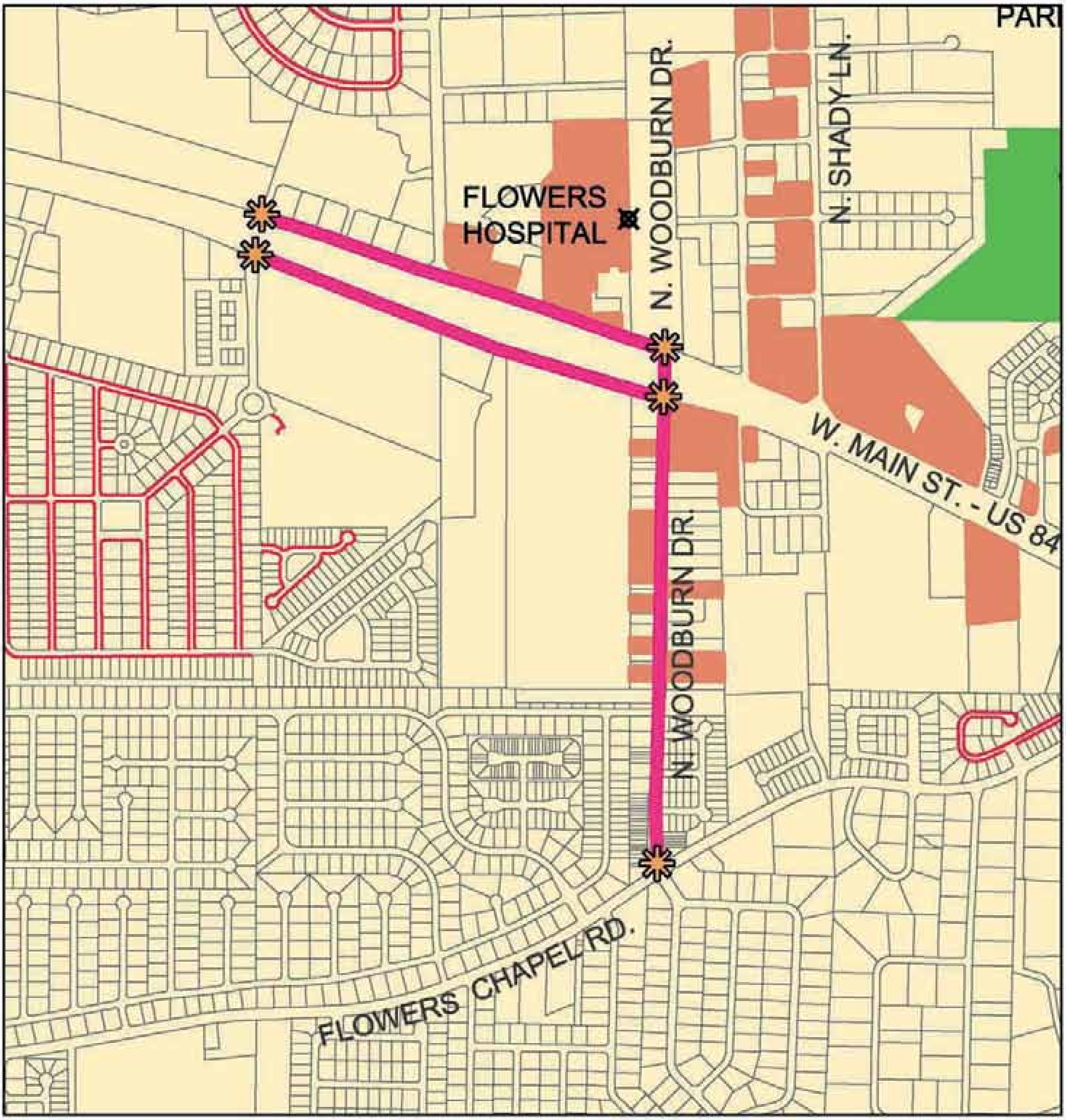
MAP: WALK-2

LEGEND:
- ON ROAD WALKWAY
- INTERSECTION IMPROVEMENTS

1,000' 500' 0 1,000'

GRAPHIC SCALE (FEET)

walk and bike DOTHAN



NORTH

"IMMEDIATE" WALKWAY ROUTE (POTENTIAL PROJECT AREA)
FLOWERS HOSPITAL AREA

MAP: WALK-3

LEGEND:

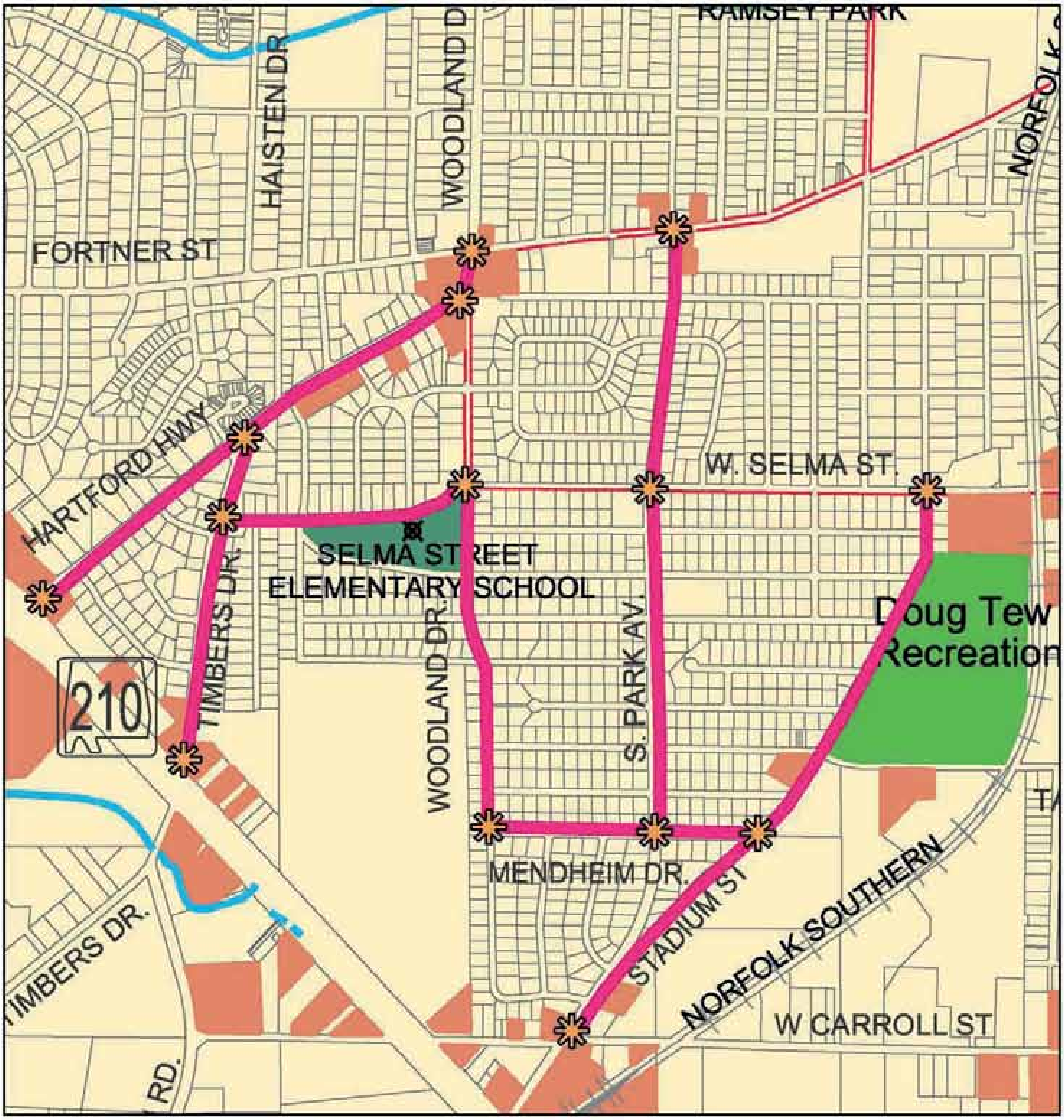
ON ROAD WALKWAY

INTERSECTION IMPROVEMENTS

1,000' 500' 0 1,000'

GRAPHIC SCALE (FEET)

walk and bike DOTHAN



NORTH

"IMMEDIATE" WALKWAY ROUTE (POTENTIAL PROJECT AREA)
SELMA STREET ELEMENTARY SCHOOL AREA

MAP: WALK-4

LEGEND:
ON ROAD WALKWAY
INTERSECTION IMPROVEMENTS

1,000' 500' 0 1,000'
GRAPHIC SCALE (FEET)

walk and bike DOTHAN

NORTH

"IMMEDIATE" WALKWAY ROUTE (POTENTIAL PROJECT AREA)
BEVERLYE MIDDLE & HIDDEN LAKES ELEMENTARY SCHOOL AREA

MAP: WALK-5

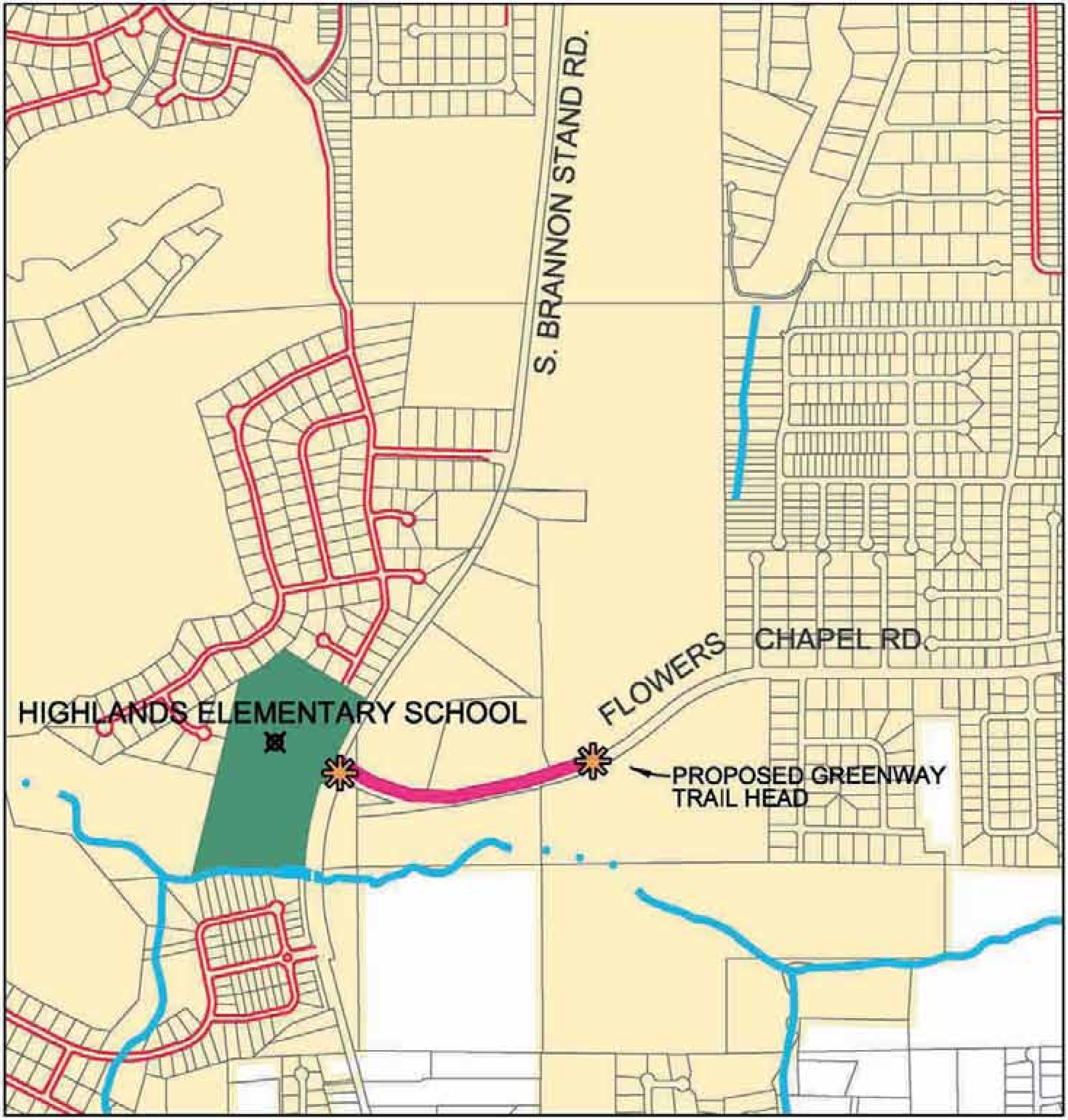
LEGEND:

- ON ROAD WALKWAY
- INTERSECTION IMPROVEMENTS

2,000' 1,000' 0 2,000'

GRAPHIC SCALE (FEET)

walk and bike DOTHAN



NORTH

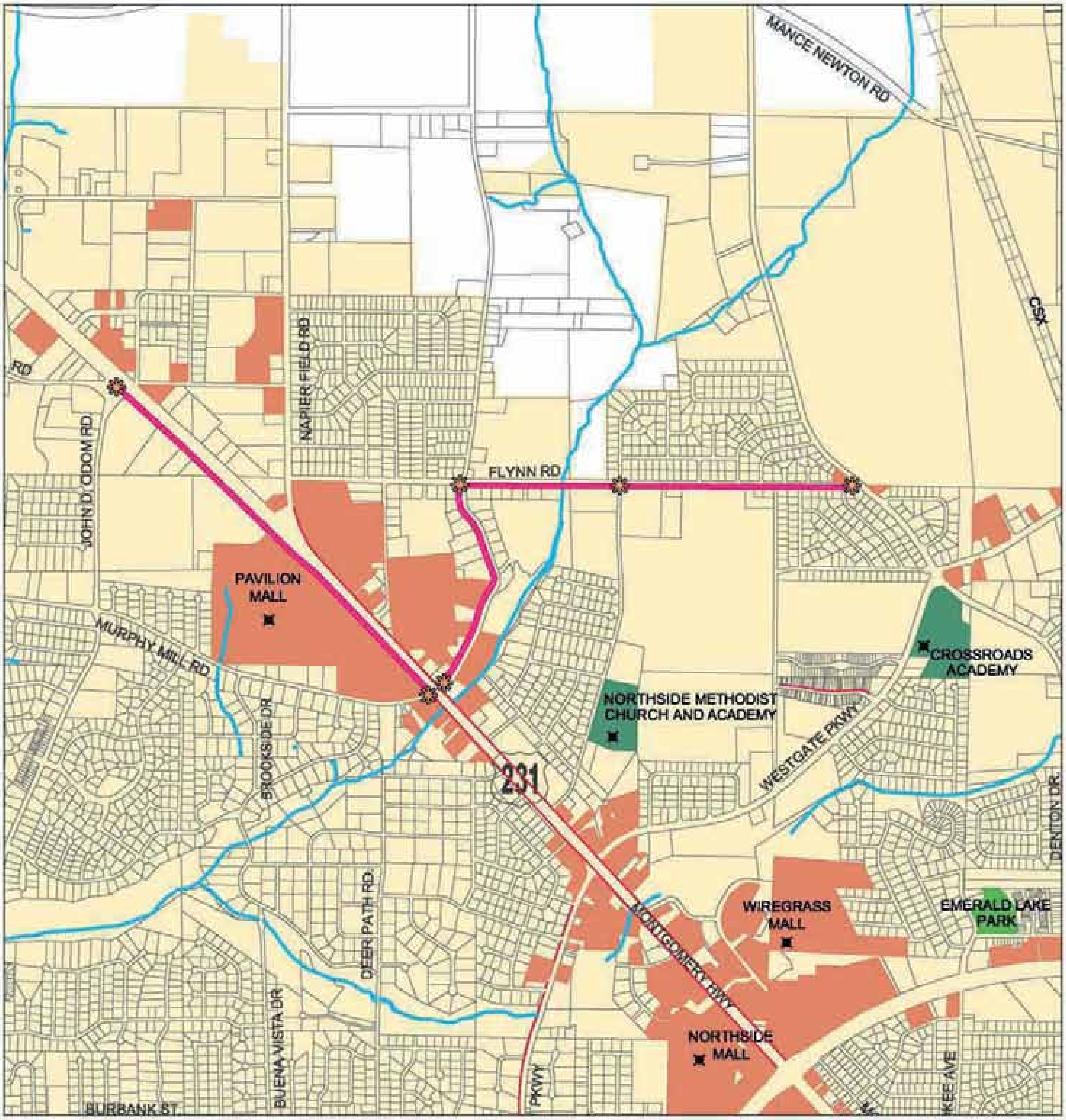
"IMMEDIATE" WALKWAY ROUTE (POTENTIAL PROJECT AREA)
HIGHLANDS ELEMENTARY SCHOOL AREA

MAP: WALK-6

LEGEND:
ON ROAD WALKWAY
INTERSECTION IMPROVEMENTS

1,000' 500' 0 1,000'
GRAPHIC SCALE (FEET)

walk and bike DOTHAN



NORTH

"IMMEDIATE" WALKWAY ROUTE (POTENTIAL PROJECT AREA)
PAVILION MALL AREA

MAP: WALK-7

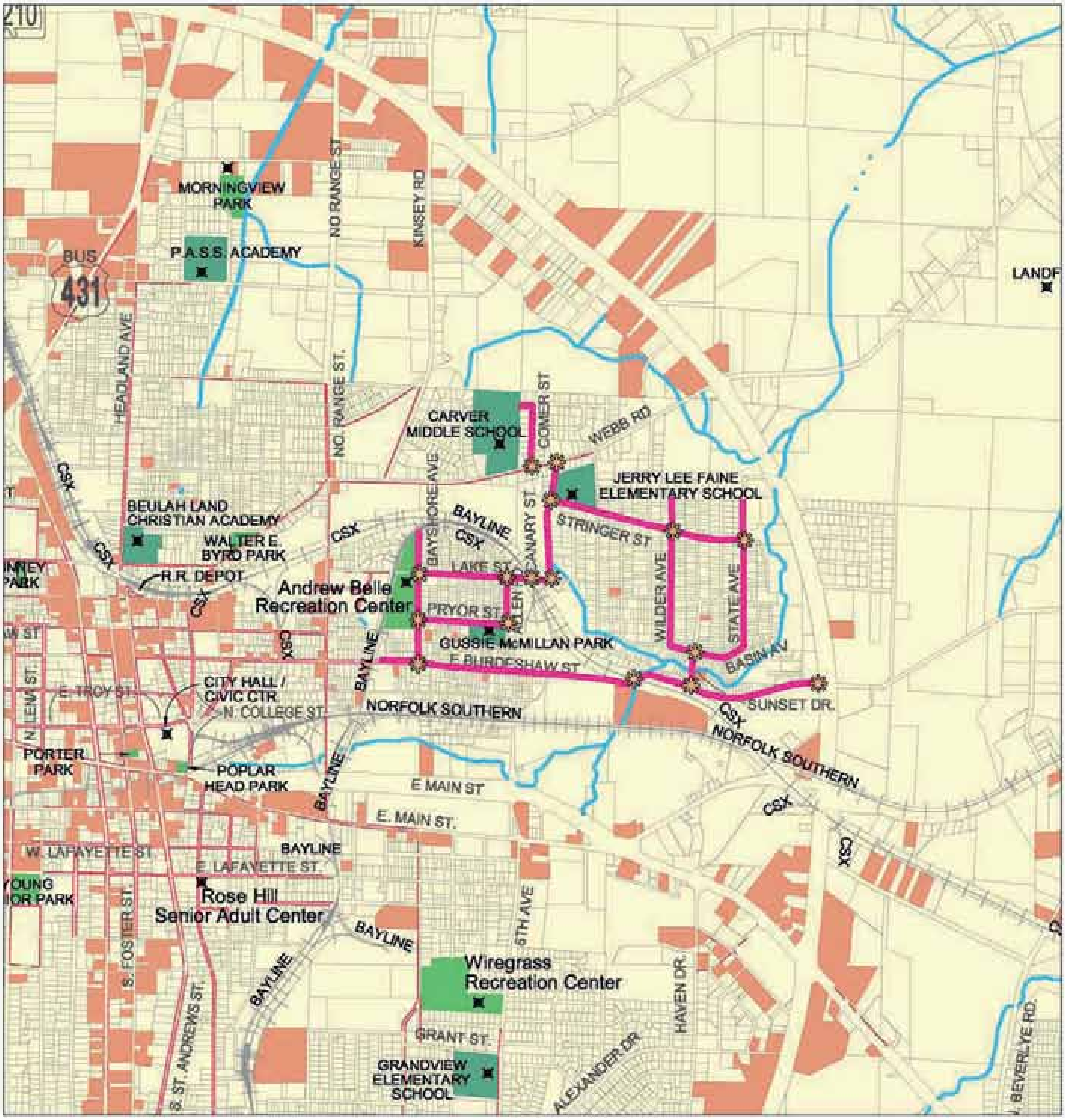
LEGEND:

- ON ROAD WALKWAY
- INTERSECTION IMPROVEMENTS

2,000' 1,000' 0 2,000'

GRAPHIC SCALE (FEET)

walk and bike DOTHAN



NORTH

"IMMEDIATE" WALKWAY ROUTE (POTENTIAL PROJECT AREA)
CARVER MIDDLE & JERRY LEE FAINE ELEMENTARY SCHOOL AREA

MAP: WALK-8

LEGEND:

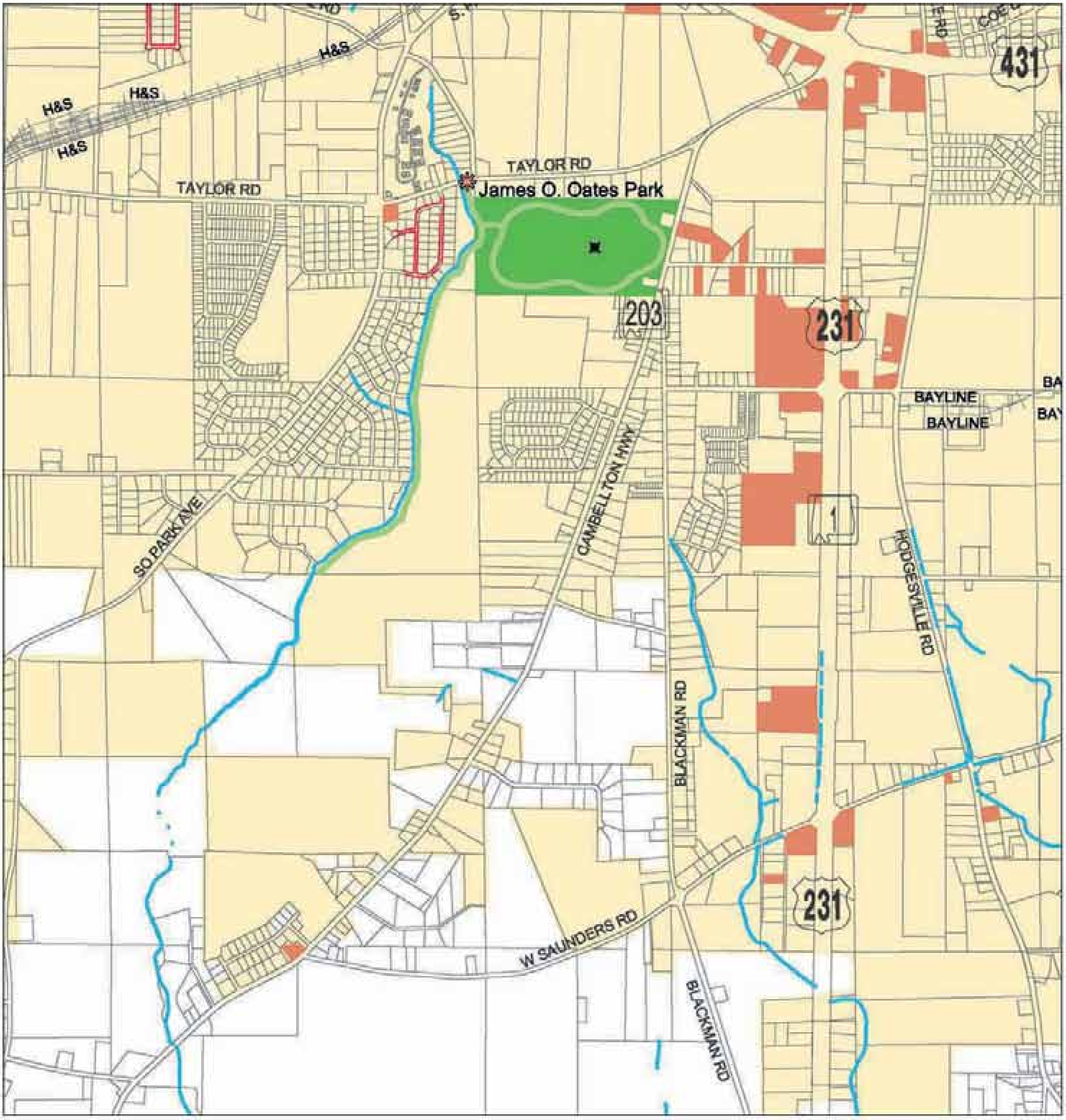
ON ROAD WALKWAY

INTERSECTION IMPROVEMENTS

2,000' 1,000' 0 2,000'

GRAPHIC SCALE (FEET)

walk and bike DOTHAN



NORTH

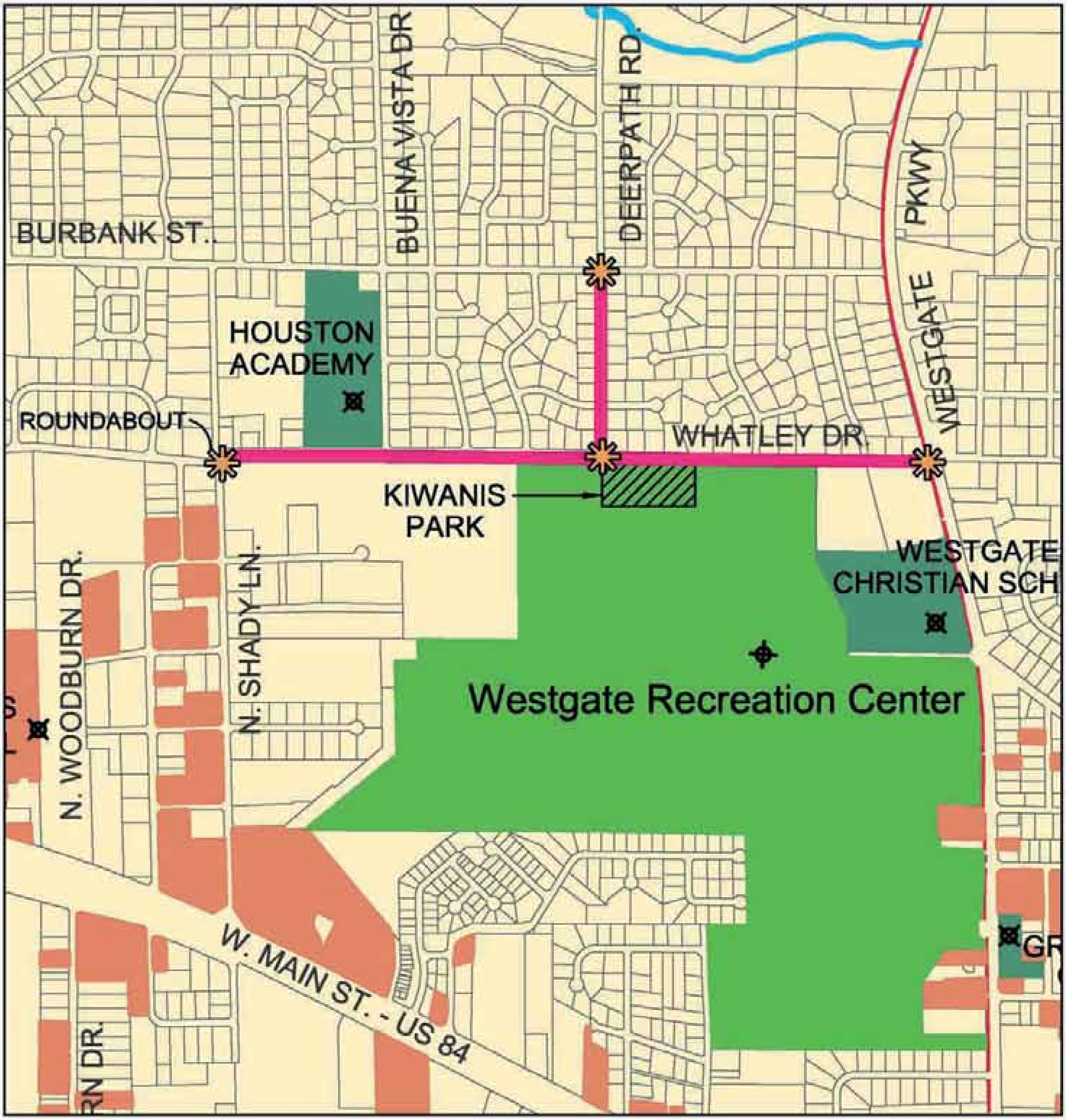
"IMMEDIATE" WALKWAY ROUTE (POTENTIAL PROJECT AREA)
JAMES O. OATES PARK AREA

MAP: WALK-9

LEGEND:
- OFF ROAD WALKWAY
- INTERSECTION IMPROVEMENTS

2,000' 1,000' 0 2,000'
GRAPHIC SCALE (FEET)

walk and bike DOTHAN



NORTH

"IMMEDIATE" WALKWAY ROUTE (POTENTIAL PROJECT AREA)
WESTGATE PARK AREA

MAP: WALK-10

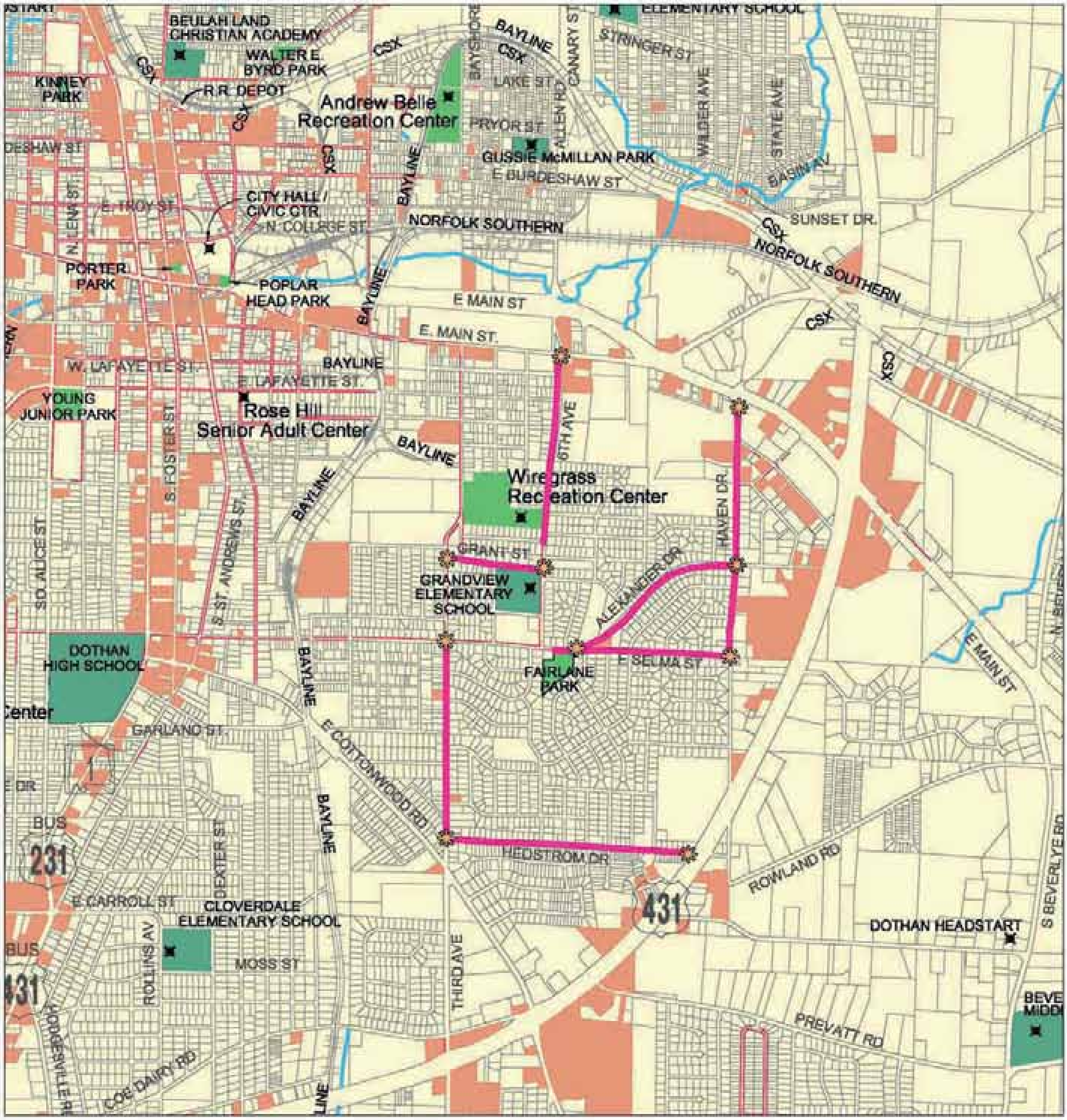
LEGEND:

ON ROAD WALKWAY

INTERSECTION IMPROVEMENTS

1,000' 500' 0 1,000'

GRAPHIC SCALE (FEET)



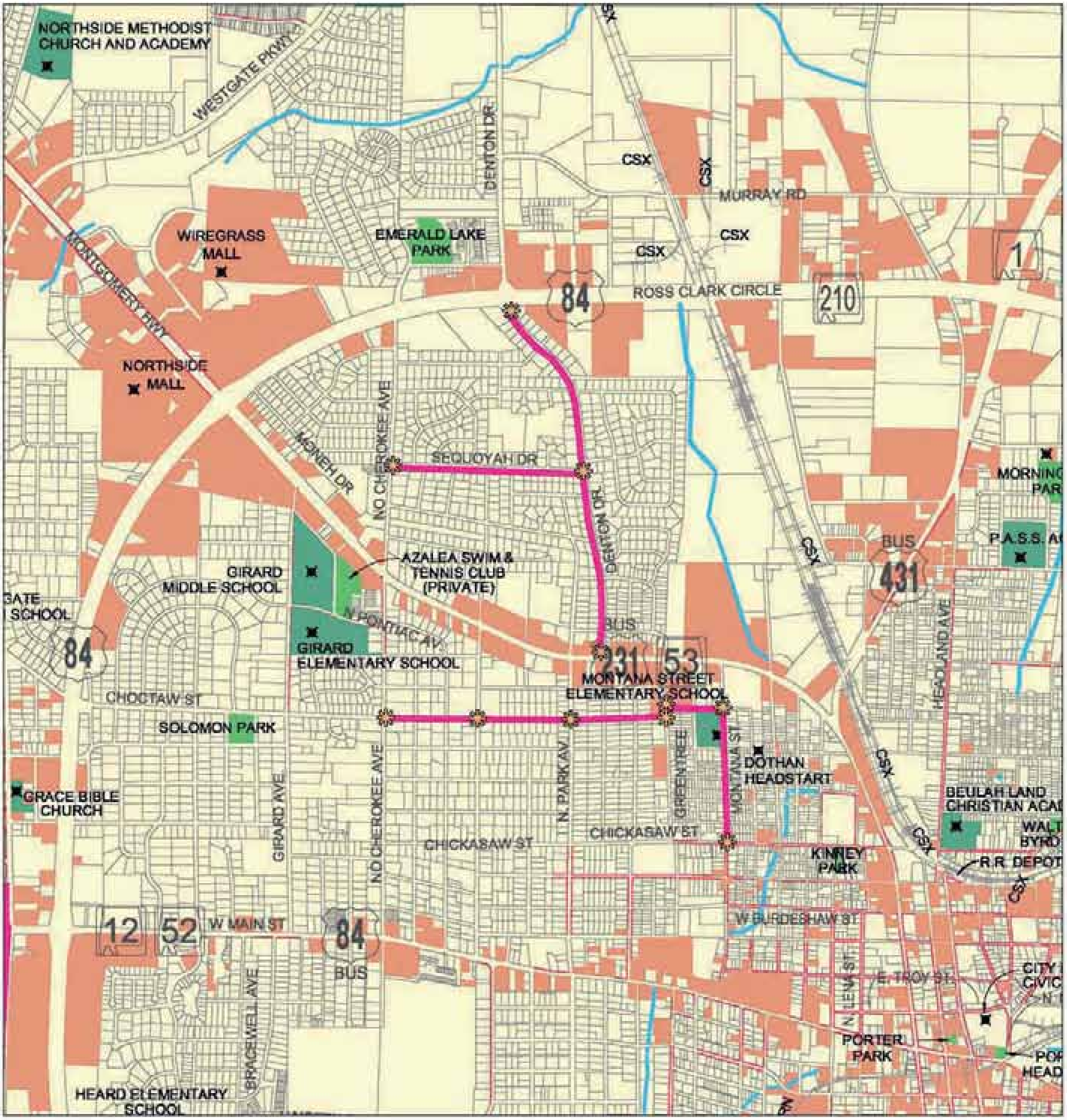
"IMMEDIATE" WALKWAY ROUTE (POTENTIAL PROJECT AREA)
GRANDVIEW ELEMENTARY SCHOOL AREA

MAP: WALK-11

LEGEND:
- ON ROAD WALKWAY
- INTERSECTION IMPROVEMENTS

2,000' 1,000' 0 2,000'

GRAPHIC SCALE (FEET)



NORTH

"IMMEDIATE" WALKWAY ROUTE (POTENTIAL PROJECT AREA)
MONTANA STREET ELEMENTARY SCHOOL AREA

MAP: WALK-12

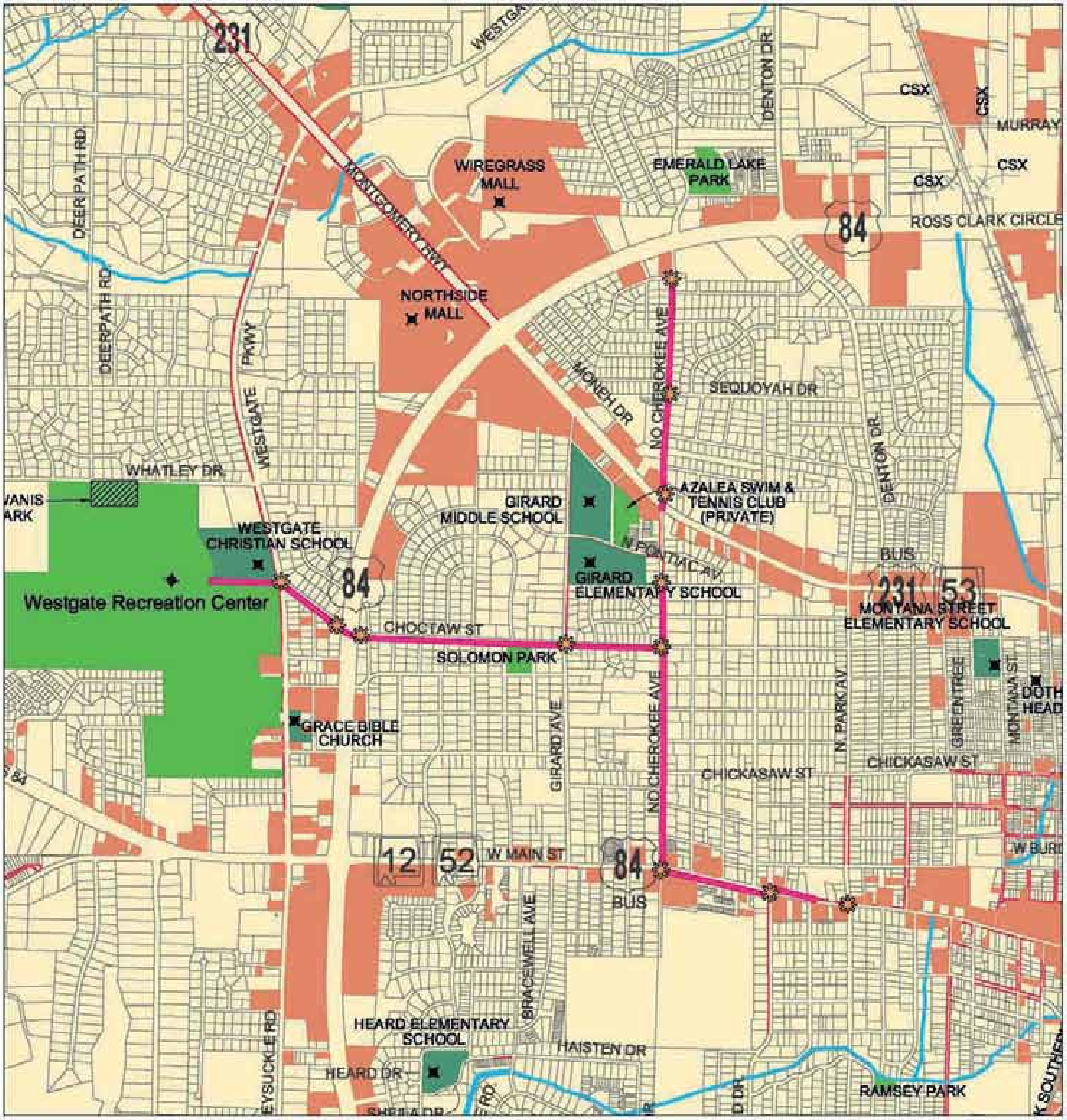
LEGEND:

- ON ROAD WALKWAY
- INTERSECTION IMPROVEMENTS

2,000' 1,000' 0 2,000'

GRAPHIC SCALE (FEET)

walk and bike DOTHAN



"IMMEDIATE" WALKWAY ROUTE (POTENTIAL PROJECT AREA)
GIRARD MIDDLE & GIRARD ELEMENTARY SCHOOL AREA

MAP: WALK-13

NORTH

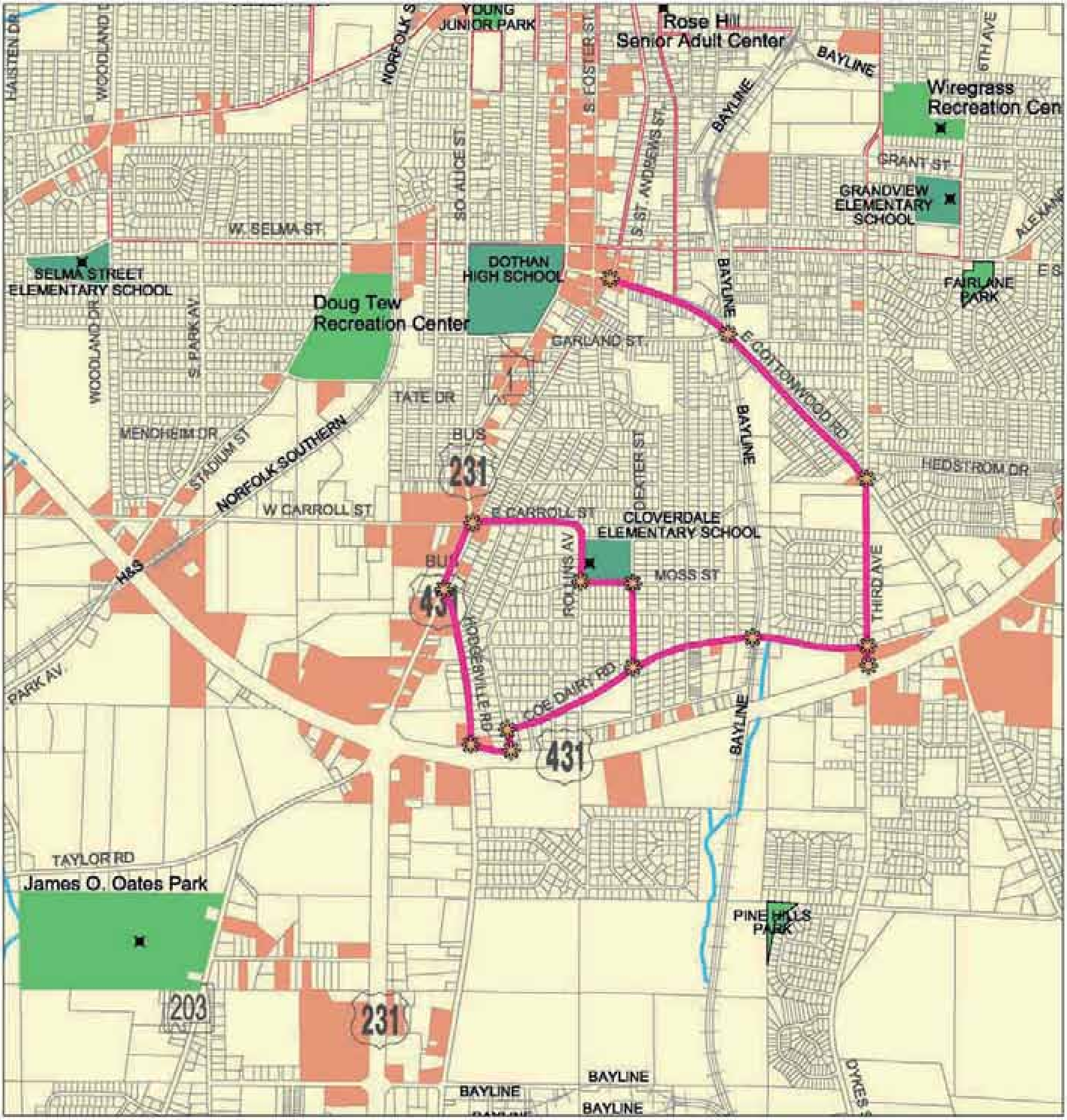
LEGEND:

- ON ROAD WALKWAY
- INTERSECTION IMPROVEMENTS

2,000' 1,000' 0 2,000'

GRAPHIC SCALE (FEET)

walk and bike DOTHAN



NORTH

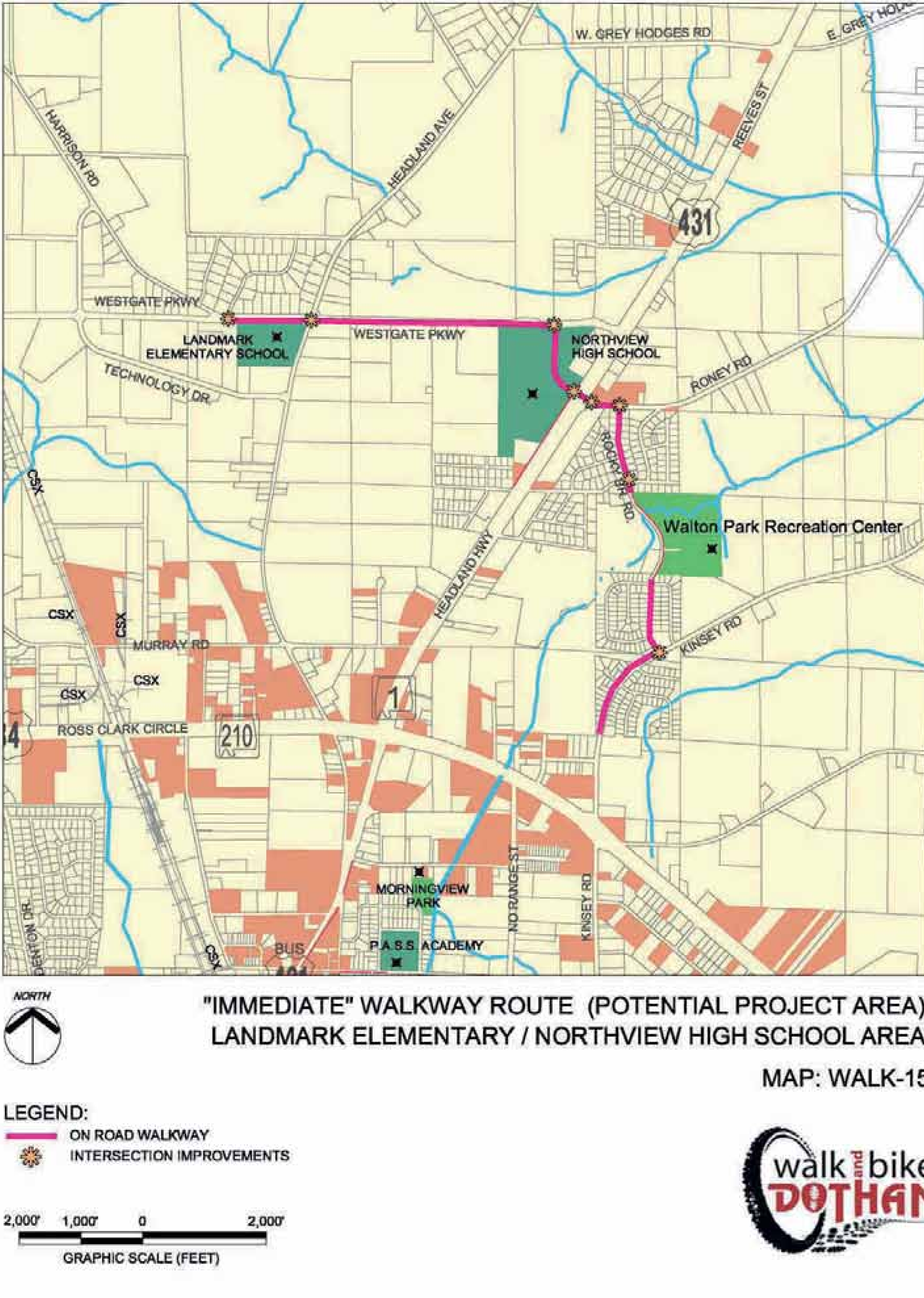
"IMMEDIATE" WALKWAY ROUTE (POTENTIAL PROJECT AREA)
COLVERDALE ELEMENTARY SCHOOL AREA

MAP: WALK-14

LEGEND:
ON ROAD WALKWAY
INTERSECTION IMPROVEMENTS

2,000' 1,000' 0 2,000'
GRAPHIC SCALE (FEET)

walk and bike DOTHAN

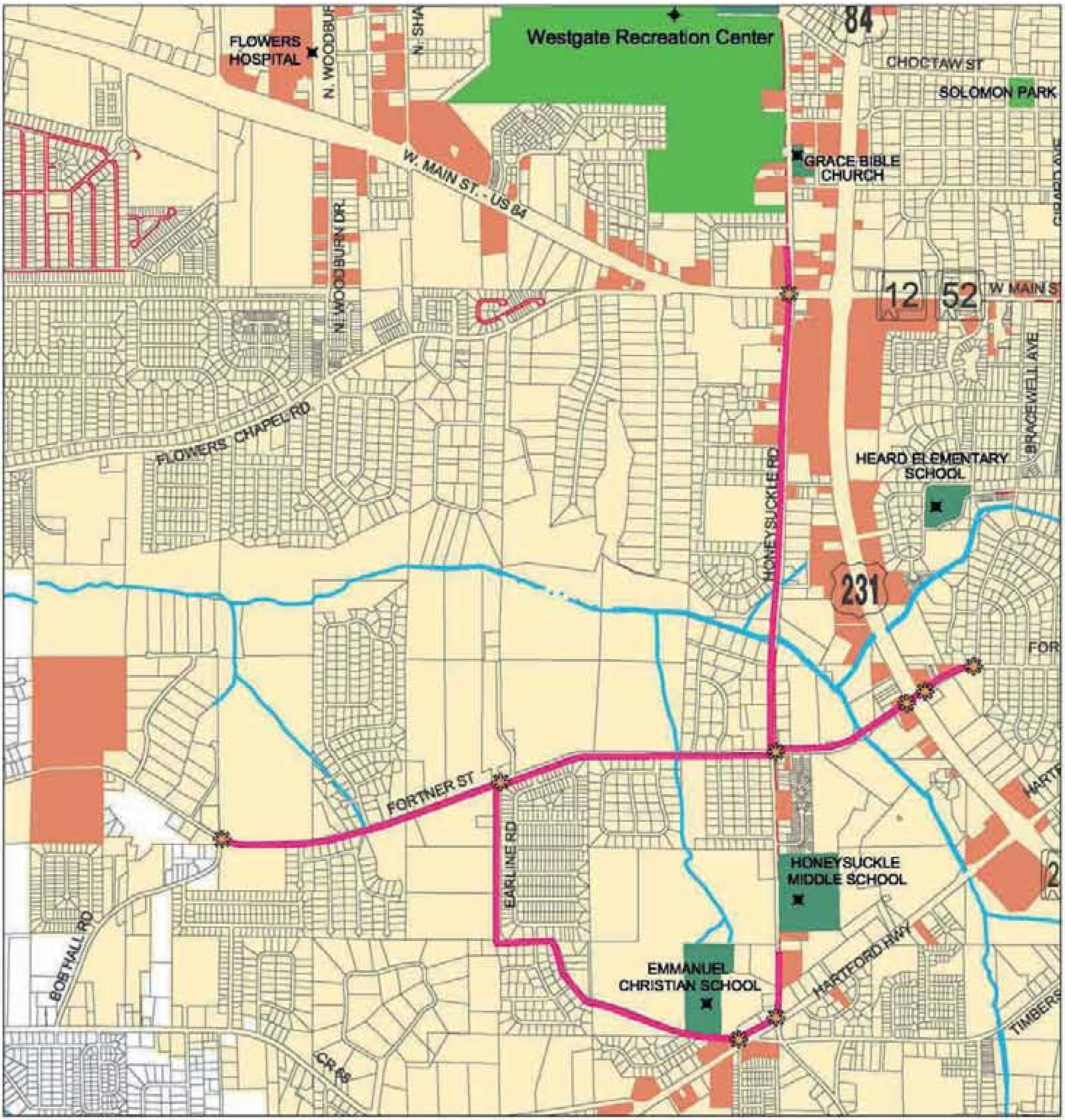


"IMMEDIATE" WALKWAY ROUTE (POTENTIAL PROJECT AREA)
LANDMARK ELEMENTARY / NORTHVIEW HIGH SCHOOL AREA

MAP: WALK-15

LEGEND:
- ON ROAD WALKWAY
- INTERSECTION IMPROVEMENTS

walk and bike DOTHAN



NORTH

"IMMEDIATE" WALKWAY ROUTE (POTENTIAL PROJECT AREA)
HONEYSUCKLE MIDDLE SCHOOL AREA

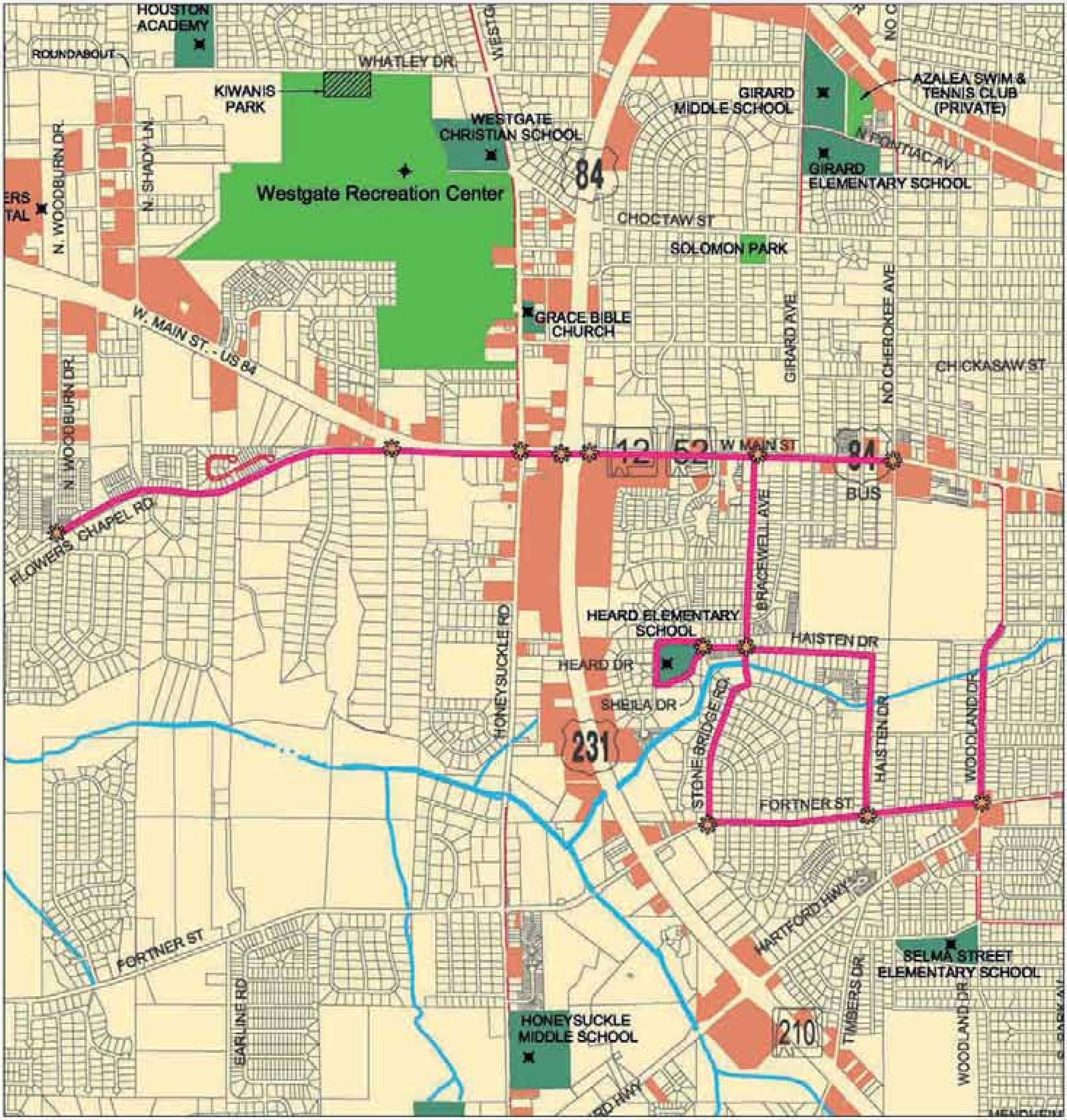
MAP: WALK-16

LEGEND:
- ON ROAD WALKWAY
- INTERSECTION IMPROVEMENTS

2,000' 1,000' 0 2,000'

GRAPHIC SCALE (FEET)

walk and bike DOTHAN



NORTH

"IMMEDIATE" WALKWAY ROUTE (POTENTIAL PROJECT AREA)
HEARD ELEMENTARY SCHOOL AREA

MAP: WALK-17

LEGEND:

- ON ROAD WALKWAY
- INTERSECTION IMPROVEMENTS

2,000' 1,000' 0 2,000'

GRAPHIC SCALE (FEET)

walk and bike DOTHAN

Short Range (5 to 10 Year) Bikeway Initiatives

Short range bikeway initiatives are based on long distance Class A Preferred routes, connections to high-priority routes and connections to major parks. The following table specifies individual short range bikeway project along with a general cost estimate for each project:

Please Note: The bikeway costs which follow are based on the following criteria:

- Assumes bikeways on both sides of road
- Assumes no disturbances to existing utilities
- Assumes private contractor selected by competitive bid
- Assumes no retaining or fill conditions
- Assumes average site accessibility
- No engineering design fees, geotechnical exploratory fees, right-of-way acquisition, legal deed research, surveying, environmental studies, archaeological studies, or other "soft costs" have been included.
- Clear & grub shoulders, 6' wide
- Remove & replace curb & gutter (c & g) where appropriate
- Excavation
- Fine grade, compact shoulders
- Regrass disturbed areas
- Bituminous concrete pavement (5' wide per lane), with aggregate base
- Paint lane stripes
- Paint bicycle icons
- Bicycle signage (assumes 1 sign per 1,000 ft., both sides of road; i.e. 10 signs per mile)

Table 17

Short Range (5 to 10 Year) Bikeway Initiatives and Estimated Cost

On-Road Bikeway Description:	Beginning Point:	Ending Point:	Design Guideline:	Miles	Est. Cost
Westgate Pkwy	Whatley Dr.	Northview High School Rd.	Figure 1	4.6	$3,105,000
Northview High School Rd.	Westgate Pkwy.	Headland Hwy.	Figure 1	0.2	$135,000
Roney Rd.	Headland Hwy.	Rocky Branch Rd.	Figure 2	0.1	$30,000
Denton Dr.	Westgate Pkwy.	Greenwood Dr.	Figure 1	2.6	$1,755,000
No. Park Ave.	Greenwood Dr.	Choctaw St.	Figure 1	0.2	$135,000
Greenwood Dr.	Denton Dr.	No. Park Ave.	Figure 1	0.1	$67,500
Kinsey Rd.	Rocky Branch Rd.	Dunn Rd.	Figure 2	0.8	$240,000
Dunn Rd.	Kinsey Rd.	Webb Rd.	Figure 2	1.4	$420,000
Webb Rd.	Dunn Rd.	Ross Clark Circle	Figure 2	0.9	$270,000
Girard Ave.	Bus. US 231	W. Main St.	Figure 1	1.2	$810,000
W. Main St.	Girard Ave.	Roosevelt Dr.	Figure 1	0.1	$67,500
Roosevelt Dr.	W. Main St.	Bracewell Ave.	Figure 1	0.5	$337,500
Bracewell Ave.	Roosevelt Dr.	Stonebridge Rd.	Figure 1	0.2	$135,000
Stonebridge Rd.	Bracewell Ave.	Fortner St.	Figure 1	0.4	$270,000
Fortner St.	Slightly West of Stonebridge Rd.	Hartford Hwy.	Figure 2	1.1	$330,000
W. Lafayette St.	No. Park Ave.	St. Andrews St.	Figure 1	1.2	$450,000
E. Lafayette St.	Third Ave.	6^{th} Ave.	Figure 1	0.3	$202,500
6^{th} Ave.	E. Lafayette St.	E. Selma St.	Figure 1	0.7	$472,500
E. Selma St.	6^{th} Ave.	Third Ave.	Figure 1	0.3	$202,500
Hartford Hwy.	Fortner St.	Timbers Dr.	Figure 2	0.4	$120,000
Timbers Dr.	Hartford Hwy.	Ross Clark Circle	Figure 2	0.4	$120,000

Table 17 - Short Range (5 to 10 Year) Bikeway Initiatives, Continued

On-Road Bikeway Description:	Beginning Point:	Ending Point:	Design Guideline:	Miles	Est. Cost
Stadium St.	W. Selma St.	Mendheim Dr.	Figure 1	0.6	$405,000
Mendheim Dr.	So. Park Ave.	Stadium St.	Figure 1	0.1	$67,500
So. Alice St.	W. Selma St.	Bus. US 231	Figure 1	0.8	$540,000
E. Carroll St.	Bus. US 231	Rollins Ave.	Figure 1	0.3	$202,500
Rollins Ave.	E. Carroll St.	Moss St.	Figure 1	0.2	$135,000
Moss St.	Rollins Ave.	Dexter St.	Figure 1	0.2	$135,000
Dexter St.	Moss St.	COE Dairy Rd.	Figure 1	0.2	$135,000
COE Dairy Rd.	Dexter St.	Third Ave.	Figure 1	0.7	$472,500
Flowers Chapel Rd.	So. Brannon Stand Rd.	Honeysuckle Rd.	Figure 2	3.2	$960,000
Honeysuckle Rd.	Flowers Chapel Rd.	Hatton Rd.	Figure 2	3.1	$930,000
So. Park Ave.	Bruner Rd.	Ross Clark Circle	Figure 1	2.0	$1,350,000
Taylor Rd.	So. Park Ave.	Campbellton Hwy.	Figure 2	0.9	$270,000
Campbellton Hwy.	Taylor Rd.	Blackman Rd.	Figure 2	0.4	$120,000
Blackman Rd.	Campbellton Hwy.	W. Saunders Rd.	Figure 2	1.6	$480,000
Forrester Rd.	E. Saunders Rd.	Prevatt Rd.	Figure 2	2.1	$630,000
Prevatt Rd.	Forrester Rd.	Sanitary Dairy Rd.	Figure 2	1.2	$360,000
Sanitary Dairy Rd.	Prevatt Rd.	Lucy Grade Rd.	Figure 2	1.9	$570,000
Lucy Grade Rd.	Sanitary Dairy Rd.	Eddins Rd.	Figure 2	1.7	$510,000
Eddins Rd.	Lucy Grade Rd.	E. Cottonwood Rd.	Figure 2	0.1	$30,000
E. Cottonwood Rd.	Forrester Rd.	Eddins Rd.	Figure 2	1.4	$420,000
Shared-Use Off-Road Trail Description:	**Beginning Point:**	**Ending Point:**	**Design Guideline:**	**Miles**	**Est. Cost**
North Creek Greenway (The Choctawhatchee / Rock Creek Trail)	John D. Odom Rd.	Westgate Pkwy	Figure 11	1.6	$740,000

Short Range (5 to 10 Year) Walkway Initiatives

Short range walkway initiatives will provide safe pedestrian access to parks, recreation centers, major shopping center (such as the Dothan Pavilion) and proposed shared-use greenways. The following table identifies short range individual walkway projects along with a general cost estimate for each project:

Please Note: The walkway costs which follow are based on the following criteria:

- Assumes walkways on both sides of road
- Assumes no disturbances to existing utilities
- Assumes private contractor selected by competitive bid
- Assumes no retaining or fill conditions
- Assumes average site accessibility
- No engineering design fees, geotechnical exploratory fees, right-of-way acquisition, legal deed research, surveying, environmental studies, archaeological studies, or other "soft costs" have been included.
- Clear & grub shoulders, 6' wide
- Remove & replace curb & gutter (c & g) where appropriate
- Excavation
- Fine grade, compact areas beneath sidewalks
- Regrass disturbed areas
- 5' wide, 4" thick reinforced concrete sidewalk, with aggregate base
- Concrete handicapped ramps at crosswalk areas
- Pedestrian signal improvements located at major intersections

Table 18

Short Range (5 to 10 Year) Walkway Initiatives and Estimated Cost

On-Road Walkway Description:	Beginning Point:	Ending Point:	Design Guideline:	Miles	Est. Cost
Burbank St.	John D. Odom Rd.	Westgate Pkwy.	Figure 5	1.4	$699,220
Ross Clark Circle	"Northside Mall"	"Wiregrass Mall"	Figure 6	0.6	$635,380
Bus. US 231	Ross Clark Circle	Chickasaw St.	Figure 5	2.2	$1,163,060
Ross Clark Circle	W. Main St.	Fortner St.	Figure 6	2.3	$1,202,290
Shared-Use Off-Road Trail Description:	**Beginning Point:**	**Ending Point:**	**Design Guideline:**	**Miles**	**Est. Cost**
North Creek Greenway (The Choctawhatchee / Rock Creek Trail)	No. Brannon Stand Rd.	Westgate Pkwy	Figure 11	3.1	$1,645,000

Mid to Long Range (10 Plus Year) Bikeway Initiatives

Mid to long range initiatives are based on secondary connections to both immediate and short range initiative access, while also allowing for more diverse community access. The following table identifies mid to long range individual bikeway projects along with a general cost estimate for each project:

Please Note: The bikeway costs which follow are based on the following criteria:

- Assumes bikeways on both sides of road
- Assumes no disturbances to existing utilities
- Assumes private contractor selected by competitive bid
- Assumes no retaining or fill conditions
- Assumes average site accessibility
- No engineering design fees, geotechnical exploratory fees, right-of-way acquisition, legal deed research, surveying, environmental studies, archaeological studies, or other "soft costs" have been included.
- Clear & grub shoulders, 6' wide
- Remove & replace curb & gutter (c & g) where appropriate
- Excavation
- Fine grade, compact shoulders
- Regrass disturbed areas
- Bituminous concrete pavement (5' wide per lane), with aggregate base
- Paint lane stripes
- Paint bicycle icons
- Bicycle signage (assumes 1 sign per 1,000 ft., both sides of road; i.e. 10 signs per mile)

Table 19

Mid to Long Range (10 Plus Year) Bikeway Initiatives and Estimated Cost

On-Road Bikeway Description:	Beginning Point:	Ending Point:	Design Guideline:	Miles	Est. Cost
No. Brannon Stand Rd.	Kelly Springs Rd.	Murphy Mill Rd.	Figure 2	0.8	$240,000
Murphy Mill Rd.	No. Brannon Stand Rd.	Brookside Dr.	Figure 2	1.1	$330,000
Brookside Dr.	Murphy Mill Rd.	Burbank St.	Figure 1	1.3	$877,500
Burbank St.	John D. Odom Rd.	Westgate Pkwy.	Figure 1	1.4	$945,000
Deer Path Rd.	Burbank St.	Whatley Dr.	Figure 1	0.2	$135,000

Table 19 - Mid to Long Range (10 Plus Year) Bikeway Initiatives, Continued

On-Road Bikeway Description:	Beginning Point:	Ending Point:	Design Guideline:	Miles	Est. Cost
No. Shady Lane	Whatley Dr.	Woodburn Dr.	Figure 2	0.4	$120,000
Woodburn Dr.	No. Shady Ln.	W. Main St., US 84	Figure 2	0.4	$120,000
Napier Field Rd.	Mance Newton Rd.	Flynn Rd.	Figure 2	1.0	$300,000
Mance Newton / Harrison Rd.	Napier Field Rd.	Westgate Pkwy.	Figure 2	3.6	$1,080,000
Headland Ave.	“Rail Road Depot”	Dothan Botanical Gardens	Figures 1 & 2	5.2	$2,535,000
W. & E. Grey Hodges Rd.	Headland Ave.	Roney Rd.	Figure 2	1.5	$450,000
Headland Hwy., US 431	Grey Hodges Rd.	“Landmark Park”	Figure 2	0.4	$120,000
Roney Rd.	E. Grey Hodges Rd.	Headland Hwy., US 431	Figure 2	1.7	$510,000
Kinsey Rd.	Dunn Rd.	Omusee Rd.	Figure 2	1.7	$510,000
Omusee Rd.	Kinsey Rd.	Glen Lawrence Rd.	Figure 2	4.6	$1,380,000
Webb Rd.	Omusee Rd.	Dunn Rd.	Figure 2	1.4	$420,000
Webb Rd.	Ross Clark Circle	No. Range St.	Figure 2	1.1	$330,000
Kinsey Rd.	Rocky Branch Rd.	Webb Rd.	Figure 2	1.6	$480,000
E. Wilson St.	Headland Ave.	Kinsey Rd.	Figure 1	0.8	$540,000
Flynn Rd.	Napier Field Rd.	Denton Dr.	Figure 2	1.5	$450,000
Denton Dr.	Flynn Rd.	Westgate Pkwy.	Figure 2	0.3	$90,000
So. Brannon Stand Rd.	No. Creek Greenway	Trawick Rd.	Figure 2	3.8	$1,140,000
Bus. US 231	Ross Clark Circle	E. Burdeshaw St.	Figure 1	2.6	$1,755,000
Montana St.	Chickasaw	W. Burdeshaw St.	Figure 1	0.2	$135,000
W. & E. Burdeshaw St.	Montana St.	Ross Clark Circle	Figure 1	0.2	$135,000
W. & E. Main St., US 84	Ross Clark Circle	Ross Clark Circle	Figure 1	4.4	$2,970,000
Columbia Hwy.	E. Main St.	Ross Clark Circle	Figure 2	0.6	$180,000
Ennis Rd.	Webb Rd.	Columbia Hwy.	Figure 2	1.6	$480,000
Columbia Hwy.	No. Beverlye Rd.	Columbia Hwy.	Figure 2	0.4	$120,000
No. Beverlye Rd.	Columbia Hwy.	“CSX Railroad”	Figure 2	0.5	$150,000
E. Selma St.	6th Ave.	Haven Dr.	Figure 1	0.5	$337,500
Haven Dr.	E. Selma St.	E. Main St.	Figure 1	0.7	$472,000
Fortner St.	Honeysuckle Rd.	“Just inside Ross Clark Circle”	Figure 2	0.5	$150,000
Hatton Rd.	Ross Clark Circle	So. Park Ave.	Figure 2	1.0	$300,000
St. Andrews St.	Selma St.	Bus. US 231	Figure 1	0.9	$607,500
Bus. US 231	E. Carroll St.	Ross Clark Circle	Figure 1	0.6	$405,000
Hedstrom Dr.	Third Ave.	Haven Dr.	Figure 1	0.8	$540,000
Haven Dr.	Hedstrom Dr.	Rowland Rd.	Figure 1	0.1	$67,500
Rowland / Cowarts Rd.	Haven Dr.	Drew Rd.	Figure 2	1.9	$570,000
Drew Rd.	Cowarts Rd.	E. Main St.	Figure 2	0.5	$150,000
E. Main St.	Drew Rd.	Glen Lawrence Rd.	Figure 1	0.6	$405,000
Glen Lawrence Rd.	Omusee Rd.	Prevatt Rd.	Figure 2	2.1	$630,000
Trawick Rd.	So. Brannon Stand Rd.	So. Shady Ln.	Figure 2	1.7	$510,000
So. Shady Ln.	Trawick Rd.	Taylor Rd.	Figure 2	1.1	$330,000
Taylor Rd.	So. Park Ave.	Bruner Rd.	Figure 2	2.4	$720,000
Bruner Rd.	Taylor Rd.	So. Park Ave.	Figure 2	2.0	$600,000
Dykes St. / Third Ave.	Ross Clark Circle	E. Saunders Rd.	Figure 2	1.8	$540,000
Blackman Rd.	W. Saunders Rd.	“National Peanut Festival Site”	Figure 2	0.9	$270,000

Table 19 - Mid to Long Range (10 Plus Year) Bikeway Initiatives, Continued

On-Road Bikeway Description:	Beginning Point:	Ending Point:	Design Guideline:	Miles	Est. Cost
E. Saunders Rd.	Blackman Rd.	E. Cottonwood Rd.	Figure 2	3.3	$990,000
So. Beverlye Rd.	Prevatt Rd.	E. Saunders Rd.	Figure 2	1.2	$360,000
Shared-Use Off-Road Trail Description:	**Beginning Point:**	**Ending Point:**	**Design Guideline:**	**Miles**	**Est. Cost**
North Creek Greenway (The Choctawhatchee / Rock Creek Trail)	No. Brannon Stand Rd.	John D. Odom Rd.	Figure 11	1.5	$705,000
Wiregrass Electric Transmission Line ROW Greenway (Murphy Mill Rd.)	Murphy Mill Rd.	"Pavilion Mall"	Figure 11	0.8	$380,000
South Creek Greenway (The Beaver Creek Trail)	Flowers Chapel Rd.	Honeysuckle Rd.	Figure 11	2.7	$1,275,000

Mid to Long Range (10 Plus year) Walkway Initiatives

Mid to Long Range walkway initiatives will provide secondary connections to both immediate and short range initiative walkway routes for faster pedestrian access, while also allowing for more diverse community access. The following table identifies mid to long range individual walkway projects along with a general cost estimate for each project:

Please Note: The walkway costs which follow are based on the following criteria:

- Assumes walkways on both sides of road
- Assumes no disturbances to existing utilities
- Assumes private contractor selected by competitive bid
- Assumes no retaining or fill conditions
- Assumes average site accessibility
- No engineering design fees, geotechnical exploratory fees, right-of-way acquisition, legal deed research, surveying, environmental studies, archaeological studies, or other "soft costs" have been included.
- Clear & grub shoulders, 6' wide
- Remove & replace curb & gutter (c & g) where appropriate
- Excavation
- Fine grade, compact areas beneath sidewalks
- Regrass disturbed areas
- 5' wide, 4" thick reinforced concrete sidewalk, with aggregate base
- Concrete handicapped ramps at crosswalk areas
- Pedestrian signal improvements located at major intersections

Table 20

Mid to Long Range (10 Plus Year) Walkway Initiatives and Estimated Cost

On-Road Walkway Description:	Beginning Point:	Ending Point:	Design Guideline:	Miles	Est. Cost
Brookside Dr.	Murphy Mill Rd.	Whatley Dr.	Figure 5	0.8	$827,680
Whatley Dr.	No. Shady Ln.	John D. Odom Rd.	Figure 6	0.5	$296,150
Headland Hwy., US 431	Ross Clark Circle	Bus US 231	Figure 5	1.2	$720,760
Bob Hall Rd.	Fortner St.	Trawick Rd.	Figure 6	0.8	$413,840
Trawick Rd.	Bob Hall St.	Hartford Hwy.	Figure 6	1.7	$716,910
Hartford Hwy.	Trawick Rd.	Earline Rd.	Figure 6	0.3	$217,690
Honeysuckle Rd.	Hartford Hwy.	Taylor Rd.	Figure 6	1.6	$677,688

Table 20 - Mid to Long Range (10 Plus Year) Walkway Initiatives, Continued

On-Road Bikeway Description:	Beginning Point:	Ending Point:	Design Guideline:	Miles	Est. Cost
So. Park Ave.	Taylor Rd.	Bruner Rd.	Figure 6	0.9	$453,070
Taylor Rd.	Sprucepine Rd.	Campbellton Why.	Figure 6	1.4	$649,220
So. Alice St.	W. Franklin St.	Helen St.	Figure 5	0.8	$513,840
Tate Dr.	So. Alice St.	Stadium St.	Figure 5	0.5	$346,150
Garland St.	So. Alice St.	Bus. US 231	Figure 5	0.2	$178,460
E. Cottonwood Rd.	Bus. US 231	St. Andrews St.	Figure 5	0.1	$189,230
Bus. US 231	E. Cottonwood Rd.	W. Carroll St.	Figure 5	0.8	$563,840
Bus. US 231	Hodgesville Rd.	Ross Clark Circle	Figure 5	0.4	$256,920
Ross Clark Circle	"The Barn"	Hodgesville Rd.	Figure 6	0.6	$335,380
W. Carroll St.	Bus. US 231	Stadium St.	Figure 5	0.8	$413,840
E. Main St.	Third Ave.	Ross Clark Circle	Figure 5	1.1	$300,000
E. Main St.	Crossing Ln.	Drew Rd.	Figure 5	$699,220	
E. Cottonwood Rd.	Third Ave.	Ross Clark Circle	Figure 5	0.5	$346,150
Ross Clark Circle	Third Ave.	E. Cottonwood Rd.	Figure 6	0.3	$317,690
Ross Clark Circle	Third Ave.	"Just north of Prevatt Rd."	Figure 6	0.7	$474,610
Prevatt Rd.	Lakeside Dr.	Forrester Rd.	Figure 6	0.8	$413,840
So. Beverlye Rd.	Longbriar Ln.	"Trinity Lutheran School"	Figure 6	0.9	$403,070
Shared-Use Off-Road Trail Description:	**Beginning Point:**	**Ending Point:**	**Design Guideline:**	**Miles**	**Est. Cost**
Wiregrass Electric Transmission Line ROW Greenway (Murphy Mill Rd.)	Murphy Mill Rd.	"Pavilion Mall"	Figure 11	0.8	$380,000
South Creek Greenway (The Beaver Creek Trail)	Flowers Chapel Rd.	Honeysuckle Rd.	Figure 11	2.7	$1,275,000

Potential Funding Sources

Adequate financing is the key ingredient for carrying out most planning recommendations. Assistance available through grants can provide a substantial portion of the funds required to implement the improvements recommended by the Plan. The effective utilization of grant funds will likely be the difference in determining the feasibility of undertaking individual components of the Plan and the overall, long-term success of the Bicycle and Pedestrian Program.

Grants alone, however, will not be sufficient to meet all needs and must be accompanied by a substantial commitment of local resources. A balanced combination of financing from the various funding sources identified in this report will help assure the success of Dothan's bicycle and pedestrian facilities without placing an undue burden on the local budget and disrupting the quality of services provided to other portions of the city.

Following is a discussion of some programs that the City of Dothan should consider and continuously monitor for funding opportunities.

Federal and State

Federal and State grant programs are a potential source of financial assistance and can, if wisely used, assist in the implementation of planning proposals. There are a number of State and Federal financial assistance programs potentially available to aid Dothan with funding for projects that cannot be undertaken entirely with local funds. The future of Federal grant funds in the current cost cutting, balanced budget environment, however, is uncertain. In addition, the city is likely to obtain only limited amounts of grant assistance through existing programs and needs to carefully plan grant applications and match grant programs to specific needs and improvements.

According to the Federal Highway Administration (FHWA), Federal surface transportation law provides tremendous flexibility to States and MPOs to fund bicycle and pedestrian improvements from a wide variety of programs. Virtually all the major transportation funding programs can be used for bicycle and pedestrian-related projects. The FHWA encourages States and MPOs to:

- Include bicycle and pedestrian improvements as an incidental part of larger projects.
- To review and use the most appropriate funding source for a particular project and not rely primarily on the Transportation Enhancement activities. Many bicycle and pedestrian projects are more suitable for funding under the Congestion Mitigation and Air Quality Improvement Program, Surface Transportation Program, or one of the other described programs.

Community Development Block Grant

Sidewalks, road improvements, commercial revitalization and neighborhood revitalization are eligible activities for United States Department of Housing and Urban Development Community Development Block Grant Programs (CDBG) funds. These are activities that would lend themselves to the incorporation of proposed bicycle and pedestrian recommendations. Dothan is an entitlement city and receives annual CDBG grant. However, whether or not and the extent such funds will be received each year and in what amount is indeterminate. In addition, CDBG funds support a variety of continuing programs and projects in the City and, therefore, may not be available and / or limited for expenditure on bicycle and pedestrian proposals.

Transportation Enhancement Fund

The Alabama Department of Transportation's Modal Programs Bureau administers the Transportation Enhancements (TE) program which offers funding opportunities to "expand transportation choices and enhance the transportation experience." Three of the Transportation Enhancement programs eligible activities relate specifically to bicycle and pedestrian transportation. They are:

- Provision of facilities for bicyclists and pedestrians;
- Provision of safety and educational activities for pedestrians and bicyclists; and
- Preservation of abandoned railroad corridors (including conversion and use for pedestrian or bicycle trails).

Dothan has successfully applied for TE grants, mostly for landscaping improvements, and should consider including eligible bicycle and pedestrian improvements in future applications. TE funds need not be located on the Federal-aid Highway System and may include non-construction activities. Transportation Enhancement funding requires a 20 percent local match and engineering and consulting fees must be paid with local monies. For more information on the TE program visit: www.enhancements.org.

Land and Water Conservation Fund (L&WCF)

The Land and Water Conservation Fund (LWCF) consist of Federal monies, which are provided through the National Park Service and administered by Alabama Department of Economic and Community Affairs (ADECA). This program is a primary source of funding for the acquisition and development of outdoor recreation areas and facilities. The LWCF program can be used to acquire and construct new park sites and recreation facilities, to upgrade existing recreation facilities and to acquire and improve passive recreation areas such as open space or trail facilities. Grants are competitively awarded on a 50-50 matching basis with a maximum grant limit of $50,000. This funding source can assist with implementing off-street walking and biking facilities and should be considered by the City. However, the program has provided little or no funding in recent years. ADECA has continued to solicit new projects and use its limited rollover funds from prior years when the program was fully funded by Congress. For more information on the LWCF Program visit ADECA's website:

www.adeca.state.al.us/C17/Land%20and%20Water%20Conservation%20Fu/default.aspx

Safe Routes to School Program

The Safe Routes to School (SRTS) Program provides funding for projects and programs that facilitate walking and bicycling to school. It is designed to enable and encourage children in grades K-8, including those with disabilities, to walk and bicycle to school and to make walking and bicycling to school safer and more appealing.

Funding proposals can be submitted annually to the Alabama Department of Transportation (ALDOT) for two program categories: infrastructure projects and non-infrastructure activities. Infrastructure project funding is limited to a two-mile radius of an elementary or middle school and may include the planning and construction of physical improvements such as sidewalks, bicycle parking facilities, street striping for crosswalks and bike lanes, signage, facilities to slow traffic off-street bicycle and pedestrian facilities and improved handicapped accessibility, among other. Non-infrastructure activities include public awareness and outreach campaigns, traffic and enforcement education, law enforcement in the vicinity of schools and training for SRTS activities. Communities receiving an award will be contacted offered education and training to promote the safe use of facilities constructed with the award.

Projects may have a budget up to $150,000 and may involve more than one school. For example, the project may involve school cross walk striping for several schools. Funding is 100% federal, and no matching funds are required. The applicant is responsible for all preliminary costs associated with project development, such as engineering or plans preparation. The SRTS program is a federal reimbursement program, meaning all infrastructure project costs must be incurred by the applicant with reimbursement is then requested from (ALDOT). For more information on the Alabama SRTS Program visit: www.adph.org/srts/Default.asp?id=2971

Recreation Trails Program

The Recreational Trails Program (RTP) was created to assist in acquiring, developing, or improving trail and trail-related resources. The Alabama Department of Economic and Community Affairs (ADECA) administers the state's allocation of (RTP) funds. Each summer ADECA solicits a new round of RTP applications each summer. The maximum grant amount that can be applied for is: $50,000 for non-motorized single use project and $100,000 for a non-motorized diverse use project and with a 20% local match requirement that can include in-kind and donations. Applications may also be made for educational projects. Only one application may be submitted by an applicant; however, an application may contain multiple sites and the non-federal matching share may exceed the minimum required to satisfy the federal matching requirement. ADECA emphasizes that extra consideration will be given to applications that request less than the maximum. Active RTP or Land and Water Conservation Fund (LWCF) grants must be closed prior to submission of a new application. Applications may be submitted for the following activities:

- Development of urban trail linkages near homes and workplaces. This category includes trail linkages to schools, parks, and existing trails.
- Maintenance of existing recreational trails.
- Restoration of areas damaged by usage of recreational trails.
- Development of trail-side and trail-head facilities that meet goals identified by the National Recreational Trails Advisory Committee. This includes trail components or associated facilities which serve the purpose and safe use of the recreational trail and may include but are not limited to the following: 1) Drainage, 2) Crossings, 3) Stabilization, 4) Parking, 5) Signage, 6) Controls, 7) Shelters, and 8) Water, Sanitary, and Access Facilities.
- Provision of features which facilitate the access and use of trails by persons with disabilities.
- Acquisition of easements for trails, or for corridors identified in a state trail plan.
- Acquisition of fee simple title to property from a willing seller.
- Construction of new trails on state, county, municipal, or private lands, where a recreational need for such construction is shown.
- Purchase of trail maintenance equipment.

For more RTP program information, visit ADECA's website at:
www.adeca.state.al.us/C16/Recreational%20Trails/default.aspx

Funding Sources: Federal Highway Administration / MPO

Funding sources from the Federal Highway Administration are potentially available through the Southeast Wiregrass MPO. These sources are authorized in the Safe Accountable Flexible efficient Transportation Equity Act a Legacy for User (SAFETEA-LU). In addition to the typical transportation facilities, the bill provides funds for bicycle and pedestrian projects. The MPO is responsible for allocating certain funds at the metropolitan level such as Congestion Mitigation and Air Quality and Surface Transportation Program Attributable.

Congestion Mitigation and Air Quality Improvement Program (CMAQ) assists areas designated as nonattainment or maintenance under the Clean Air Act Amendments of 1990 to achieve and maintain healthful levels of air quality by funding transportation projects and programs. Dothan has not yet been designated as a nonattainment area, but should be cognizant of this program if nonattainment status is designated at a future date.

Eligible activities set out by the Act include transportation control measures including "limiting portions of the road surface or sections of a metropolitan area to the use of non-motorized vehicles"; "employer participation in programs to encourage bicycling"; and "programs for secure bicycle storage facilities and other facilities, including bicycle lanes, for the convenience and protection of bicyclists in both public and private places." Federal Highway Administration's Guidance on the CMAQ program identifies:

- construction of bicycle and pedestrian facilities
- non-construction projects related to safe bicycle use, and
- establishment and funding of bicycle/pedestrian coordinator positions for the promoting and facilitating the increased use of non-motorized modes of transportation. This includes public education, promotional, and safety programs for using such facilities.

Nationwide the CMAQ program has funded numerous bicycle and pedestrian improvements including bicycle parking, bicycle racks on buses, sidewalks, trails, and promotional programs such as bike-to-work events. CMAQ funds have also been used to fund bicycle and pedestrian coordinator positions at the local level.

National Highway System

Bicycle and pedestrian facilities within NHS corridors are eligible activities for NHS funds. U.S. Highway 84 from its western intersection with Ross Clark Circle to the eastern city limits is the only designated NHS facility in Dothan.

Funding is possible for bike lane, shoulder and sidewalk improvements on major arterial roads that are part of the National Highway System, and bicycle and/or pedestrian bridges and tunnels that cross NHS facilities. Funding requires a 20 percent match.

Opportunities to improve conditions for the non-motorized modes should be taken whenever resurfacing, reconstruction, or expansion projects on NHS routes are undertaken.

Highway Bridge Replacement and Rehabilitation Program

The Highway Bridge Replacement and Rehabilitation Program enables States to replace or rehabilitate highway bridges over waterways, other topographical barriers, other highways, or railroads when those bridges are unsafe. Highway bridges, located on any public road, that are either "functionally obsolete" or "structurally deficient" are eligible for replacement or rehabilitation using Bridge Program funds.

Where a highway bridge deck is being replaced or rehabilitated with Federal financial participation and bicyclists are permitted to operate at each end of such bridge, the safe accommodation of bicyclists can be provided at reasonable cost as part of such replacement or rehabilitation. Bicycle and pedestrian improvements on bridges are usually carried out as an incidental part of a larger replacement or rehabilitation project and funds can be used to provide a range of on-street, sidewalk, and trail facilities depending on the appropriate design for the bridge and the location.

Surface Transportation Program

Bicycle and pedestrian improvements are eligible activities under the Surface Transportation Program (STP). This covers a wide variety of projects such as on-road facilities, off-road trails, sidewalks, crosswalks, bicycle and pedestrian signals, parking, and other ancillary facilities. The modification of sidewalks to comply with the requirements of the Americans with Disabilities Act is an eligible activity.

As an exception to the general rule described above, STP-funded bicycle and pedestrian facilities may be located on local and collector roads which are not part of the Federal-aid Highway System. In addition, bicycle-related non-construction projects, such as maps, coordinator positions, and encouragement programs, are eligible for STP funds.

STP funds are eligible to be spent on a wide variety of improvements for bicycling and walking including, but not limited to, on- and off-road facilities, bicycle parking, planning studies, local bicycle and pedestrian coordinator positions, spot improvement programs, sidewalks, crosswalks, and traffic calming projects. As the category of funding with probably the broadest eligibility, the STP should be considered as a source of funds for both independent and incidental bicycle and pedestrian projects, as well as non-construction projects.

Highway Safety Improvement Program

Highway Safety Improvement Program (HSIP) funds can be used for pedestrian and bicycle safety improvements on any public road or publicly owned bicycle or pedestrian pathway or trail.

Bikes Belong Coalition

Bikes Belong Coalition is a private organization funded by and representing the bicycle industry, whose mission is, "Putting more people on bikes more often through the implementation of Transportation Enhancement." To that end, Bikes Belong awards grants of up to $10,000 each to projects that seek Transportation Enhancement funding for bicycle facilities. Bikes Belong is looks for grant seekers, groups, or communities for which a grant can provide financial support. Bikes Belong grants have been used for concept plans, design, outreach, and preliminary engineering, as well as local match contributions. The grant application, guide and other information can be viewed at www.bikesbelong.org.

Local Funding

Most all of the Plans recommended public activities and improvements will require some type of local financial assistance to implement. In order for these monies to be utilized there would have to be a surplus of funds sufficient to be appropriated for this purpose in any given fiscal year as with any other public project or program.

Local funding sources which can be utilized to finance public aspects of the Plan recommendations include the General Fund, gasoline taxes, general obligation bonds and property assessments. These are discussed below in more detail.

General Fund

General Fund revenues are derived from a variety of tax sources (e.g., sales tax, lodging tax, business licenses) and provide the basis for funding most public improvements and activities. The General Fund is a source of financing for small to medium scale infrastructure projects which can be included in the annual city budget. The General Fund should be used primarily to supplement or match other sources of financing (i.e., grants) and/or to fund activities or improvements (i.e., sidewalks) which cannot be financed through other revenue sources.

Gasoline Taxes

The sales tax on gasoline is a primary funding source for street improvements and associated storm water drainage facilities (i.e., curbs and gutters). The amount of funds available can be anticipated from previous gas tax revenues and street improvements can be planned and budgeted based upon projections of future revenues.

General Obligation Bonds

General Obligation Bonds are a frequently used method of financing for large-scale capital improvements. Bonds can be issued for up to 30 years and can be used to finance proposed public infrastructure improvements. In incurring long-term or bond financing, local officials should consider terms for repayment of the debt. There are several drawbacks to this type of bond for the type of improvements needed to implement bicycle and pedestrian facility proposals. One is that the interest on the bond can significantly increase the initial cost of the project. Another is that it may not be prudent to issue such debt on improvements that do not generate a source of revenue to retire the debt. Furthermore, the Alabama Constitution of 1901 at Section 225 modified by Amendment 268, limits the amount of general obligation bonds a municipality can issue to that equal to twenty percent of the assessed valuation of property within the municipality.

APPENDICES IMMEDIATELY FOLLOW THIS PAGE

APPENDIX:

Alabama Pedestrian Laws – State Article 10
Alabama Bicycle & Safety Laws – State Articles 12 and 13

FHWA Crosswalk Safety Article

Safety Effects of Marked Versus Unmarked Crosswalks at Uncontrolled Locations, FHWA
Publication Number: HRT-04-100, September 2005

Large Folded Maps – 36”x 40”
(Located in Map Pockets at End of Document)

Large Map 1: Existing Bicycle, Pedestrian Facilities / Potential Biking, Walking Destinations
Large Map 2: Proposed Bikeways
Large Map 3: Proposed Walkways
Large Map 4: Bikeway Route Prioritization
Large Map 5: Walkway Route Prioritization

ALABAMA PEDESTRIAN LAWS – ARTICLE 10

BEGIN ARTICLE 10
PEDESTRIANS' RIGHT AND DUTIES

- **<u>Section 32-5A-210</u>:**
  Pedestrian obedience to traffic-control devices and traffic regulations.

  (a) A pedestrian shall obey the instructions of any official traffic-control device specifically applicable to him, unless otherwise directed by a police officer.

  (b) Pedestrians shall be subject to traffic and pedestrian control signals as provided in Sections 32-5A-32 and 32-5A-33.

  (c) At all other places, pedestrians shall be accorded the privileges and shall be subject to the restrictions stated in this chapter.

  (Acts 1980, No. 80-434, p. 604, §5-101.)

- **<u>Section 32-5A-211</u>**:
  Pedestrians' right-of-way in crosswalks.

  (a) When traffic-control signals are not in place or not in operation the driver of a vehicle shall yield the right-of-way, slowing down or stopping if need be to so yield, to a pedestrian crossing the roadway within a crosswalk when the pedestrian is upon the half of the roadway upon which the vehicle is traveling, or when the pedestrian is approaching so closely from the opposite half of the roadway as to be in danger.

  (b) No pedestrian shall suddenly leave a curb or other place of safety and walk or run into the path of a vehicle which is so close as to constitute an immediate hazard.

  (c) Subsection (a) shall not apply under the conditions stated in Section 32-5A-212(b).

  (d) Whenever any vehicle is stopped at a marked crosswalk or at any unmarked crosswalk at an intersection to permit a pedestrian to cross the roadway, the driver of any other vehicle approaching from the rear shall not overtake and pass such stopped vehicle.

  (Acts 1980, No. 80-434, p. 604, §5-102.)

- **<u>Section 32-5A-212</u>:**
  Crossing at other than crosswalks.

  (a) Every pedestrian crossing a roadway at any point other than within a marked crosswalk or within an unmarked crosswalk at an intersection shall yield the right-of-way to all vehicles upon the roadway.

  (b) Any pedestrian crossing a roadway at a point where a pedestrian tunnel or overhead pedestrian crossing has been provided shall yield the right-of-way to all vehicles upon the roadway.

  (c) Between adjacent intersections at which traffic-control signals are in operation pedestrians shall not cross at any place except in a marked crosswalk.

(d) No pedestrian shall cross a roadway intersection diagonally unless authorized by official traffic-control devices; and, when authorized to cross diagonally, pedestrians shall cross only in accordance with the official traffic-control devices pertaining to such crossing movements.

(Acts 1980, No. 80-434, p. 604, §5-103.)

- **Section 32-5A-213:**
  Drivers to exercise care.
  Notwithstanding other provisions of this chapter or the provisions of any local ordinance, every driver of a vehicle shall exercise due care to avoid colliding with any pedestrian and shall give warning by sounding the horn when necessary and shall exercise proper precaution upon observing any child or any obviously confused, incapacitated or intoxicated person.
  (Acts 1980, No. 80-434, p. 604, §5-104.)

- **Section 32-5A-214:**
  Pedestrians to use right half of crosswalks.
  Pedestrians shall move, whenever practicable, upon the right half of crosswalks.
  (Acts 1980, No. 80-434, p. 604, §5-105.)

- **Section 32-5A-215:**
  Pedestrians on roadways.

  (a) Where a sidewalk is provided and its use is practicable, it shall be unlawful for any pedestrian to walk along and upon an adjacent roadway.

  (b) Where a sidewalk is not available, any pedestrian walking along and upon a highway shall walk only on a shoulder, as far as practicable from the edge of the roadway.

  (c) Where neither a sidewalk nor a shoulder is available any pedestrian walking along and upon a highway shall walk as near as practicable to an outside edge of the roadway, and if on a two-way roadway, shall walk only on the left side of the roadway.

  (d) Except as otherwise provided in this chapter, any pedestrian upon a roadway shall yield the right-of-way to all vehicles upon the roadway.

  (Acts 1980, No. 80-434, p. 604, §5-106.)

- **Section 32-5A-216:**
  Pedestrian soliciting rides or business or fishing.

  (a) No person shall stand in a roadway for the purpose of soliciting a ride.

  (b) No person shall stand on a highway for the purpose of soliciting employment, business, or contributions from the occupant of any vehicle, nor for the purpose of distributing any article, unless otherwise authorized by official permit of the governing body of the city or county having jurisdiction over said highway.

  (c) No person shall stand on or in proximity to a street or highway for the purpose of soliciting the watching or guarding of any vehicle while parked or about to be parked on a street or highway.

(d) No person shall fish from a bridge, viaduct, or trestle, or the approaches thereto, within the State of Alabama, unless otherwise authorized by the governing body of the city or county having jurisdiction over said highway or from the State of Alabama in the case of state highways. The authorizing authority shall erect and maintain appropriate signs giving notice that fishing is allowed.

(Acts 1980, No. 80-434, p. 604, §5-107; Acts 1981, No. 81-803, p. 1412, §1.)

- **Section 32-5A-217:**
  Driving through safety zone prohibited.
  No vehicle shall at any time be driven through or within a safety zone.
  (Acts 1980, No. 80-434, p. 604, §5-108.)

- **Section 32-5A-218:**
  Pedestrians' right-of-way on sidewalk.
  The driver of a vehicle shall yield the right-of-way to any pedestrian on sidewalk.
  (Acts 1980, No. 80-434, p. 604, §5-109.)

- **Section 32-5A-219:**
  Pedestrians to yield to authorized emergency vehicles.

  (a) Upon the immediate approach of an authorized emergency vehicle making use of an audible signal meeting the requirements of Section 32-5-213 and visual signals meeting the requirements of law, or of a police vehicle properly and lawfully making use of an audible signal only, every pedestrian shall yield the right-of-way to the authorized emergency vehicle.

  (b) This section shall not relieve the driver of an authorized emergency vehicle from the duty to drive with due regard for the safety of all persons using the highway nor from the duty to exercise due care to avoid colliding with any pedestrian.

  (Acts 1980, No. 80-434, p. 604, §5-110.)

- **Section 32-5A-220:**
  Right-of-way to blind persons, guide dogs in training.
  The driver of a vehicle shall yield the right-of-way to any blind pedestrian carrying a clearly visible white cane or accompanied by a guide dog, or any person employed by an accredited school for training guide dogs who provides notice through a sign or other method that he or she is training the dog accompanying him or her as a guide dog for the blind.
  (Acts 1980, No. 80-434, p. 604, §5-111; Act 99-698, 2nd Sp. Sess., p. 207, §1.)

- **Section 32-5A-221:**
  Pedestrians under influence of alcohol or drugs.
  A pedestrian who is under the influence of alcohol or any drug to a degree which renders himself a hazard shall not walk or be upon a highway.
  (Acts 1980, No. 80-434, p. 604, §5-112.)

- **Section 32-5A-222:**
  Bridge and railroad signals.

  (a) No pedestrian shall enter or remain upon any bridge or approach thereto beyond the bridge signal, gate or barrier after a bridge operation signal indication has been given.

  (b) No pedestrian shall pass through, around, over or under any crossing gate or barrier at a railroad grade crossing or bridge while such gate or barrier is closed or is being opened or closed.

  (Acts 1980, No. 80-434, p. 604, §5-113.)

END ARTICLE 10
PEDESTRIANS' RIGHT AND DUTIES

END OF ALABAMA PEDESTRIAN LAWS

ALABAMA BICYCLE LAWS – ARTICLES 12 AND 13

BEGIN ARTICLE 12
BICYCLES AND PLAY VEHICLES

- **Section 32-5A-260:**
  Traffic laws apply to persons riding bicycles.
  Every person riding a bicycle upon a roadway shall be granted all of the rights and shall be subject to all of the duties applicable to the driver of a vehicle by this chapter, except as to special regulations in this article and except as to those provisions of this chapter which by their nature can have no application.
  (Acts 1980, No. 80-434, p. 604, §12-102.)

- **Section 32-5A-261**:
  Riding on bicycles.

  (a) A person propelling a bicycle shall not ride other than upon or astride a permanent and regular seat attached thereto.

  (b) No bicycle shall be used to carry more persons at one time than the number for which it is designed and equipped.

  (Acts 1980, No. 80-434, p. 604, §12-103.)

- **Section 32-5A-262:**
  Clinging to vehicles.
  No person riding upon any bicycle, coaster, roller skates, sled or toy vehicle shall attach the same or himself to any vehicle upon a roadway.
  (Acts 1980, No. 80-434, p. 604, §12-104.)

- **Section 32-5A-263:**
  Riding on roadways and bicycle paths.

  (a) Every person operating a bicycle upon a roadway shall ride as near to the right side of the roadway as practicable, exercising due care when passing a standing vehicle or one proceeding in the same direction.

  (b) Persons riding bicycles upon a roadway shall not ride more than two abreast except on paths or parts of roadways set aside for the exclusive use of bicycles.

  (c) Wherever a usable path for bicycles has been provided adjacent to a roadway, bicycle riders shall use such path and shall not use the roadway.

  (Acts 1980, No. 80-434, p. 604, §12-105.)

- **Section 32-5A-264:**
  Carrying articles.
  No person operating a bicycle shall carry any package, bundle or article which prevents the driver from keeping at least one hand upon the handlebars.
  (Acts 1980, No. 80-434, p. 604, §12-106.)

- **<u>Section 32-5A-265</u>:**

  Lamps and other equipment on bicycles.

  (a) Every bicycle when in use at nighttime shall be equipped with a lamp on the front which shall emit a white light visible from a distance of at least 500 feet to the front and with a red reflector on the rear of a type approved by the department which shall be visible from all distances from 100 feet to 600 feet to the rear when directly in front of lawful lower beams of head lamps on a motor vehicle. A lamp emitting a red light visible from a distance of 500 feet to the rear may be used in addition to the red reflector.

  (b) Every bicycle shall be equipped with a brake which will enable the operator to make the braked wheels skid on dry, level, clean pavement.

  (Acts 1980, No. 80-434, p. 604, §12-107.)

- **<u>Section 32-5A-266</u>:**
  Violations of article as misdemeanor; responsibility of parent or guardian; applicability of article.

  (a) It is a misdemeanor for any person to do any act forbidden or fail to perform any act required in this article.

  (b) The parent of any child and the guardian of any ward shall not authorize or knowingly permit any such child or ward to violate any of the provisions of this chapter.

  (c) These regulations applicable to bicycles shall apply whenever a bicycle is operated upon any highway or upon any path set aside for the exclusive use of bicycles subject to those exceptions stated herein.

  (Acts 1980, No. 80-434, p. 604, §12-101.)

END ARTICLE 12
BICYCLES AND PLAY VEHICLES

BEGIN ARTICLE 13
BICYCLE SAFETY

- **<u>Section 32-5A-280</u>:**
  Short title.
  This article shall be known and may be cited as the "Brad Hudson-Alabama Bicycle Safety Act of 1995."
  (Acts 1995, No. 95-198, p. 306, §1.)

- **<u>Section 32-5A-281</u>:**
  Definitions.
  As used in this article, the following words shall have the following meanings:

  (1) BICYCLE. A human-powered vehicle with two wheels in tandem design to transport by the act of pedaling one or more persons seated on one or more saddle seats on its frame. "Bicycle" includes, but is not limited to, a human-powered vehicle designed to transport

by the act of pedaling which has more than two wheels when the vehicle is used on a public roadway, public bicycle path, or other public road or right-of-way, but does not include a tricycle.

(2) OPERATOR. A person who travels on a bicycle seated on a saddle seat from which that person is intended to and can pedal the bicycle.

(3) OTHER PUBLIC RIGHT-OF-WAY. Any right-of-way other than a public roadway or public bicycle path that is under the jurisdiction and control of the state or a local political subdivision thereof.

(4) PASSENGER. Any person who travels on a bicycle in any manner except as an operator.

(5) PROTECTIVE BICYCLE HELMET. A piece of headgear which meets or exceeds the impact standard for protective bicycle helmets set by the American National Standards Institute (ANSI) or the Snell Memorial Foundation, or which is otherwise approved by the Alabama Department of Public Safety.

(6) PUBLIC BICYCLE PATH. A right-of-way under the jurisdiction and control of the state, or a local political subdivision thereof, for use primarily by bicyclists and pedestrians.

(7) PUBLIC ROADWAY. A right-of-way under the jurisdiction and control of the state or a local political subdivision thereof for use primarily by motor vehicular traffic.

(8) RESTRAINING SEAT. A seat separate from the saddle seat of the operator of the bicycle or a bicycle trailer or similar product that is fastened securely to the frame of the bicycle and is adequately equipped to restrain the passenger in the seat and protect the passenger from the moving parts of the bicycle.

(9) TRICYCLE. A three-wheeled human-powered vehicle designed for use by a child under the age of six.

(Acts 1995, No. 95-198, p. 306, §2.)
http://www.legislature.state.al.us/CodeofAlabama/1975/32-5A-281.htm

- **Section 32-5A-282:**
  Purpose.
  The purpose of this article is to reduce the incidence of disability and death resulting from injuries incurred in bicycling accidents by requiring that, while riding on a bicycle on public roadways, public bicycle paths, or other public rights-of-way, all operators and passengers who are under 16 years of age to wear approved protective bicycle helmets, and by requiring that all bicycle passengers who weigh less than 40 pounds or are less than 40 inches in height be seated in separate restraining seats.
  (Acts 1995, No. 95-198, p. 306, §3.)

- **Section 32-5A-283:**
  Unlawful for person to use bicycle under certain conditions.
  It is unlawful for any person to use a bicycle on a public roadway, public bicycle path, other public rights-of-way, state, city, or county public park under any one of the following conditions:

(1) For any person under the age of 16 years to operate or be a passenger on a bicycle unless at all times the person wears a protective bicycle helmet of good fit, fastened securely upon the head with the straps of the helmet.

(2) For any person to operate a bicycle with a passenger who weighs less than 40 pounds or is less than 40 inches in height unless the passenger is properly seated in and adequately secured in a restraining seat.

(3) For any parent or legal guardian of a person under the age of 16 years to knowingly permit the person to operate or be a passenger on a bicycle in violation of subdivision (1) or (2).

(Acts 1995, No. 95-198, p. 306, §4.)

- **Section 32-5A-284:**
  Duties of person regularly engaged in business of renting bicycles.

(a) A person regularly engaged in the business of renting bicycles shall require each person seeking to rent a bicycle to provide his or her signature either on the rental form or on a separate form indicating both of the following:
   (1) Receipt of a written explanation of the provisions of this article and the penalties for violations.
   (2) A statement concerning whether a person under the age of 16 years will operate the bicycle in an area where the use of a helmet is required.

(b) A person regularly engaged in the business of renting bicycles shall provide a helmet to any person who will operate the bicycle in an area requiring a helmet, if the person does not already have a helmet in his or her possession. A reasonable fee may be charged for the helmet rental.

(c) A person regularly engaged in the business of selling or renting bicycles who complies with this article shall not be liable in a civil action for damages for any physical injuries sustained by a bicycle operator or passenger as a result of the operator's or passenger's failure to wear a helmet or to wear a properly fitted or fastened helmet in violation of this article.

(Acts 1995, No. 95-198, p. 306, §5.)

- **Section 32-5A-285:**
  Statewide bicycle safety education program; manner violations handled.

It is the legislative intent to implement an effective statewide bicycle safety education program to reduce disability and death resulting from improper or unsafe bicycle operation. Violations of Section 32-5A-283 shall be handled in the following manner:

(1) On the first offense, the police officer shall counsel and provide written information to the child relative to bicycle helmet safety. The officer shall instruct the child to deliver the written information to the parent.

(2) On the second offense, the police officer shall counsel the child and provide written information on bicycle helmet safety. A warning citation shall be issued to the child to give to the parent. The citation shall instruct the parent or guardian to contact the police department for further information about the law and where to obtain a bicycle helmet.

(3) Beginning on July 1, 1996, upon a third offense, the police officer shall counsel the child, confiscate the bicycle, and take the child to his or her residence. The officer shall then return the bicycle and give a warning ticket to the parent or guardian. If the parent or guardian is unavailable, the ticket shall be left at the residence with instructions to the parent or guardian to pick up the bicycle at the police department.

(4) Beginning on July 1, 1996, upon a fourth offense, the police officer shall confiscate the bicycle, take the child to his or her residence, whereupon a citation for fifty dollars ($50) will be issued to the parent or guardian of the child. No court costs nor fees may be added to the fine or penalty. The fine or penalty shall be waived or suspended if the operator or passenger presents by the court date, proof of purchase or evidence of having provided a protective bicycle helmet or restraining seat and intends to use or causes to be used or intends to cause to be used the helmet as provided by law.

(5) Any fine or penalty monies shall be earmarked and used separately by the local school system for the purpose of safety education or the local municipality for the purchase of helmets for the financially disadvantaged.

(6) The Traffic Safety Center of the University of Montevallo, in conjunction with the Child Safety Institute at Children's Hospital of Alabama, shall furnish all materials, handouts, brochures, and other information related to bicycle safety used by police departments.

(Acts 1995, No. 95-198, p. 306, §6.)
http://www.legislature.state.al.us/CodeofAlabama/1975/32-5A-285.htm

- **Section 32-5A-286:**
  Establishment of more comprehensive bicycle safety program by ordinance.
  A municipality may establish a more comprehensive bicycle safety program than that imposed by this article by local ordinance.
  (Acts 1995, No. 95-198, p. 306, §7.)

END ARTICLE 13
BICYCLE SAFETY

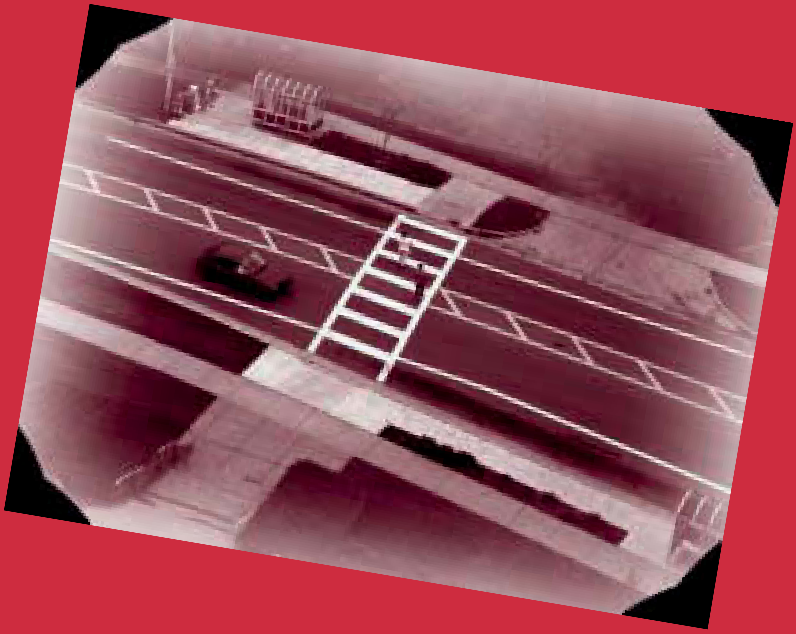
END OF ALABAMA BICYCLE LAWS

Safety Effects of Marked Versus Unmarked Crosswalks at Uncontrolled Locations

Final Report and Recommended Guidelines

FHWA PUBLICATION NUMBER: HRT-04-100

SEPTEMBER 2005



U.S. Department of Transportation
Federal Highway Administration

Research, Development, and Technology
Turner-Fairbank Highway Research Center
6300 Georgetown Pike
McLean, VA 22101-2296

Pedestrian and Bicycle Safety

FOREWORD

The Federal Highway Administration's (FHWA) Pedestrian and Bicycle Safety Research Program's overall goal is to increase pedestrian and bicycle safety and mobility. From better crosswalks, sidewalks, and pedestrian technologies to expanding public educational and safety programs, FHWA's Pedestrian and Bicycle Safety Research Program strives to pave the way for a more walkable future. The following document presents the results of a study that examined the safety of pedestrians at uncontrolled crosswalks and provides recommended guidelines for pedestrian crossings. The crosswalk study was part of a large FHWA study, "Evaluation of Pedestrian Facilities," that has produced a number of other documents regarding the safety of pedestrian crossings and the effectiveness of innovative engineering treatments on pedestrian safety. It is hoped that readers also will read the reports documenting the results of the related pedestrian safety studies. The results of this research will be useful to transportation engineers, planners, and safety professionals who are involved in improving pedestrian safety and mobility.

Michael F. Trentacoste
Director, Office of Safety
Research and Development

NOTICE

QUALITY ASSURANCE STATEMENT

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15. Supplementary Notes

This report is part of a larger study for FHWA entitled "Evaluation of Pedestrian Facilities." FHWA Contracting Officer's Technical Representatives (COTRs): Carol Tan and Ann Do, HRDS.

16. Abstract

Pedestrians are legitimate users of the transportation system, and they should, therefore, be able to use this system safely. Pedestrian needs in crossing streets should be identified, and appropriate solutions should be selected to improve pedestrian safety and access. Deciding where to mark crosswalks is only one consideration in meeting that objective. The purpose of this study was to determine whether marked crosswalks at uncontrolled locations are safer than unmarked crosswalks under various traffic and roadway conditions. Another objective was to provide recommendations on how to provide safer crossings for pedestrians. This study involved an analysis of 5 years of pedestrian crashes at 1,000 marked crosswalks and 1,000 matched unmarked comparison sites. All sites in this study had no traffic signal or stop sign on the approaches. Detailed data were collected on traffic volume, pedestrian exposure, number of lanes, median type, speed limit, and other site variables. Poisson and negative binomial regressive models were used.

The study results revealed that on two-lane roads, the presence of a marked crosswalk alone at an uncontrolled location was associated with no difference in pedestrian crash rate, compared to an unmarked crosswalk. Further, on multilane roads with traffic volumes above about 12,000 vehicles per day, having a marked crosswalk alone (without other substantial improvements) was associated with a higher pedestrian crash rate (after controlling for other site factors) compared to an unmarked crosswalk. Raised medians provided significantly lower pedestrian crash rates on multilane roads, compared to roads with no raised median. Older pedestrians had crash rates that were high relative to their crossing exposure.

More substantial improvements were recommended to provide for safer pedestrian crossings on certain roads, such as adding traffic signals with pedestrian signals when warranted, providing raised medians, speed-reducing measures, and others.

17. Key Words	18. Distribution Statement
Marked crosswalk, safety, pedestrian crashes	No restrictions. This document is available to the public through the National Technical Information Service, Springfield, VA 22161.

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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
		NOTE: volumes greater than 1000 L shall be shown in m^3		
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
^oF	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	^oC
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
^oC	Celsius	1.8C+32	Fahrenheit	^oF
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.
(Revised March 2003)

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CHAPTER 1. BACKGROUND AND INTRODUCTION

Pedestrians are legitimate users of the transportation system, and they should, therefore, be able to use this system safely and without unreasonable delay (figure 1). Pedestrians have a right to cross roads safely, and planners and engineers have a professional responsibility to plan, design, and install safe and convenient crossing facilities. Pedestrians should be included as design users for all streets.

As a starting point, roads should be designed with the premise that there will be pedestrians, that they must be able to cross the street, and that they must be able to do it safely. The design question is, "How can this task best be accomplished?"

Providing marked crosswalks traditionally has been one measure used in an attempt to facilitate crossings. Such crosswalks commonly are used at uncontrolled locations (i.e., sites not controlled by a traffic signal or stop sign) and sometimes at midblock locations. However, there have been conflicting studies and much controversy regarding the safety effects of marked crosswalks. This study evaluated marked crosswalks at uncontrolled locations and offers guidelines for their use.

Figure 1. Pedestrians have a right to cross the road safely and without unreasonable delay.

HOW TO USE THIS STUDY

Marked crosswalks are one tool used to direct pedestrians safely across a street. When considering marked crosswalks at uncontrolled locations, the question should not be simply, "Should I provide a marked crosswalk or not?" Instead, the question should be, "Is this an appropriate tool for directing pedestrians across the street?" Regardless of whether marked crosswalks are used, there remains the fundamental obligation to get pedestrians safely across the street.

In most cases, marked crosswalks are best used in combination with other treatments (e.g., curb extensions, raised crossing islands, traffic signals, roadway narrowing, enhanced overhead lighting, traffic calming measures). Marked crosswalks should be one option in a progression of design treatments. If one treatment does not accomplish the task adequately, then move on to the next one. Failure of one particular treatment is not a license to give up and do nothing. In all cases, the final design must accomplish the goal of getting pedestrians across the road safely.

WHAT IS THE LEGAL DEFINITION OF A CROSSWALK?

The 2000 *Uniform Vehicle Code and Model Traffic Ordinance* (Uniform Vehicle Code) (Section 1-112) defines a crosswalk as: [1]

(a) "That part of a roadway at an intersection included within the connections of the lateral lines of the sidewalks on opposite sides of the highway measured from the curbs, or in the absence of curbs, from the edges of the traversable roadway; and in the absence of a sidewalk on one side of the roadway, the part of a roadway included within the extension of the lateral lines of the existing sidewalk at right angles to the centerline.

(b) Any portion of a roadway at an intersection or elsewhere distinctly indicated for pedestrian crossing by lines or other markings on the surface."

Thus, a crosswalk at an intersection is defined as the extension of the sidewalk or the shoulder across the intersection, regardless of whether it is marked or not. The only way a crosswalk can exist at a midblock location is if it is marked. Most jurisdictions have crosswalk laws that make it legal for pedestrians to cross the street at any intersection, whether marked or not, unless the pedestrian crossing is specifically prohibited.

According to Section 3B.17 of the *Manual on Uniform Traffic Control Devices* (MUTCD), crosswalks serve the following purposes:[2]

> "Crosswalk markings provide guidance for pedestrians who are crossing roadways by defining and delineating paths on approaches to and within signalized intersections, and on approaches to other intersections where traffic stops.
>
> Crosswalk markings also serve to alert road users of a pedestrian crossing point across roadways not controlled by traffic signals or STOP signs.
>
> At intersection locations, crosswalk markings legally establish the crosswalk."

The MUTCD also provides guidance on marked crosswalks, including:

- Crosswalk width should not be less than 1.8 meters (m) (6 feet (ft)).
- Crosswalk lines should extend across the full width of the pavement (to discourage diagonal walking between crosswalks).
- Crosswalks should be marked at all intersections that have "substantial conflict between vehicular and pedestrian movements."
- Crosswalk markings should be provided at points of pedestrian concentration, such as at loading islands, midblock pedestrian islands, and/or where pedestrians need assistance in determining the proper place to cross the street.

The MUTCD further states that: "Crosswalk lines should not be used indiscriminately. An engineering study should be performed before they are installed at locations away from traffic signals or STOP signs."

However, the MUTCD does not provide specific guidance relative to the site condition (e.g., traffic volume, pedestrian volume, number of lanes, presence or type of median) where marked crosswalks should or should not be used at uncontrolled locations. Such decisions have historically been left to the judgment of State and local traffic engineers.

Furthermore, practices on where to mark or not mark crosswalks have differed widely among highway agencies, and this has been a controversial topic among researchers, traffic engineers, and pedestrian safety advocates for many years. More specific safety research and guidelines have been needed on where to mark or not mark crosswalks at uncontrolled locations.

Designated marked or unmarked crosswalks are also required to be accessible to wheelchair users if an accessible sidewalk exists. The level of connectivity between pedestrian facilities is directly related to the placement and consistency of street crossings.

Why Are Marked Crosswalks Controversial?

There has been considerable controversy in the United States about whether marked crosswalks increase or decrease pedestrian safety at crossing locations that are not controlled by a traffic signal or stop sign. Many pedestrians consider marked crosswalks as a tool to enhance pedestrian safety and mobility. They view the markings as proof that they have a right to share the roadway, and in their opinion, the more the better. Many pedestrians do not understand the legal definition of a crosswalk and think that there is no crosswalk unless it is marked. They may also think that a driver can see the crosswalk markings as well as they can, and they assume that it will be safer to cross where drivers can see the white crosswalk lines.

When citizens request the installation of marked crosswalks, some engineers and planners still refer to the 1972 study by Herms as justification for not installing marked crosswalks at uncontrolled locations.[(3)] That study found an increased incidence of pedestrian collisions in marked crosswalks, compared to unmarked crosswalks, at 400 uncontrolled intersections in San Diego, CA. Questions have been asked about the validity of that study, and the study results have sometimes been misquoted or misused. Some have misinterpreted the results of that study. The study did not conclude that all marked crosswalks are unsafe, and the study also did not include school crosswalks. A few other studies have also tried to address this issue since the Herms study was completed. Some were not conclusive because of their methodology or sample size problems, while others have fueled the disagreements and confusion on this matter.

Furthermore, most of the previous crosswalk studies have analyzed the overall safety effects of marked crosswalks but did not investigate their effects for various numbers of lanes, traffic volumes, or other roadway features. Like other traffic control devices, crosswalks should not be expected to be equally effective or appropriate under all roadway conditions.

Where Are Crosswalks Typically Installed?

The practice of where to install crosswalks differs considerably from one jurisdiction to another across the United States, and engineers have been left with using their own judgment (sometimes influenced by political and/or public pressure) in reaching decisions. Some cities have developed their own guidelines on where marked crosswalks should or should not be installed. At a minimum, many cities tend to install marked crosswalks at signalized intersections, particularly in urban areas where there is pedestrian crossing activity. Many jurisdictions also commonly install marked crosswalks at school crossing locations (especially where adult crossing guards are used), and they are more likely to mark crosswalks at intersections controlled by a stop sign. At uncontrolled locations, some agencies rarely, if ever, choose to install marked crosswalks; other agencies install marked crosswalks at selected pedestrian crossing locations, particularly in downtown areas. Some towns and cities have also chosen to supplement selected marked crosswalks with advance overhead or post-mounted pedestrian warning signs, flashing lights, “Stop for Pedestrians in Crosswalk” signs mounted at the street centerline (or mounted along the side of the street or overhead), and/or supplemental pavement markings.

STUDY PURPOSE AND OBJECTIVE

Many highway agencies routinely mark crosswalks at school crossings and signalized intersections. While questions have been raised concerning marking criteria at these sites, most of the controversy on whether to mark crosswalks has pertained to the many uncontrolled locations in U.S. towns and cities. The purpose of this study was to determine whether marked crosswalks at uncontrolled locations are safer than unmarked crosswalks under various traffic and roadway conditions. Another objective was to provide recommendations on how to provide safer crossings for pedestrians. This includes providing assistance to engineers and planners when making decisions on:

- Where marked crosswalks may be installed.
- Where an existing marked crosswalk, by itself, is acceptable.
- Where an existing marked crosswalk should be supplemented with additional improvements.
- Where one or more other engineering treatments (e.g., raised median, traffic signal with pedestrian signal) should be considered instead of having only a marked crosswalk.
- Where marked crosswalks are not appropriate.

The results of this study should not be misused as justification to do nothing to help pedestrians cross streets safely. Instead, pedestrian crossing problems and needs should be identified routinely, and appropriate solutions should be selected to improve pedestrian safety and access. Deciding where to mark or not mark crosswalks is only one consideration in meeting that objective.

This final report is based on a major study for the Federal Highway Administration (FHWA) on the safety effects of pedestrian facilities. The report titled, “Safety Effects of Marked versus Unmarked Crosswalks at Uncontrolled Locations: Executive Summary and Recommended Guidelines” also was prepared as a companion document.[(4)]

PAST RESEARCH

Studies of the effects of marked crosswalks have yielded contradictory results. Some studies reported an association of marked crosswalks with an increase in pedestrian crashes. Other studies did not show an elevated collision level associated with marked crosswalks, but instead showed favorable changes. As to the negative findings, assertions were made that marked crosswalks somehow induced incautious behavior on the part of pedestrians, triggered perhaps by what they thought the markings signified. The following paragraphs describe the findings of some of these studies.

Crash Studies

An early and oft-quoted study in California performed by Herms investigated pedestrian crash risk at marked and unmarked crosswalks.[(3)] This study evaluated pedestrian crashes at 400 intersections where at least 1 crosswalk was painted and another was not. There are thousands of other intersections in San Diego, CA, where neither crosswalk was painted or both were painted, but those were not included in the Herms study. That study rightly emphasizes the difficulty of “maintaining equivalent conditions” in comparing marked and unmarked crosswalks, and lists 12 factors to try to address such difficulties. Since the study was confined to intersections that had one marked and one unmarked crosswalk across the same main thoroughfare, it is not surprising that the vehicle traffic exposure was quite similar between the marked and unmarked crosswalks. However, pedestrian volume was three times as high on the marked crosswalks as on the unmarked crosswalks. Herms stated:

> "Evidence indicates that the poor crash record of marked crosswalks is not due to the crosswalk being marked as much as it is a reflection on the pedestrian's attitude and lack of caution when using the marked crosswalk."[3]

The Herms study, however, does not say what evidence the author had in mind regarding incautious pedestrian behavior. No behavioral data was presented. Other authors have advanced similar assertions with regard to pedestrian behavior in marked crosswalks.

One of the issues involved in this crosswalk controversy relates to questions on the warrants used in San Diego, CA, to determine where to paint crosswalks. Specifically, the warrant directive for San Diego (January 15, 1962), established a point system calling for painting crosswalks when: (1) traffic gaps were fewer rather than more numerous; (2) pedestrian volume was high; (3) speed was moderate (not low, not high); and (4) other prevailing factors were present, such as previous crashes. Thus, it is possible that crosswalks may have been more likely to be painted in San Diego, CA, where the conditions were most ripe for pedestrian collisions (compared to sites which were unmarked). This could at least partly explain the increase in pedestrian crashes at marked crosswalks in the Herms study. Furthermore, the city of San Diego did not eliminate the use of marked crosswalks at uncontrolled locations based on the results of this study. The study recommended against the indiscriminate use of markings at uncontrolled locations. It should be mentioned that the Herms study did not distinguish whether the results would have differed, for example, for two-lane versus multilane roads, or for low-volume versus high-volume roads.

Gibby et al. later revisited the issue.[5] Their report contains a thorough review of the literature and also includes an analysis of pedestrian crashes at 380 highway intersections in California. These intersections were picked after a detailed, multistep selection process in which more than 10,000 intersections were initially considered, and all but 380 were excluded. Their results showed that pedestrian crash rates at these 380 unsignalized intersections were 2 or 3 times higher in marked than in unmarked crosswalks when expressed as crash rates per unit pedestrian-vehicle volume. This study had the advantage of including a relatively large sample of intersections in cities throughout California, which may have minimized any data bias resulting from crosswalk marking criteria. However, it should be mentioned that, as with the Herms study, the Gibby study also did not determine how the results (between marked and unmarked crosswalks) might have differed for two-lane versus multilane roads, and/or for roads with low average daily traffic (ADT) compared to high ADT.

Other studies have been conducted to address this issue. Gurnett described a project to remove painted stripes from some crosswalks following a bad crash experience.[6] This was a before-after study of three locations that were selected for crosswalk removal because they had a recent bad crash record. After removing the crosswalks, crashes decreased. Such results do not show the effect of removing the paint, but are very likely the result of the well-known statistical phenomenon of regression to the mean. It is also not clear whether pedestrian crossing volumes may have dropped after the marked crosswalks were removed.[6]

Another study of marked crosswalks at unsignalized intersections was reported by the Los Angeles, CA, County Road Department in July 1967.[7] The county reported results of a before-after study of 89 intersections. Painted crosswalks were added at each site, but the basis for selecting those sites was not mentioned. Pedestrian crashes increased from 4 during the before period to 15 in the after period. The before-after design in this study is preferable to a treatment-control model in this instance, and better takes the selection effect into account. All sites that showed crash increases were intersections with an ADT rate above 10,900. Thus, at sites with a lower ADT rate, no change in pedestrian crashes was seen. Also, rear-end collisions increased from 31 to 58 after marked crosswalks were added. The report stated that rear-end collisions increased as traffic volume increased. Nevertheless, the study showed more pedestrian crashes after painting the crosswalks than before for the sites with ADT rates above 10,500. The study could have been enhanced by including an analysis of crashes within a comparison group of unpainted sites during the same time period. It is not clear whether pedestrian volumes may have increased at the crosswalks after they were marked.(7)

In contrast to the studies described above, Tobey et al. reported *reduced* crashes associated with marked crosswalks.(8) They examined crashes at marked and unmarked crosswalks as a function of pedestrian volume (*P*) multiplied by vehicle volume (*V*). When the *P* times *V* product was used as a denominator, crashes at unmarked crosswalks were found to be considerably overrepresented; crashes at marked crosswalks were underrepresented considerably. Communication with the authors indicates that this study included controlled (signalized) as well as uncontrolled crossings. It seems likely, therefore, that more marked crosswalks than unmarked crosswalks were present at controlled crossings, which could at least partially explain the different results compared to other studies. The study methodology was quite useful for determining pedestrian crash risk for a variety of human and locational features. However, the study results were not intended to be used for quantifying the specific safety effects of marked versus unmarked crosswalks for various traffic and roadway situations.(8)

In 1996, Ekman conducted an analysis of pedestrian crashes at zebra crossings compared to crossings with traffic signals and also to crossings with no facilities.(9) Zebra crossings in Sweden (figure 2) consist of high-visibility crosswalk markings on the roadway, accompanied by zebra crossing signs (figure 3). The study included 6 years of collected pedestrian crash data from crossings in five cities in southern Sweden along with pedestrian counts, traffic volume, and other information for each of the three types of pedestrian crossings.

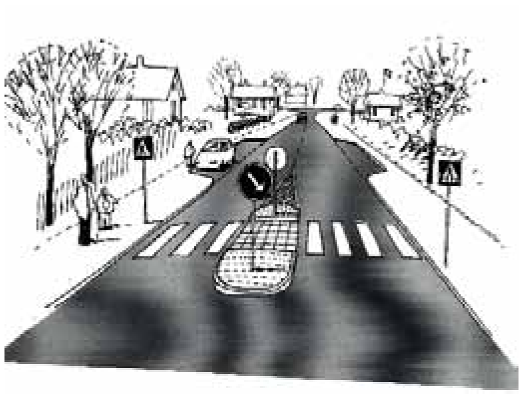


Figure 2. A zebra crossing used in Sweden.

Figure 3. Sign accompanying zebra crossings in Sweden.

The rate of pedestrian crashes was found to be higher (approximately twice as high) at intersections which had zebra crossings, compared to locations that were signalized or had no facilities. Further, pedestrians age 60 and above were most at risk, followed by pedestrians below age 16 (see figure 4). The author also controlled for motor vehicle traffic and found similar results.(9)

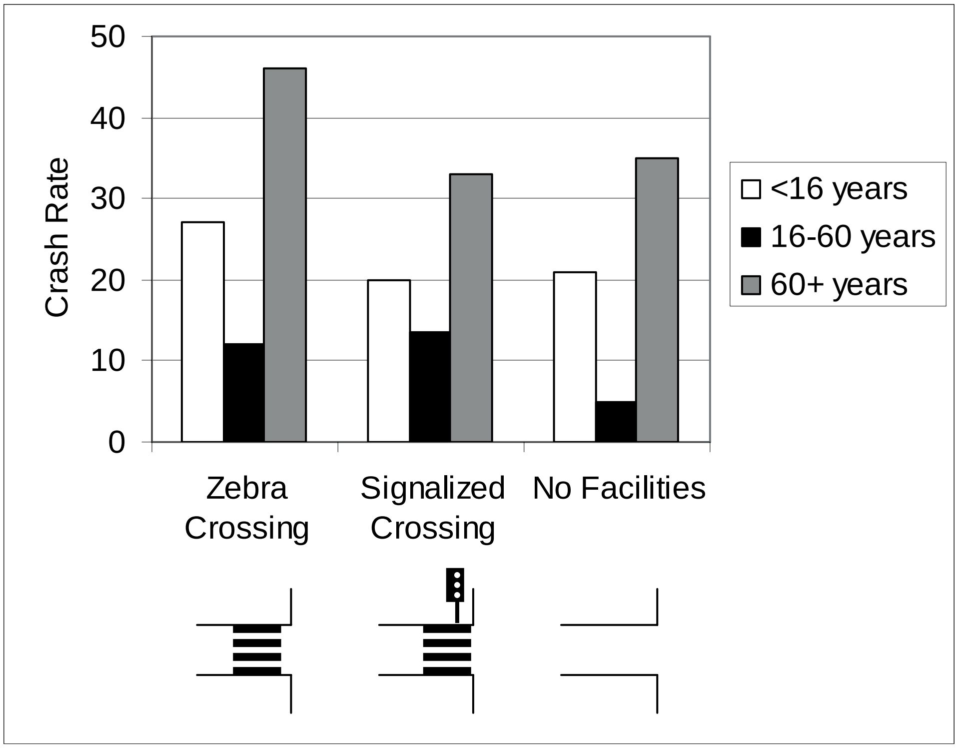


Figure 4. Pedestrian crash rates for the three crossing types by age group.

In a 1999 study involving the relationship between crashes or conflicts and exposure, Ekman and Hyden compared intersections with and without zebra crossings on major streets in the cities of Malmö and Lund, Sweden. Among other conclusions, the study found that "Zebra crossings seem to have higher crash rate than approaches without zebra," and "The increased crash rate for approaches with zebra crossings is only valid on locations where the car flow is larger than 10 cars per hour." Conflict rates were about twice as high with zebra crossings compared to crossings with no control. The authors reported that the dataset did not include enough sites with car exposure greater than 250 cars per hour. The study also found that the positive effects of pedestrian refuge islands "seem to be stronger than the negative effect of zebra crossing, at least in the lower region of car exposure." This finding supports the safety benefit of having a raised pedestrian refuge island at pedestrian crossings.[10]

Yagar reported the results of introducing marked crosswalks at 13 Toronto, Canada intersections.[11] The basis for selecting the particular intersections was not described. A before-after study was conducted, and it was found that crashes had been increasing during the before period and continued to increase after crosswalks were installed. It is not apparent from the graphs that there was any change in slope associated with the time of painting the crosswalks; it would appear that marking the crosswalks did not have much of an effect on crashes. However, the author points to an increase in tailgating crashes at the intersections after crosswalk painting. He also reports that the increased crashes during the after phase seemed to be entirely explained by an increase in crashes involving out-of-town drivers. Perhaps the increase in crashes by out-of-town motorists was because they were not expecting any change in pedestrian or motorist behavior of the local residents, who may have been more familiar with the new markings. However, no behavioral data was included in the study.

In summary, there are no clear-cut results from the studies reviewed to permit concluding with confidence that either marked or unmarked crosswalks are safer. The selection bias (on where crosswalks are marked) could certainly affect the results of a given study. Units of pedestrian crash experience were also inconsistent from one study to another. Another important question relates to whether analyzing sites separately by site type (e.g., two-lane versus multilane road, high volume versus low volume) would produce different results on the safety effects of marked versus unmarked crosswalks.

Behavioral Studies Related to Marked Crosswalks

In addition to crash-based studies, it is also important to review studies that evaluate the effects of crosswalk marking on pedestrian and motorist behavior. Such review can reveal changes in behavior, which can lead to crashes for different crosswalk conditions. The following paragraphs discuss some of these behavioral studies.

Katz et al. conducted an experimental study of driver and pedestrian interaction when the pedestrian crossed a street.(12) The pedestrians in question were members of the study team, and they crossed a street under a variety of conditions (960 trials). It was found that drivers stop for pedestrians as a function of several variables. Drivers stop more frequently when the vehicle's approach speed is low, when the pedestrian is in a marked crosswalk, when the distance between vehicle and pedestrian is greater rather than less, when pedestrians are in groups, and when the pedestrian does not make eye contact with the driver. Thus, the marked crosswalk is a specific factor in positive driver behavior in this study.

A study by Knoblauch et al. was conducted to determine the effect of crosswalk markings on driver and pedestrian behavior at unsignalized intersections.(13) A before-after evaluation of crosswalk markings was conducted at 11 locations in 4 U.S. cities. The observed behaviors included pedestrian crossing location, vehicle speed, driver yielding, and pedestrian crossing behavior. It was found that drivers approach a pedestrian in a crosswalk somewhat more slowly, and that crosswalk usage increases, after markings are installed. No evidence was found indicating that pedestrians are less vigilant in a marked crosswalk. No changes were found in driver yielding or pedestrian assertiveness as a result of adding the marked crosswalk. Marking pedestrian crosswalks at relatively low-speed, low-volume, unsignalized intersections was not found to have any measurable negative effect on pedestrian or motorist behavior at the selected sites (which were all two- or three-lane roads with speed limits of 56 or 64 kilometers per hour (km/h) or 35 or 40 miles per hour (mi/h)).

In a comparison study to the one discussed above, Knoblauch and Raymond conducted a before-after evaluation of pedestrian crosswalk markings in Maryland, Virginia, and Arizona.(14) Six sites that had been recently resurfaced were selected. All sites were at uncontrolled intersections with a speed limit of 56 km/h (35 mi/h). The before data were collected after the centerline and edgeline delineations were installed but before the crosswalk was installed. The after data were collected after the crosswalk markings were installed. Speed data were collected under three conditions: no pedestrian present, pedestrian looking, and pedestrian not looking. All pedestrian conditions involved a staged pedestrian. The results indicate a slight reduction in vehicle speed at most, but not all, of the sites. Overall, there was a significant reduction in speed under both the no pedestrian and the pedestrian not looking conditions. (Note: This study and the 2001 behavioral study by Knoblauch et al. mentioned above were both conducted as part of the larger FHWA study conducted in conjunction with the current study described here.)

These studies found pedestrian behavior to be, if anything, slightly better in the presence of marked crosswalks compared to unmarked crosswalks. Certainly the results showed no indication of an increase in reckless or incautious pedestrian behavior associated with marked crosswalks. All of the sites used in the Knoblauch studies were two-lane and three-lane roads, and all had speed limits of 56 or 64 km/h (35 or 40 mi/h). No formal behavioral studies were found which have studied pedestrian and motorist behaviors and conflicts on roads with four or more lanes with and without marked crosswalks. Such multilane situations may pose different types of risks for pedestrians, particularly where high traffic volume exists and/or where vehicle speeds are high.

Finally, Van Houten studied factors that might cause motorists to yield for pedestrians in marked crosswalks.[15] He measured several behaviors at intersections in Dartmouth, Nova Scotia, where interventions were introduced sequentially to increase the "vividness" of crosswalks. Researchers added signs, then a stop line, and then amber lights activated by pedestrians and displayed to motorists. The percentage of vehicles stopping when they should increased by up to 50 percent. Conflicts dropped from 50 percent to about 10 percent at one intersection, and from 50 percent to about 25 percent at another. The number of motorists who yielded increased from about 25 percent to 40 percent at one intersection, and from about 35 percent to about 45 percent at another.[15]

Behavioral Studies Related to Crosswalk Signs and Other Treatments

The preceding discussion of the literature has dealt primarily with the safety and behavioral effects of marked versus unmarked crosswalks at uncontrolled intersections. Of course, a wide variety of supplemental measures have been used with or without marked crosswalks at pedestrian crossing locations in the United States. Examples of these treatments include:

- Pedestrian warning signs on the approach and/or at the crossing.
- Advance stop lines with supplemental signs (e.g., "Stop Here for Crosswalk").
- Rumble strips on the approaches to the crosswalk.
- Pedestrian crossing pavement stencils on the approach to the crosswalk.
- In-pavement flashing lights (activated by push-button or by automatic pedestrian detectors).
- Flashing beacons.
- Variations of overhead pedestrian crosswalk signs. Such signs may be warning or regulatory and may be illuminated and/or convey a message when activated (examples of such signs are shown in figures 5–10).
- Crosswalk lighting.
- Raised medians or refuge islands.
- Flat-topped speed humps (sometimes called speed tables) where pedestrians may cross the street on the raised flat top.
- Traffic-calming measures such as curb extensions and lane reductions.
- Various combinations of these and other measures.
- Traffic signals (with pedestrian signals) are sometimes added at pedestrian crossings when warranted.

Numerous research studies have been conducted in the United States and abroad in recent years to evaluate such treatments and/or to summarize research results. Some of these include:

- *A Review of Pedestrian Safety Research in the United States and Abroad.*[16]
- *Pedestrian Safety in Sweden* (www.walkinginfo.org/rd/international.htm).[17]

- *Research, Development, and Implementation of Pedestrian Safety Facilities in the United Kingdom* (www.walkinginfo.org/rd/international.htm).[18]

- *Canadian Research on Pedestrian Safety* (www.walkinginfo.org/rd/international/htm).[19]

- *Pedestrian Safety in Australia* (www.walkinginfo.org/rd/international.htm).[20]

- *Dutch Pedestrian Safety Research Review* (www.walkinginfo.org/rd/inernational.htm).[21]

In addition to these research summaries, several other documents, which describe a wide range of pedestrian and traffic calming measures, include:

- *Pedestrian Facilities User Guide: Providing Safety and Mobility* (www.walkinginfo.org/rd/international.htm).[22]

- *Alternative Treatments for At-Grade Pedestrian Crossings* (http://www.ite.org/bookstore/index.asp).[23]

- *Traffic Calming: State of the Practice* (http://www.ite.org/traffic/tcstate.htm#tcsop).[24]

The study described in this report was primarily intended to compare the safety effects of marked versus unmarked crosswalks at uncontrolled locations. It did not focus on evaluating various signs, traffic calming, or other measures and devices. Instead, several companion studies were conducted as part of the larger FHWA effort, which presents evaluation results of innovative devices. These research reports may be found at www.walkinginfo.org/rd/devices.htm.

Figure 5. High visibility crossing with pedestrian crossing signs in Kirkland, WA.

Figure 6. Experimental pedestrian regulatory sign in Tucson, AZ.

Figure 7. Overhead crosswalk sign in Clearwater, FL.

Figure 8. Overhead crosswalk sign in Seattle, WA.

Figure 9. Example of overhead crosswalk sign used in Canada.

Figure 10. Regulatory pedestrian crossing sign in New York State.

Figures 5–10. Examples of crosswalk signs.[(25)]

CHAPTER 2. DATA COLLECTION AND ANALYSIS METHODOLOGY

For the purpose of assessing pedestrian safety, an ideal study design would involve removing all crosswalks in several test cities, then randomly assigning sites for crosswalk markings and to serve as unmarked control sites. However, due to liability considerations, it would be impossible to get the level of cooperation needed from the cities to conduct such a study. Also, such random assignment of crosswalk marking locations would result in many crosswalks not being marked at the most appropriate locations.

Given such real-world constraints, a treatment and matched comparison site methodology was used to quantify the pedestrian crash risk in marked and unmarked crosswalks. This study design allowed for selection of a large sample of sites in cities throughout the United States where marked crosswalks and similar unmarked comparison sites were available. At intersections, the unmarked crosswalk comparison site was typically the opposite leg of the same intersection as the selected marked crosswalk site. For each marked midblock crosswalk, a nearby midblock *crossing* location was chosen as the comparison site on the same street (usually a block or two away) where pedestrians were observed to cross. (Even though an unmarked midblock crossing is not technically or legally a crosswalk, it was a suitable comparison site for a midblock crosswalk). The selection of a matched comparison site for each crosswalk site (typically on the same route and very near the crosswalk site) helped to control for the effects of vehicle speeds, traffic mix, and a variety of other traffic and roadway features.

A before-after study design was considered impractical because of regression-to-the-mean problems, limited sample sizes of new crosswalk installations, and other factors. A total of 1,000 marked crosswalk sites and 1,000 matched unmarked (comparison) crossing sites in 30 cities across the United States (see figure 11) were selected for analysis. In this study, no attempt was made to actually paint any of the 1,000 unmarked crosswalks to determine any crash effects in a before and after study. Instead, a separate (companion) study was conducted to monitor the effects of marking crosswalks on pedestrian and motorist behaviors. These study results are discussed in chapter 3 of this report.

Figure 11. Cities and States used for study sample.

Test sites were chosen without any prior knowledge of their crash history. School crossings were not included in this study because the presence of crossing guards and/or special school signs and markings could increase the difficulty of quantifying the safety effects of crosswalk markings.

Test sites were selected from the following cities:

- East: Cambridge, MA; Baltimore, MD (city and county); Pittsburgh, PA; Cleveland, OH; Cincinnati, OH.
- Central: Kansas City, MO; Topeka, KS; Milwaukee, WI; Madison, WI; St. Louis, MO (city and county).
- South: Gainesville, FL; Orlando, FL; Winter Park, FL; New Orleans, LA; Raleigh, NC; Durham, NC.
- West: San Francisco, CA; Oakland, CA; Salt Lake City, UT; Portland, OR; Seattle, WA.
- Southwest: Austin, TX; Ft. Worth, TX; Phoenix, AZ; Scottsdale, AZ; Glendale, AZ; Tucson, AZ; Tempe, AZ.

Detailed information was collected at each of the 2,000 sites, including pedestrian crash history (average of 5 years per site), daily pedestrian volume estimates, ADT volume, number of lanes, speed limit, area type, type of median, type and condition of crosswalk marking patterns, location type (midblock or intersection), and other site characteristics. It was recognized that pedestrian crossing volumes would likely be different in marked and unmarked crosswalks. This study design involved collecting pedestrian volume counts at each of the 2,000 sites, and controlled for differences in pedestrian crossing exposure. The study computed pedestrian crashes per million crossings to normalize the crash data for pedestrian crossing volumes, as described below in more detail.

All of the 1,000 marked crosswalks had one of the marking patterns shown in figure 12 (i.e., none had a brick pattern for the crosswalk). Of the 2,000 crosswalks, 1,622 (81.2 percent) were at intersections; the others were at midblock. Very few of the marked crosswalks had any type of supplemental pedestrian warning signs. While not much information currently exists on the safety effects of various types of warning signs (under various conditions), a behavioral evaluation of several innovative signs performed in 2000 by Huang et al. may be found at www.walkinginfo.org/rd.[25] Furthermore, none of the test sites had traffic-calming measures or special pedestrian devices (e.g., in-pavement flashing lights). Estimates of daily pedestrian volumes at each crosswalk site and unmarked comparison site were determined based on pedestrian volume counts at each site, which were expanded to estimated daily pedestrian volume counts based on hourly adjustment factors. Specifically, at each of the 2,000 crossing locations, trained data collectors conducted onsite counts of pedestrian crossings and classified pedestrians by age group based on observations.

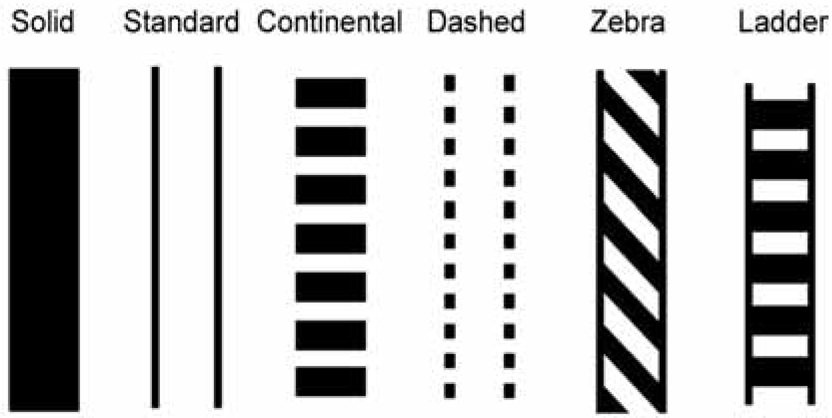


Figure 12. Crosswalk marking patterns.

Pedestrian counts were collected simultaneously for 1 hour at each of the crosswalk and comparison sites. Full-day (8- to 12-hour) counts were conducted at a sample of the sites and were used to develop adjustment factors by area type (urban, suburban, fringe) and by time of day. The adjustment factors were then used to determine estimated daily pedestrian volumes in a manner similar to that used by many cities and States to expand short-term traffic counts to average annual daily traffic (AADT). Performing the volume counts simultaneously at each crosswalk site and its matched comparison site helped to control for time-related influences on pedestrian exposure. Further details of the data collection methodology are given in appendix A.

STATISTICAL ANALYSIS

Analysis Approach

This study was structured to address a variety of questions related to crosswalks and pedestrian crashes. The primary analysis question was, "What are the safety effects of marked versus unmarked crosswalks?"

Several other analysis questions needed to be answered as well, including:

- What traffic and roadway features have a significant effect on pedestrian cashes? Specifically, how are pedestrian crashes affected by traffic volume, pedestrian volume, number of lanes, speed limit, presence and types of median, area type, type of crosswalk marking, condition of marked crosswalks, and other factors?

- Do pedestrian crashes differ significantly in different cities and/or regions of the country?

- How does pedestrian crash risk differ by pedestrian age group?

The amount of pedestrian crash data varied somewhat from city to city and averaged approximately 5 years per site (typically from about January 1, 1994 to December 31, 1998). Police crash reports were obtained from each of the cities except for Seattle, WA, (where detailed computerized printouts were obtained for each crash). Crashes were carefully reviewed to assign crash types to ensure accurate matching of the correct location and to determine whether the crash occurred at the crossing location (i.e., at or within 6.1 m (20 ft) of the marked or unmarked crossing of interest).

Standard pedestrian crash typology was used to review police crash reports and determine the appropriate pedestrian crash types (e.g., multiple threat, midblock dartout, intersection dash), as discussed later in this report. All treatment (crosswalk) and comparison sites were chosen without prior knowledge of crash history. All sites used in this study were intersection or midblock locations with no traffic signals or stop signs on the main road approach (i.e., uncontrolled approaches). This study focused on pedestrian safety and, therefore, data were not collected for vehicle-vehicle or single-vehicle collisions, even though it is recognized that marking crosswalks may increase vehicle stopping, which may also affect other collision types.

The selected analysis techniques were deemed to be appropriate for the type of data in the sample. Due to relatively low numbers of pedestrian crashes at a given site (many sites had zero pedestrian crashes in a 5-year period), Poisson modeling and negative binomial regression were used to analyze the data. Using these analysis techniques allowed determination of statistically valid safety relationships. In fact, there were a total of 229 pedestrian crashes at the 2,000 crossing sites over an average of 5 years per site. This translates to an overall average of one pedestrian crash per crosswalk site every 43.7 years.

While this rate of pedestrian crashes seems small on a per-site basis, it must be understood that many cities have hundreds or thousands of intersections and midblock locations where pedestrians regularly cross the street. Considering that pedestrian collisions with motor vehicles often result in serious injury or death to pedestrians, it is important to better understand what measures can be taken by engineers to improve pedestrian safety under various traffic and roadway conditions.

All analyses of crash rates at marked and unmarked crosswalks took into account traffic volume, pedestrian exposure, and other roadway features (e.g., number of lanes). To supplement the pedestrian crash analysis, a corresponding study was conducted on pedestrian and driver behavior before and after marked crosswalks were installed at selected sites in California, Minnesota, New York, and Virginia, as discussed earlier.(13,14)

Statistical Techniques

The Poisson and negative binomial regression modeling were conducted in two ways in terms of how the comparison sites were handled. These were:

- Including all of the comparison (unmarked) crosswalk sites in one group and all of the treated (marked) crosswalks in another group. In other words, no direct matching of sites was used in the modeling.

- Analyzing 1,000 site pairs; each pair had a marked crosswalk and an unmarked, matched comparison site.

Analyses were conducted using both assumptions to insure that the results were not influenced merely by the manner in which the matching was conducted.

The analyses revealed very similar results using either of the assumptions listed above in terms of:

- The variables found to be significantly related to pedestrian crashes.

- The individual and interaction effects.

- The magnitude of the effects of each traffic and roadway variable on pedestrian crashes, including the effect of marked versus unmarked crosswalks.

In short, using either analysis approach—grouping comparison sites or using an analysis that matches marked and unmarked sites—produced nearly identical results. The discussion below includes results of both analysis approaches.

Estimation of Daily Pedestrian Volume

At each of the 2,000 crossing sites, at least 1 hour-long count of pedestrian street crossings was conducted. Based on the time of day of the count, an expansion factor was used to compute an approximate pedestrian ADT. At a given observation site, i, a count n_i is made of pedestrians crossing the street during some interval of time T_i. Now, from a standard pedestrian volume by time of day distribution, the proportion p_i of daily pedestrian traffic expected during T_i can be determined. If $n_i \neq 0$, an estimate of the daily total pedestrian volume is made by, $N_i = n_i/p_i$.

This estimate has the property that if N_i was known, then the estimated pedestrian volume during the interval T_i would be $N_i p_i = n_i$, the observed number.

A detailed discussion of how pedestrian ADTs were determined based on short-term pedestrian crossing counts is given in appendix A.

Calculation of Pedestrian Crash Rates

Assuming that motor vehicle volumes, speeds, and other site features remain constant, it is reasonable to expect that the number of pedestrian crashes will increase as the number of pedestrians crossing the street (pedestrian exposure) increases. When comparing sites to see which has the greatest risk of a pedestrian crash, it is necessary to control for the number of pedestrians. The pedestrian crash rate is a more appropriate measure of safety than the total number of pedestrian crashes for comparing the relative safety of marked and unmarked crosswalks, particularly since pedestrian crossing volumes differ at marked and unmarked crosswalks. In this study, crash rates were calculated in terms of crashes per million pedestrian crossings. For example, if an average of 1,000 pedestrians cross an intersection every day, then there will be 365,000 (or 0.365 million) pedestrian crossings in a year. The number of pedestrian crashes in a year is then divided by 0.365 million times the number of years to get the pedestrian crash rate.

Determination of Crash-Related Variables

The following analysis was conducted to determine which traffic and roadway variables have a significant effect on pedestrian crashes. Table 1 shows some summary values of pedestrian volumes and crashes for marked and unmarked crosswalks categorized by number of lanes.

For each marked crosswalk, a closely matched unmarked comparison site was chosen—usually a nearby site on the same street. Quite often, the comparison site was the opposite approach to the same intersection (on the same road). As a result of this matching, the distributions of site characteristics, including traffic volumes, should be essentially the same for marked and unmarked sites. Pedestrian volumes were recorded at a marked crosswalk and its matched unmarked location at essentially the same time of day and for an equal period of time. Thus, pedestrian volumes were free to vary between marked and unmarked sites but were collected in such a way as to represent equal proportions of expected daily pedestrian traffic at the respective locations.

Table 1. Pedestrian crashes and volumes for marked and unmarked crosswalks.

No. of Lanes	Type	Sites	Ped. Vol.*	Avg. Ped. ADT/site	Number of Ped. Crashes	Avg. Yrs.**
2	Marked	456	176,345	387	37	4.81
	Unmarked	458	104,922	229	23	4.81
3 or 4	Marked	401	104,237	260	94	4.59
	Unmarked	395	37,941	96	12	4.60
5 or more	Marked	143	31,266	219	57	4.65
	Unmarked	147	11,955	81	6	4.60
All	Marked	1,000	311,848	312	188	4.70
	Unmarked	1,000	154,818	155	41	4.70

*Ped. Vol. = Sum of the pedestrian ADT at sites within a given grouping (by number of lanes).
**Avg. Yrs. = Average number of years of crash data per site.

The pedestrian ADT per site was 312 at marked crosswalks and 155 at unmarked crosswalks, as shown in table 1. Thus, 66.8 percent of this pedestrian volume occurred at marked crosswalk sites. A total of 229 pedestrian crashes were recorded at these 2,000 sites over a period of roughly 5 years. If marked and unmarked crosswalks were equally safe (or unsafe), then given that 229 crashes occurred, it would be expected that 66.8 percent of them (153 crashes) would have occurred at marked crosswalk sites. This expected number is considerably smaller than the actual number of 188 observed at marked crosswalks. Under the hypothesis of equal safety, and conditional on 229 total crashes, the probability of observing 188 or more crashes at the marked sites can be obtained from the binomial distribution with parameters, $\underline{p}$ = .668 and $\underline{n}$ = .229, as

$$P\,(A \geq 188 \mid \underline{p}, \underline{n}) = .000002 \tag{1}$$

Thus, the hypothesis of equal safety across the entire set of sites would be rejected.

On the other hand, there may be subsets defined by various site characteristics where such a hypothesis would not be rejected. For example, consider the first two rows of table 1, which refer to sites on streets having two lanes. At these sites, 62.7 percent of the pedestrian volume occurred on marked crosswalks. Of the 60 crashes that occurred at these sites, 37.6 crashes would be expected at the marked crosswalk sites compared with the observed count of 37. Clearly, the hypothesis of equal safety could not be rejected for this subset of sites. In other words, for the two-lane road sites in the database, there was no significant difference in pedestrian crashes between marked and unmarked crosswalks.

From the rows of table 1 corresponding to three- or four-lane roads and roads with five or more lanes, the observed crash frequencies for the marked crosswalk sites are 94 and 57, respectively. Both totals considerably exceed the expected values of 77.6 and 45.7 based on proportions of pedestrian exposure at these sites. The probabilities of observing values this extreme by chance are:

$$P\,(A \geq 94 \mid p_1 = .7324,\, n_1 = 106) = .0001 \tag{2}$$

and

$$P\,(A \geq 57 \mid p_2 = .7256,\, n_2 = 63) = .0005 \tag{3}$$

In the expressions given above, the parameters p_1 and p_2 represent proportions of pedestrian volumes at marked sites adjusted for slight differences in exposure times over which crash data were obtained. These results suggest that, in general, marked crosswalks are less safe than unmarked crosswalks on streets having more than two lanes, but that the two types do not differ significantly on streets with two lanes. Note that the analysis described above did not require adjustment for motor vehicle volume, since matched pairs of marked and unmarked sites typically were selected at or near the same intersection where vehicle volumes were similar.

To investigate the relationship between other factors and combinations of factors on crosswalk pedestrian crashes, generalized linear regression models were fit to the data to predict crashes as functions of these variables. Consider a model based on pedestrian volumes (ADP); traffic volumes (ADT); and two indicator variables, one which indicates one or two travel lanes (L_2), and the other which indicates three or four travel lanes (L_4). The resulting model has the form

$$E\,(\text{Accs}_i) = \text{yrs}_i e^{\beta_0} (\text{ADP}_i)^{\beta_1} (\text{ADT}_i)^{\beta_2} e^{\beta_2 L_{2i}} e^{\beta_2 L_{4i}} \quad (4)$$

where E (Accs$_i$) is expected pedestrian crashes at site i, yrs$_i$ is the number of years over which crash data was available for site i, and $\beta_0, \beta_{1, \dots,} \beta_4$ are parameters to be estimated. Models of this form were fit to data from marked and unmarked crosswalks separately. The models were fit by maximum likelihood methods using Procedure for General Models (PROC GENMOD) software, as developed by the SAS Institute. Crashes were assumed to follow a negative binomial distribution.

Parameter estimates for these basic models are shown in table 2.

Table 2. Parameter estimates for basic marked and unmarked crosswalk models.

Parameter	Marked Crosswalks			Unmarked Crosswalks		
	Estimate	S.E.*	*p*-Value	Estimate	S.E.*	*p*-Value
Constant (β_0)	-14.55	1.95	< .0001	-10.25	2.72	.0002
ADP (β_1)	.381	.065	< .0001	.602	.134	< .0001
ADT (β_2)	1.006	.184	< .0001	.304	.258	.2388
L_2 (β_3)	-.599	.328	.0678	-.066	.592	.9115
L_4 (β_4)	.075	.247	.7608	-.208	.553	.7076

*S.E. = Standard Error

For marked crosswalks, the results in table 2 show that expected crashes increased to a significant degree with both increasing pedestrian volume and increasing traffic volumes, with a much steeper increase for traffic volume. The lane variables compare two-lane roads with roads having five or more lanes, and three- or four-lane roads with roads having five or more lanes. The two-lane variable is marginally significant, while the three- or four-lane variable is not. The overall lanes effect (not shown) is significant (p-value of .0262). In subsequent models, a two-level lanes effect comparing two lanes with three or more is used. This variable is usually significant at a level of about .02.

The results for unmarked crosswalks show the only statistically significant effect to be for pedestrian volume. Thus, expected crashes on unmarked crosswalks increased consistently with increasing pedestrian volumes (at a somewhat higher rate than that at marked crosswalks), but did not change consistently with increasing traffic volumes or with number of lanes. These results suggest that multilane streets with low traffic volumes might represent another subset of the data where marked and unmarked crosswalks might not differ significantly with respect to safety. This issue is addressed in more detail later in the report.

In addition to the variables included in the models presented above, data were available for several other factors potentially associated with crosswalk safety. These included:

- Speed limit.
- Location of crosswalk (intersection or midblock).
- Presence and type of median.
- Type of crosswalk marking (marked only).

Neither speed limit nor crosswalk location (intersection or midblock) had a significant effect in the models for marked or unmarked crosswalk crashes. Initially, three types of medians were compared with no median. These were:

- Raised medians.
- Painted medians.
- Two-way left turn lanes.

Several specific types of crosswalks were represented in the data, but the primary comparison came down to a comparison between the standard markings (two parallel lines) versus designs with more markings (e.g., continental or ladder patterns shown in figure 12).

In attempting to estimate these more detailed models, it was also a concern to consider effects due to specific locations (i.e., cities, States, regions) from which the data were obtained since crashes, types of medians and crosswalks, and other variables were not uniformly distributed across these locations. To this end, two sets of regions were identified (North-South and East-Midwest-West), and class variables indicating these regions were included in the models. A second approach was to estimate a model using data from all locations, then to re-estimate the model while omitting the data from each of the eight cities where the most data had been obtained, one step at a time, to see how the estimates changed. These eight cities and the total number of observation sites at each are listed below.

- Seattle, WA (204).
- San Francisco, CA (182).
- New Orleans, LA (160).
- Milwaukee, WI (136).
- Cleveland, OH (110).
- Cambridge, MA (92).
- Oakland, CA (90).
- Gainesville, FL (90).

A few iterations of this process resulted in a model for marked crosswalk crashes summarized in table 3. The model for table 3 contains no variable pertaining to crosswalk type, a single variable indicating a raised median as opposed to no median or another median type, and another variable indicating the western region of the country as opposed to the East or Midwest.

In some preliminary models, there was an indication that the crosswalk types with more markings were associated with slightly lower crash rates than the standard type. These results were not consistent across models and became quite nonsignificant when regional variables were included. Similarly, preliminary models indicated that raised medians were marginally better (associated with lower crash rates) than crosswalks having no median or painted medians, while two-way left turn lanes were significantly worse than the other types. With the addition of the East-Midwest-West regional variables, the two-way left turn lane effect became nonsignificant, and the raised median effect became more significant. All of the two-way left turn lanes in the study sample were in the western region. The two-way left turn lanes did not account for the estimated West effect, however, since this estimate remained virtually unchanged when the data from the two-way left turn lane sites were deleted from the model.

Table 3. Results for a marked crosswalk pedestrian crash model.

Parameter	Estimate	S.E.*	95% Confidence Limits	*p*-Value
Intercept	−15.09	1.65	(−18.33, −11.86)	< .0001
Log (ADP)	.33	.06	(.20, .45)	< .0001
Log (ADT)	.99	.17	(.65, 1.19)	< .0001
Two lanes	−.68	.26	(−1.19, -.18)	.0074
Raised median	−.58	.27	(−1.12, −.04)	.0338
West region	.77	.19	(.40, 1.14)	< .0001
Dispersion	1.48	.41	(.85, 2.55)	–

*S.E. = Standard Error

The North-South regional variable was not statistically significant. East-to-West effects were modeled as two variables, one comparing West to East, and the other comparing Midwest to East. The West-to-East comparison was significant, while the Midwest-to-East comparison was not. These variables were then collapsed to a single variable contrasting West with Midwest and East combined, which is the form used in the model of table 3. The apparent effect due to the western region was investigated further to see if this effect could be attributed to differing distributions of speed limits and/or numbers of lanes. This did not prove to be the case.

Table 4 shows estimates of the same model parameters on the data subsets obtained by leaving out the data from each of the major cities. In general, the estimates are quite consistent across the subsets. All estimates listed were statistically significant at a .05 level with the exception of the two marked with an asterisk. These were the raised median effects on the datasets that omitted data from New Orleans, LA, and from Milwaukee, WI. The *p*-values for these estimates were .10 and .08, respectively.

Results from the more detailed crash modeling on unmarked crosswalks are presented in tables 5 and 6. In contrast to the results of table 2, table 5 shows that when a variable indicating the presence of a median was included in the model, the effect of traffic volume (ADT) became statistically significant. As with marked crosswalks, various median types were also considered; in this case, a variable indicating a median of any type versus no median was the most relevant characterization. For unmarked crosswalks, the East, Midwest, and West comparisons showed the eastern region to have significantly lower crash rates than either the West or Midwest. Thus, a two-level variable contrasting east with the other two regions was used. The North-South comparison was again not significant.

Table 4. Parameter estimates for marked subset models.

Parameters	Estimates on Subsets							
	Seattle	San Francisco	Oakland	New Orleans	Milwaukee	Cleveland	Gainesville	Cambridge
Intercept	−15.16	−15.22	−15.07	−14.91	−15.52	−14.97	−14.99	−15.54
Log (ADP)	.32	.34	.36	.31	.34	.30	.34	.34
Log (ADT)	1.01	1.00	.97	.95	1.04	1.00	.98	1.05
Two lanes	−.68	−.77	−.69	−.96	−.64	−.69	−.65	−.53
Raised median	−.59	−.71	−.59	−.49*	−.50*	−.60	−.58	−.60
Western region	.86	.75	.58	.87	.71	.77	.70	.70

*Not statistically significant at .05 level.

Table 5. Results for an unmarked crosswalk model.

Parameter	Estimate	S.E.*	95% Confidence Limits	*p*-Value
Intercept	−12.11	2.59	(−17.18, −7.04)	< .0001
Log (ADP)	.64	.13	(.37, .90)	< .0001
Log (ADT)	.55	.26	(.04, 1.05)	.0319
Median	−1.27	.45	(−2.14, −.39)	.0047
Eastern region	−1.31	.48	(−2.25, −.38)	.0060
Dispersion	1.18	1.30	(.14, 10.23)	–

*S.E. = Standard Error

Table 6 shows the estimates of these model parameters were again consistent across the eight data subsets. The estimates marked with an asterisk (which were not significant at a .05 level) were the ADT effect on the subset with Seattle, WA, data omitted, and the ADT effect and eastern region effects on the subset with New Orleans, LA, data omitted. The *p*-values for these estimates were .06 in each case.

Table 6. Parameter estimates for unmarked subset models.

Parameters	Estimates on Subsets							
	Seattle	**San Francisco**	**Oakland**	**New Orleans**	**Milwaukee**	**Cleveland**	**Gainesville**	**Cambridge**
Intercept	−11.19	−12.43	−11.89	−11.80	−11.92	−12.72	−11.94	−12.48
Log (ADP)	.56	.69	.64	.52	.64	.69	.66	.65
Log (ADT)	.48*	.54	.52	.54*	.52	.58	.52	.58
Median	−1.24	−1.17	−1.17	−1.07	−1.25	−1.16	−1.24	−1.30
Eastern region	−1.28	−1.23	−1.25	−.93*	−1.56	−1.29	−1.03	1.03

* Not statistically significant at .05 level.

While the models presented above examine the effects of medians, crosswalk designs, and other factors on pedestrian crashes, the primary factors associated with these crashes were shown to be pedestrian volumes and traffic volumes. Analyses based on the data shown in table 1 indicated no significant difference in the safety of marked and unmarked crosswalks on streets having two or fewer lanes, while marked crosswalks were less safe overall on multilane roads. The models suggest a further examination of multilane roads as a function of varying traffic volumes and the presence of raised medians.

Table 7 shows pedestrian volumes, crashes, and average exposure years for a number of categories defined by number of lanes, traffic volumes, and median type. Using the same approach as for table 1, a marked crosswalk exposure proportion, p_{mi}, was computed for category *i*, as

$$P_{mi} = \frac{X_{mi}}{X_{mi} + X_{umi}} \qquad (5)$$

where

$$X_{mi} = \sum_{S=1}^{S_i} (\text{marked pedestrian volume})_s \, X \text{ years} \qquad (6)$$

where the sum extends over all sites (S) in category *i*, X_{mi} is the total exposure for marked crosswalks in category *i*, and X_{umi} is similarly defined as the total exposure for unmarked crosswalks in category *i*.

Table 7. Pedestrian crashes and volumes for marked and unmarked crosswalks.

Lanes	Median	Traffic Volume	Type	Sites	Pedestrian Volume	Crashes	Avg. Yrs.*
Two	None	≤ 8,000	Marked	248	110,697	15	4.85
			Unmarked	252	67,793	10	4.86
Two	None	> 8,000	Marked	199	62,530	19	4.74
			Unmarked	200	35,957	13	4.75
Multi	No raised median	≤ 3,000	Marked	10	1,446	0	3.80
			Unmarked	13	998	0	4.08
Multi	No raised median	3,000–6,000	Marked	33	6,382	3	4.58
			Unmarked	29	3,298	1	4.48
Multi	No raised median	6,000–9,000	Marked	37	20,608	0	4.43
			Unmarked	39	5,397	2	4.49
Multi	No raised median	9,000–12,000	Marked	47	23,024	12	4.87
			Unmarked	52	6,721	4	4.90
Multi	No raised median	12,000–15,000	Marked	76	20,719	23	4.82
			Unmarked	73	7,825	2	4.79
Multi	No raised median	> 15,000	Marked	210	39,835	91	4.57
			Unmarked	207	12,700	6	4.57
Multi	With raised median	≤ 9,000	Marked	30	5,024	2	4.87
			Unmarked	23	1,182	0	4.83
Multi	With raised median	9000–15,000	Marked	22	4,924	3	4.18
			Unmarked	25	1,671	0	4.28
Multi	With raised median	> 15,000	Marked	88	16,659	20	4.60
			Unmarked	87	11,276	3	4.56

*Avg. Yrs. = Average number of years of crash data per site.

Then conditional on total crashes, N_i in category i, expected marked crosswalk crashes under the hypothesis of equal safety were estimated as $\hat{A}_{mi} = N_i \, p_{mi}$. The probability under this hypothesis of observing as many or more crashes in marked crosswalks as actually occurred was obtained from the binomial distribution with parameters p_i and N_i. Table 8 lists these quantities for the various crosswalk categories.

The results in table 8 suggest that on two-lane roads, multilane roads without raised medians and traffic volumes below 12,000 ADT, and multilane roads having raised medians and traffic volumes below 15,000 ADT, the hypothesis of equal safety for marked and unmarked crosswalks cannot be rejected.

In other words, there was no significant effect of marked versus unmarked crosswalks on pedestrian crashes under the following conditions:

- Two-lane roads.
- Multilane roads without raised medians and with ADTs below 12,000.
- Multilane roads with raised medians and with ADTs below 15,000.

For multilane roads with ADTs above these values, there was a significant increase in pedestrian crashes on roads with marked crosswalks, compared to roads with unmarked crosswalks (after controlling for traffic ADT and pedestrian ADT).

Table 8. Crashes, exposure proportions, expected crashes, and binomial probabilities for categories of marked crosswalks.

Number of Lanes	Median Type	Traffic Volume (ADT)	A_m	p_m	$E(A_m)$	$P(a \geq A_m)$
Two	–	$\leq$ 8,000	15	.6173	15.43	.6541
Two	–	> 8,000	19	.6382	20.42	.7631
Multi	Not raised	$\leq$ 3,000	0	.6443	0	–
Multi	Not raised	3,000–6,000	3	.6612	2.64	.8529
Multi	Not raised	6,000–9,000	0	.7985	1.60	1.00
Multi	Not raised	9,000–12,000	12	.7741	12.39	.7149
Multi	Not raised	12,000–15,000	23	.7383	18.46	.0242
Multi	Not raised	> 15,000	91	.7535	73.08	.000002
Multi	Raised	$\leq$ 9,000	2	.8035	1.61	.6456
Multi	Raised	9,000–15,000	3	.7500	2.25	.4219
Multi	Raised	$\geq$ 15,000	20	.5919	13.61	.0041

p_m= Proportion of pedestrian exposure at marked crosswalks.
A_m = Actual number of pedestrian crashes at the marked crosswalks.
$E(A_m)$ = Estimated (predicted) number of pedestrian crashes at marked crosswalks.
$P(a \geq A_m)$ = Binomial probabilities.

Comparisons of Pedestrian Age Distribution Effects

Each pedestrian in both the crash and exposure samples was classified into one of seven age categories: 12 and under, 13–18, 19–25, 26–35, 36–50, 51–64, and 65 and over. Across the entire set of sites, the two age distributions differed substantially, with a considerably higher proportion of young adults (19–35) in the exposure sample (compared to other age groups), and a much higher proportion of the oldest age group in the crash sample. The difference was statistically significant, $\chi^2_{6df} = 216.86$, $\underline{p} = .001$.

The data were then partitioned into four subsets determined by marked or unmarked crosswalks on streets having two lanes or having three or more lanes. The same general pattern of the exposure and crash age distributions tended to hold on the subsets. In particular, the crash distribution tended to always be higher for the oldest pedestrian group. The relatively small sample sizes of crashes in some of the subsets necessitated combining some of the age categories to obtain a valid statistical comparison of the distributions.

Marked crosswalks on two-lane roads. There were 33 crashes in this subset. With seven age categories, several cells had expected counts of fewer than five, so the two youngest and the two oldest age groups were combined. It might be noted, however, that 7 of the 33 crashes (21.2 percent) involved pedestrians in the 65-and-over age group, compared to 3.4 percent in the exposure sample. The five-category collapsed distributions differed significantly ($\chi^2_{4df} = 11.00$, $\underline{p} = .027$). Of the crash-involved pedestrians, 30.3 percent were in the 51-and-over age category, compared to 13.2 percent in the exposure sample.

Unmarked crosswalks on two-lane roads. Only 21 pedestrian crashes occurred in this subset. Again, five-category age distributions were used for the statistical test. While the percentage of crash-involved pedestrians in the oldest age category (51 and older) was higher than that of the exposure sample (19.1 percent versus 10.8 percent), the distributions overall did not differ significantly ($\chi^2_4 = 4.40$, $\underline{p} = 0.354$).

Marked crosswalks on multilane roads. Nearly 70 percent of the pedestrian crosswalk crashes occurred in this subset. Comparison of the seven-category age distributions was quite similar to that of the overall samples, with the proportion of young adults being lower in the crash sample and the proportion in the 65+ age group being much higher in the crash sample (18.1 percent versus 2.2 percent. The distributions differed significantly ($\chi^2_{6df} = 166.88$, $p = .001$).

Unmarked crosswalks on multilane roads. Only 16 pedestrian crashes occurred at unmarked crosswalks on multilane roads, 6 of which involved pedestrians 51 years old or older. A simple comparison of this age category versus younger pedestrians between the two samples yielded a significant result ($\chi^2_{1df} = 18.48$, $p = .001$). There were 37.5 percent of crashes involving pedestrians 51 and older in the crash sample compared with 8.1 percent of this age group in the exposure sample.

The multilane marked crosswalk subset was further subdivided on the basis of traffic volume (ADT). In the subset with ADT $\leq$ 15,000, there were 39 pedestrian crashes; 10 (25.6 percent) of these involved pedestrians more than 50 years old. Only 13.9 percent of the exposure sample was over 50. A one-degree-of-freedom chi-square test indicated a significant difference ($\chi^2_{1df} = 4.51$, $p = .034$).

Lowering the ADT cutoff to 12,000 reduced the size of the crash sample to 15. The percentages of pedestrians over 50 in the two samples were essentially unchanged (26.7 percent versus 13.9 percent), but with the smaller sample size the difference was no longer significant ($\chi^2_{1df} = 2.04$, $p = .1540$).

In summary, older pedestrians were more at risk than younger pedestrians on virtually all types of crosswalks. This difference seemed most pronounced for marked crosswalks on multilane roads with high traffic volumes (ADT above 12,000), where crash occurrence was highest.

COMPARISONS OF CROSSWALK CONDITIONS

Data were collected on the condition of marked crosswalks. Conditions were coded as E (excellent), G (good), F (fair), and P (poor). This variable was entered as a class variable in the model for crashes on marked crosswalks to assess its effect on crashes. The estimated effect was not statistically significant ($p = .1655$).

Furthermore, there is no assurance that the condition of the crosswalk markings was consistent over the data collection period.

Pedestrian Crash Severity on Marked and Unmarked Crosswalks

Overall, crashes tended to be more severe in marked crosswalks on multilane roads, but sample sizes were too small to draw any firm conclusions in that regard. In particular, there were six fatal crashes in marked crosswalks and none in unmarked crosswalks. The fatal crashes all occurred on multilane roads with traffic volumes greater than 12,000 ADT (5 with ADT > 15,000). Crash severity distributions did not differ significantly between marked and unmarked crosswalks on two-lane roads, based on a χ^2-statistic comparing A or B level injury crashes with lesser or no injuries ($\chi^2_{1df} = .268$, $p = .604$). Similarly, on multilane roads with ADT < 12,000, the χ^2-statistic and p-value ($\chi^2_{1df} = .210$, $p = .647$) showed no significant difference.

FINAL PEDESTRIAN CRASH PREDICTION MODEL

Previous models shown in this report used subgroups of the 2,000 crosswalks and modeled marked and unmarked separately. A final model (which incorporates the aforementioned results) also was fitted to all 2,000 crosswalks, and it includes direct correlation or matching of marked and unmarked crosswalks. To develop the final model form, generalized estimating equations (GEEs) were used, since they provide a practical method to analyze correlated data with reasonable statistical efficiency. PROC GENMOD uses GEE and permits the analysis of correlated data. Another feature of the final model is that the distribution of pedestrian crashes at a crosswalk is assumed to follow a negative binomial distribution. The negative binomial is a distribution with an additional parameter (k) in the variance function. PROC GENMOD estimates k by maximum likelihood. (Refer to McCullagh and Nelder (chapter 11),[26] Hilbe,[27] or Lawless[28] for discussions of the negative binomial distribution.)

The final model is a negative binomial regression model that was fitted with the observed number of pedestrian crashes as the dependent measure. A negative binomial model is an extension of traditional linear models that allows the mean of a population to depend on a linear predictor through a nonlinear link function and allows the response probability distribution to be a negative binomial distribution. PROC GENMOD is capable of performing negative binomial regression GENMOD using GEE methodology.[29]

The final model uses the observed number of pedestrian crashes at a crosswalk as the dependent measure. The independent measures are estimated average daily pedestrian volume (pedestrian ADT), average daily traffic volume (traffic ADT), an indicator variable for marked crosswalks (C_M); two indicator variables for number of lanes (one that indicates two travel lanes, L_2; the other indicates three or four travel lanes, L_4); and two indicators for median type (no raised median, M_{none}, and raised median, M_{raised}).

There are two interactions in the model. The first interaction in an interaction between pedestrian ADT and the indicator for marked crosswalk, ADP*C_M. The second interaction in the model is between traffic ADT and the indicator for marked crosswalk, ADT*C_M.

The linear predictor has the form:

$$\eta_i = \beta_0 + \beta_1 * \mathrm{ADP}_i + \beta_2 * \mathrm{ADT}_i + \beta_3 * C_{M,i} + \beta_4 * L_{2,i} + \beta_5 * L_{4,i} + \beta_6 * M_{none,i} + \beta_7 * M_{raised,i} + \beta_8 * \mathrm{ADP}_i * C_{M,i} + \beta_9 * \mathrm{ADT}_i * C_{M,i}. \quad (7)$$

where η_i is the linear predictor for site i = 1 ,2, ..., 2,000. The number of years of accident data available for a site is used as an offset. $\beta_0, \beta_{1,\ldots,}\beta_9$ are parameters to be estimated. The estimates of the parameters were obtained using PROC GENMOD. Parameter estimates for the final model are shown in table 9.

Table 9. Parameter estimates for final model combining marked and unmarked crosswalks.

Parameter	Marked		
	Estimate	**S.E.***	***p*-Value**
Constant (β_0)	−8.2455	0.4633	< 0.0001
ADP (β_1)	0.0011	0.0004	0.0149
ADT (β_2)	0.0000	0.0000	0.7842
C_M (β_3)	0.3257	0.3988	0.4141
L_2 (β_4)	−0.4786	0.3180	0.1323
L_4 (β_5)	0.0053	0.2638	0.9840
M_{none} (β_6)	0.1541	0.2090	0.4610
M_{raised} (β_7)	−0.5439	0.3064	0.0759
ADP*C_M (β_8)	−0.0008	0.0004	0.0780
ADT*C_M (β_9)	0.0001	0.0000	0.0016
Dispersion	2.1970	0.5898	–

*S.E. = Standard Error

The final model provides a framework to test the hypothesis of whether marked crosswalks have the same expected number of pedestrian crashes in 5 years controlling for the effects of pedestrian ADT, vehicle traffic ADT, number of lanes, and presence of a raised median. Because the interaction between traffic ADT and the indicator for marked crosswalk, ADT*C_M (β_9), was statistically significant, it was concluded that the presence of a marked crosswalk increases the expected number of pedestrian crashes in 5 years; however, the effect size is dependent on the traffic ADT and number of lanes.

There is also a statistically significant interaction between pedestrian volume and the indicator for marked crosswalk, which was interpreted as the effect size of the presence of a marked crosswalk as dependent on the pedestrian volume. The lane indicator variables compare two lanes with five or more, and three or four lanes with five lanes or more. A two-degrees-of-freedom test for any lane effect has an associated *p*-value of 0.1071. The two median variables compare no median with other median, and raised median with other median. A two-degrees-of-freedom test for any median effect has an associated *p*-value of 0.0531. The number of lanes, type of median, pedestrian volume, and ADT are all intracorrelated. This correlation is evidenced by the fact that ADT increases as the number of lanes increases. Also, sites with two lanes do not have a median. The number of lanes was also included in the model and probably is expressed indirectly through ADT and median type. In the final model form, the regional effect was only marginally significant, and including the regional variables (i.e., western versus eastern region) into the model had virtually no influence on the crash effects of the other variables. Thus, the regional variable was not included in the final model.

Further discussion of the final model relative to the goodness-of-fit measures, residuals, and possible biases of multicollinearity is contained in appendix B. In short, the final model was found to be valid and appropriate for the available database. A considerable amount of data exploration was also conducted during the analysis phase of study before developing the final model.

Pedestrian Crash Plots

The final pedestrian crash prediction model can be illustrated by inputting various values of pedestrian ADT, traffic ADT, number of lanes (two lanes, four lanes, or more), and median type (raised median or no raised median). All values used in the following figures (and in appendix B) are well within the actual distributions of the data sample.

Figures 13 through 17 and the figures in appendix C (figures 45 through 64) all contain plots of response curves based on the final negative binomial prediction model. Each of these graphs shows a solid line for both marked and unmarked locations. For each solid line, there is a dashed line above and below it representing the upper and lower bounds of the 95 percent confidence intervals.

The relationship of pedestrian crashes in a 5-year period is shown in figure 13 for a range of pedestrian ADTs for traffic ADT of 5,000 using the final crash prediction model. Notice that there is no difference in predicted pedestrian crashes in marked versus unmarked crosswalks for these conditions.

Plots of pedestrian crashes in a 5-year period from the model are shown for two-lane roads as a function of traffic ADT in figure 14 (where pedestrian ADT = 300). Note that there is little if any difference in pedestrian crashes between marked and unmarked crosswalks, even for traffic ADTs as high as 15,000. In fact, for marked crosswalks with traffic ADT of 15,000 and 300 pedestrians per day, expected pedestrian crashes are 0.10 per 5 years, or 1 pedestrian crash per 50 years per site.

Figure 15 illustrates the predicted pedestrian crashes for a five-lane pedestrian crossing with no median and a pedestrian ADT of 250. As traffic ADT increases, pedestrian crashes stay relatively consistent on unmarked crosswalks (approximately 0.10 or less per 5 years). However, on marked crosswalks, pedestrian crashes increase as traffic ADT increases.

Plots of the final model are given for five-lane crosswalks with a raised median in figures 16 and 17. Average pedestrian ADT is plotted versus pedestrian crashes in figure 16 for traffic ADT of 10,000, and there is little difference in pedestrian crashes at marked versus unmarked crosswalks. Note in figure 17, however, that marked crosswalks have an increasingly greater number of pedestrian crashes than unmarked crosswalks, as ADT increases from 15,000 to 50,000.

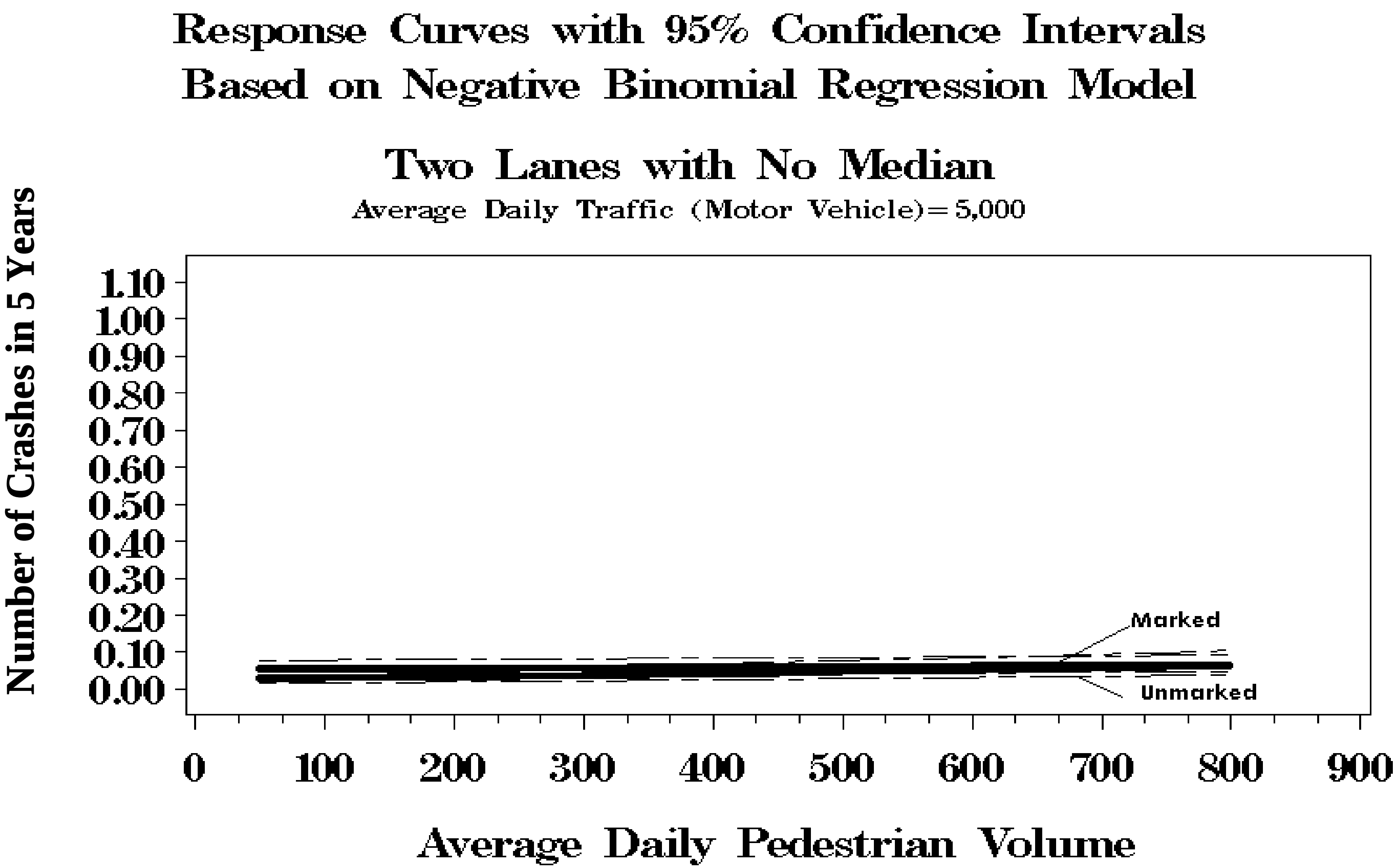


Figure 13. Predicted pedestrian crashes versus pedestrian ADT for two-lane roads based on the final model.

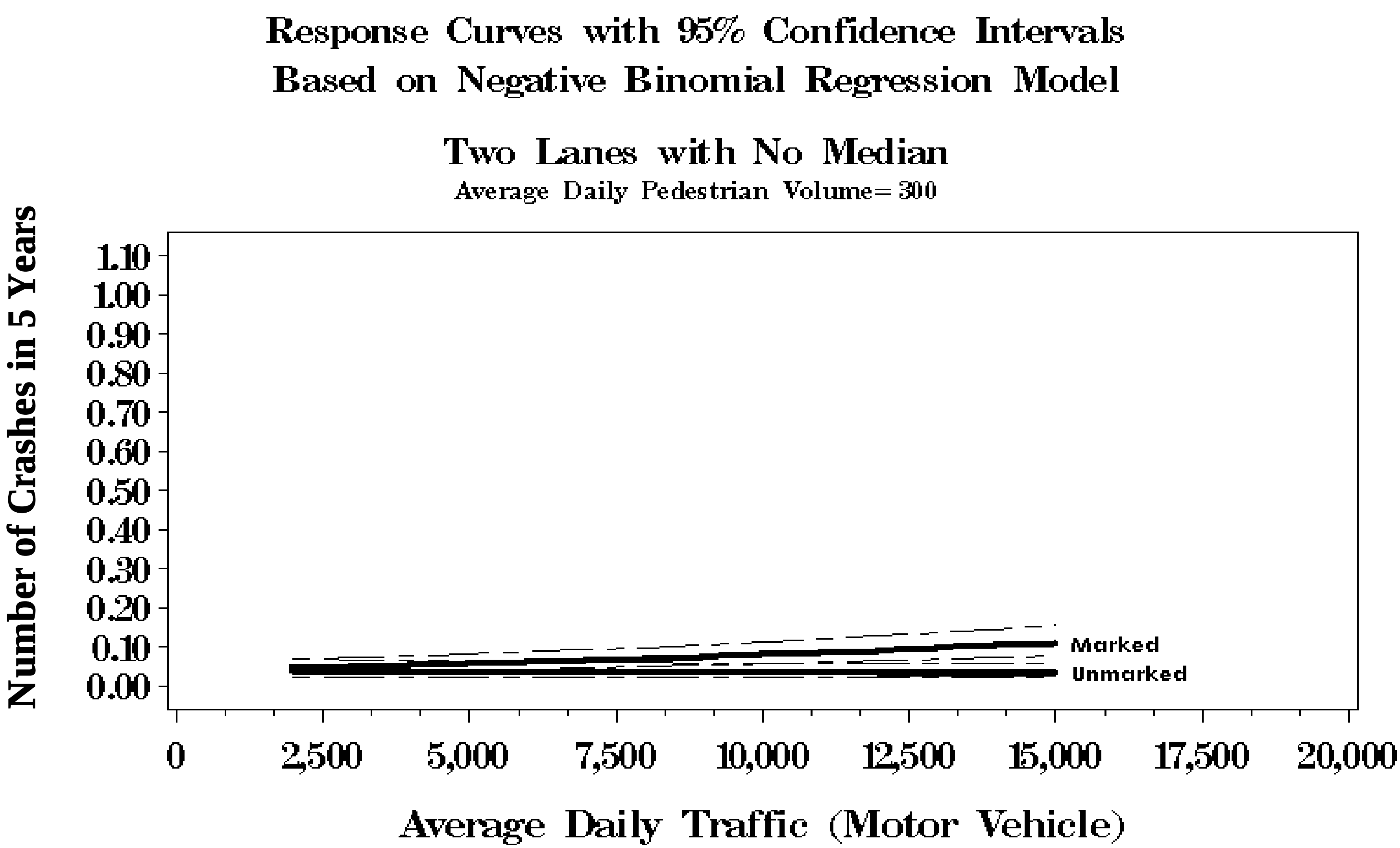


Figure 14. Predicted pedestrian crashes versus traffic ADT for two-lane roads based on the final model (pedestrian ADT = 300).

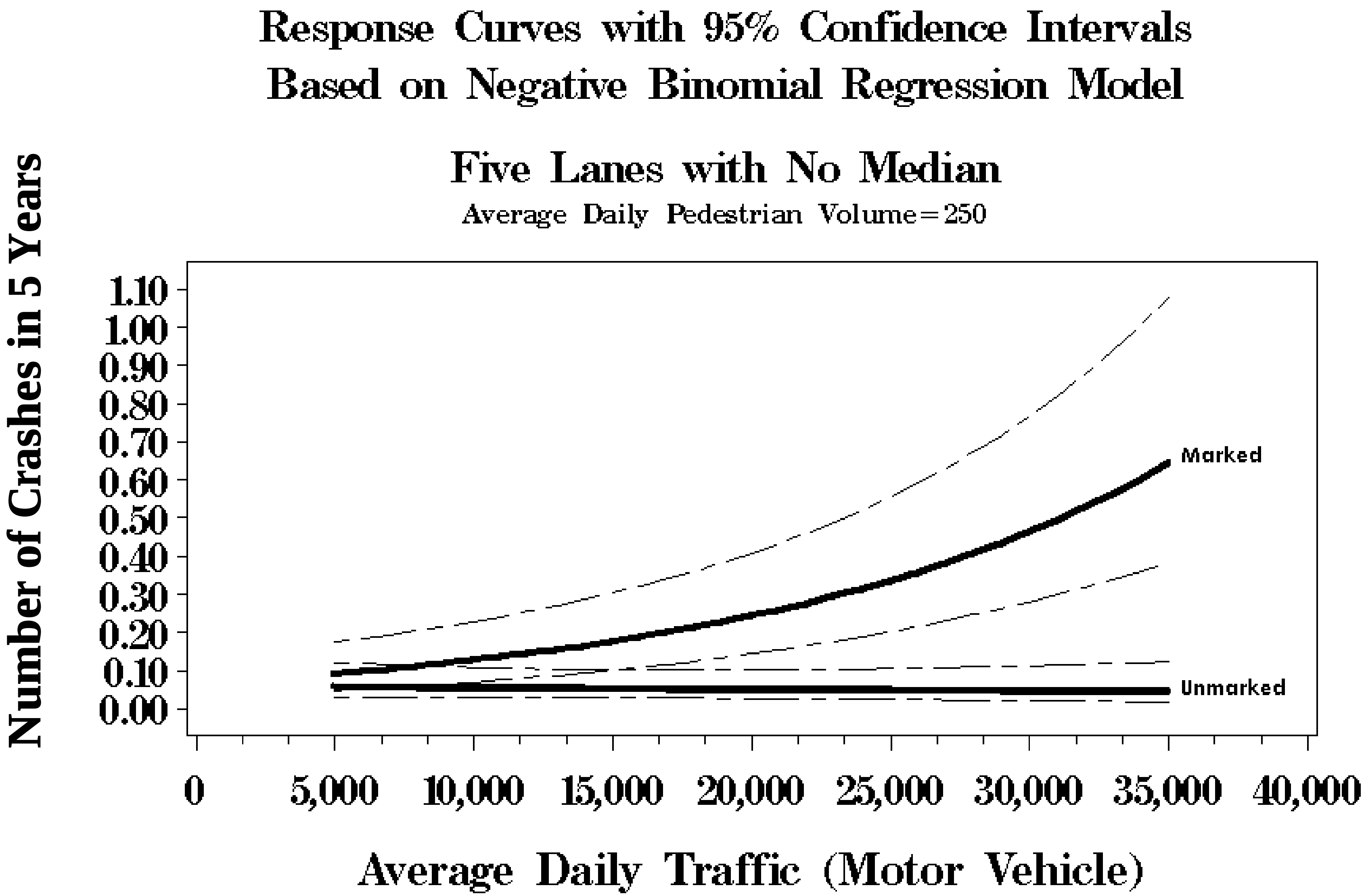


Figure 15. Predicted pedestrian crashes versus traffic ADT for five-lane roads (no median) based on the final model.

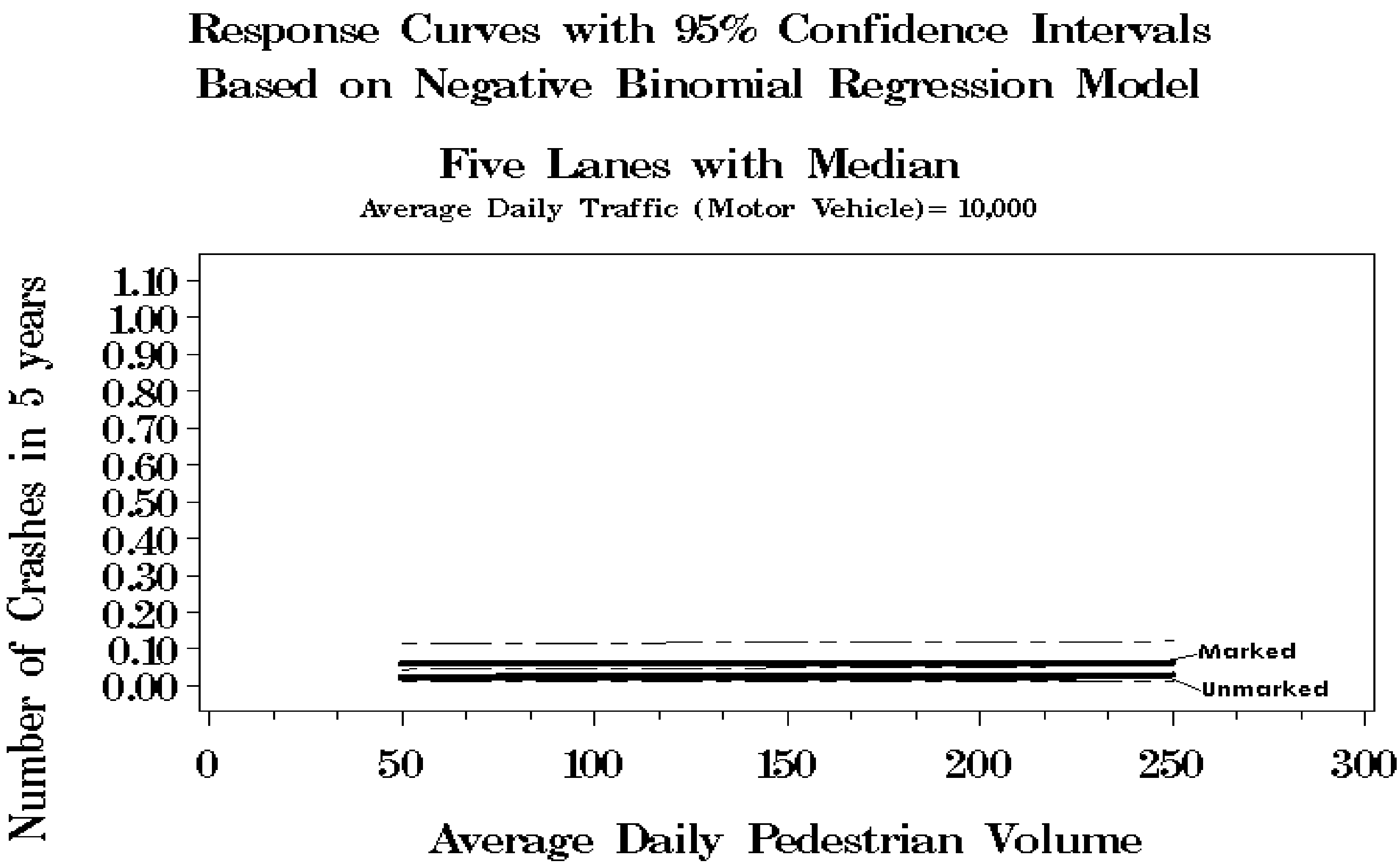


Figure 16. Predicted pedestrian crashes versus pedestrian ADT for five-lane roads (with median) based on the final model.

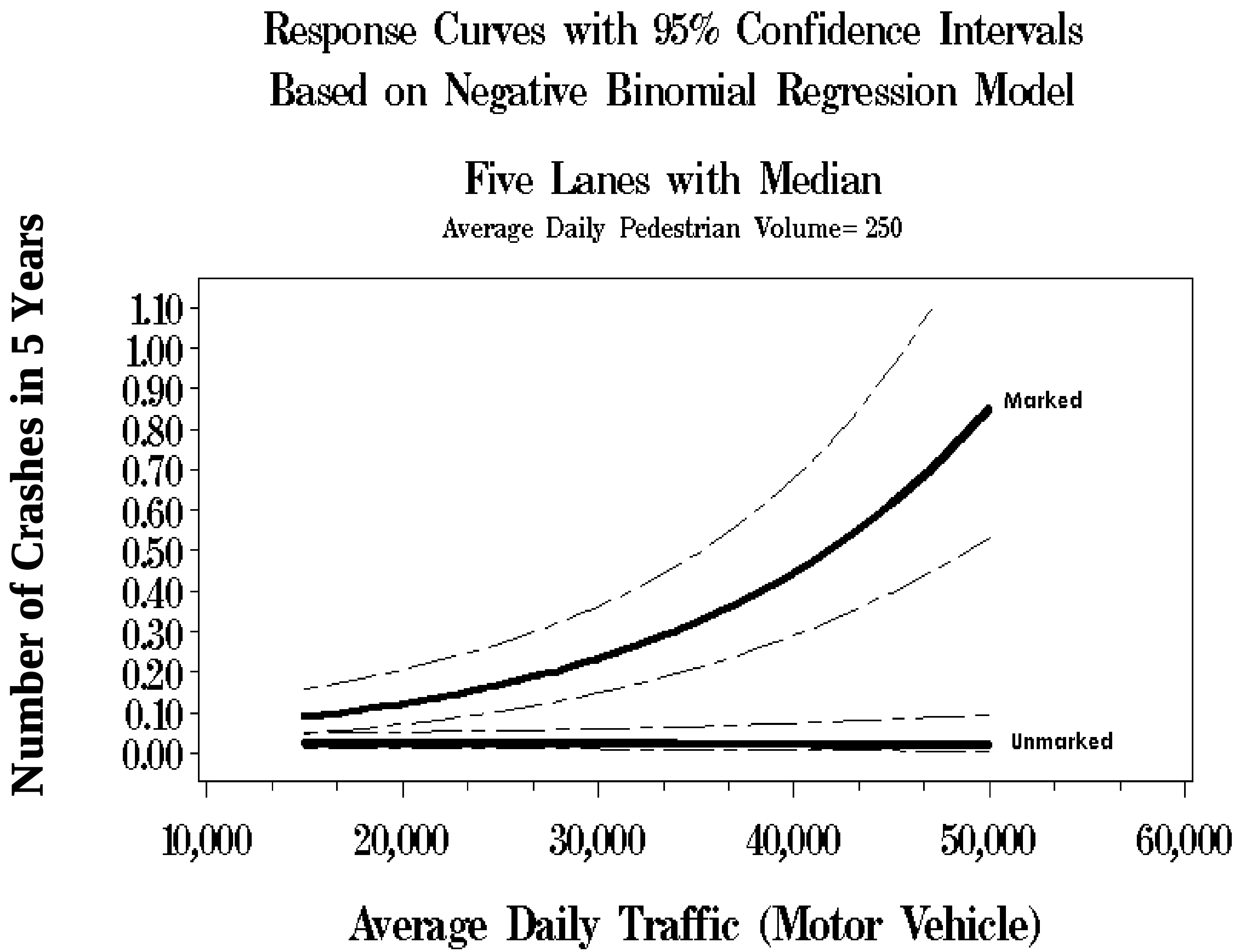


Figure 17. Predicted pedestrian crashes versus traffic ADT for five-lane roads (with median) based on the final model (pedestrian ADT = 250).

Additional plots of pedestrian crashes using the final crash prediction model are given in appendix C for various combinations of the input variables. Tables of estimated pedestrian crashes per 5-year period are given in appendix D using the final model and inputting various combinations of traffic ADT, pedestrian ADT, numbers of lanes, and median type. Table 10 provides estimated pedestrian crashes for marked and unmarked five-lane crossings with a raised median. For example, from table 10, consider a marked crosswalk on a five-lane road (with a raised median) with 150 pedestrian crossings per day and a traffic ADT of 28,000. There would be 0.20 expected pedestrian crashes per 5-year period, or 1 pedestrian crash every 25 years, unless a pedestrian crossing improvement (e.g, traffic signals with pedestrian signals if warranted) is installed. In all cases, values of input variables are chosen well within actual ranges of the study database. A detailed discussion of potential pedestrian safety improvements at uncontrolled locations is in chapter 4 of this report.

Table 10. Estimated number of pedestrian crashes in 5 years based on negative binomial model.

		Five Lanes with Median					
Average Daily Pedestrian Volume	Average Daily Traffic (Motor Vehicle)	Unmarked Lower 95%	Unmarked Predicted	Unmarked Upper 95%	Marked Lower 95%	Marked Predicted	Marked Upper 95%
150	9,000	0.01	0.03	0.05	0.03	0.06	0.11
150	10,000	0.01	0.02	0.05	0.03	0.06	0.12
150	11,000	0.01	0.02	0.05	0.03	0.07	0.12
150	12,000	0.01	0.02	0.05	0.04	0.07	0.13
150	13,000	0.01	0.02	0.05	0.04	0.07	0.14
150	14,000	0.01	0.02	0.05	0.04	0.08	0.15
150	15,000	0.01	0.02	0.05	0.05	0.08	0.15
150	16,000	0.01	0.02	0.05	0.05	0.09	0.16
150	17,000	0.01	0.02	0.05	0.06	0.10	0.17
150	18,000	0.01	0.02	0.05	0.06	0.10	0.18
150	19,000	0.01	0.02	0.05	0.06	0.11	0.19
150	20,000	0.01	0.02	0.05	0.07	0.12	0.20
150	21,000	0.01	0.02	0.05	0.07	0.13	0.21
150	22,000	0.01	0.02	0.05	0.08	0.13	0.22
150	23,000	0.01	0.02	0.05	0.09	0.14	0.24
150	24,000	0.01	0.02	0.05	0.09	0.15	0.25
150	25,000	0.01	0.02	0.05	0.10	0.16	0.26
150	26,000	0.01	0.02	0.05	0.11	0.17	0.28
150	27,000	0.01	0.02	0.05	0.12	0.19	0.30
150	28,000	0.01	0.02	0.05	0.13	0.20	0.31
150	29,000	0.01	0.02	0.05	0.13	0.21	0.33
150	30,000	0.01	0.02	0.05	0.14	0.23	0.35
150	31,000	0.01	0.02	0.05	0.15	0.24	0.37
150	32,000	0.01	0.02	0.05	0.17	0.26	0.40
150	33,000	0.01	0.02	0.06	0.18	0.27	0.42
150	34,000	0.01	0.02	0.06	0.19	0.29	0.45
150	35,000	0.01	0.02	0.06	0.20	0.31	0.48
150	36,000	0.01	0.02	0.06	0.22	0.33	0.51
150	37,000	0.01	0.02	0.06	0.23	0.36	0.54
150	38,000	0.01	0.02	0.06	0.25	0.38	0.58
150	39,000	0.01	0.02	0.06	0.27	0.40	0.62
150	40,000	0.01	0.02	0.07	.028	0.43	0.66

CHAPTER 3. STUDY RESULTS

SIGNIFICANT VARIABLES

Poisson and negative binomial regression models were fit to pedestrian crash data from marked and unmarked crosswalks. These analyses showed that several factors in addition to crosswalk markings were associated with pedestrian crashes. Traffic and roadway factors found to be related to a greater frequency of pedestrian crashes included higher pedestrian volumes, higher traffic ADT, and a greater number of lanes (i.e., multilane roads with three or more lanes had higher pedestrian crash rates than two-lane roads). For this study, a center two-way left-turn lane was considered to be a travel lane and not a median.

Surprisingly, after controlling for other factors (e.g., pedestrian volume, traffic volume, number of lanes, median type), speed limit was not significantly related to pedestrian crash frequency. Certainly, one would expect that higher vehicle speed would be associated with an increased probability of a pedestrian crash (all else being equal). However, the lack of association between speed limit and pedestrian crashes found in this analysis may be due to the fact that there was not much variation in the range of vehicle speed or speed limit at the study sites (i.e., 93 percent of the study sites had speed limits of 40.2 to 56.3 km/h (25 to 35 mi/h). Another possible explanation, as hypothesized by Garder, is that pedestrians may be more careful when crossing streets with higher speed limits; that is, they may avoid short gaps on high-speed roads, which may minimize the effect of vehicle speed on pedestrian crash rates.[30] In terms of speed and crash severity, the analysis showed that speed limits of 56.3 km/h (35 mi/h) and greater were associated with a higher percentage of fatal and type A (serious or incapacitating) injuries (43 percent) compared to sites having lower speed limits (23 percent of the crashes resulting in fatal or type A injuries).

The presence of a raised median or raised crossing island was associated with a significantly lower pedestrian crash rate at multilane sites with both marked and unmarked crosswalks. These results were in basic agreement with a major study by Bowman and Vecellio[31] and also a study by Garder[32] that found safety benefits for pedestrians due to raised medians and refuge islands, respectively. Furthermore, on multilane roads, medians that were painted (but not raised) and center two-way left-turn lanes did not offer significant safety benefits to pedestrians, compared to multilane roads with no median at all.

There did appear to be some regional effect. Marked and unmarked crosswalks in western U.S. cities had a significantly higher pedestrian crash rate than eastern U.S. cities (after controlling for pedestrian exposure, number of lanes, median type, and other site conditions). The reason(s) for these regional differences in pedestrian crash rate is not known, although it could be related to regional differences in driver and pedestrian behavior, higher vehicle speeds in western cities, differences in pedestrian-related laws or enforcement levels, variations in roadway design features, and/or other factors. However, this effect was only marginally significant in the final crash prediction model, and excluding it from the model had little effect on the model results.

All of the variables related to pedestrian crashes (i.e., pedestrian volume, traffic ADT, number of lanes, existence of median and median type, and region of the country) then were included in the models for determining the effects of marked and unmarked sites. Factors having no significant effect on pedestrian crash rate included: area (e.g., residential, central business district (CBD)), location (i.e., intersection versus midblock), speed limit, traffic operation (one-way or two-way), condition of crosswalk marking (excellent, good, fair, or poor), and crosswalk marking pattern (e.g., parallel lines, ladder type, zebra stripes). One may expect that crosswalk marking condition may not necessarily be related to pedestrian crash rate, since the condition of the markings may have varied over the 5-year analysis period, and the condition of the markings was observed only once. Furthermore, in some regions, the crosswalk markings may be less visible during or after rain or snow storms. It is also recognized, however, that some agencies may maintain and restripe crosswalks more often than other agencies included in the study sample.

MARKED AND UNMARKED CROSSWALK COMPARISONS

The results revealed that on two-lane roads, there were no significant differences in pedestrian crashes for marked and unmarked crosswalk sites. In other words, pedestrian safety on two-lane roads was not found to be different, whether the crosswalk was marked or unmarked. This conclusion is based on a sample size of 914 crossing sites on two-lane roads (out of 2,000 total sites). Specifically, binomial comparison of pedestrian crash rates were computed for marked and unmarked sites within subsets by ADT, median type, and number of lanes, as shown in figure 18.

On multilane roads with ADT of 12,000 or less, there were also no differences in pedestrian crash rates between marked and unmarked sites. On multilane roads with no raised medians and ADTs greater than 12,000, sites with marked crosswalks had higher pedestrian crash rates than unmarked crossings. On multilane roads (roads with three to eight lanes) with raised medians and vehicle ADTs greater than 15,000, a significantly higher pedestrian crash rate was associated with marked crosswalk sites compared to unmarked sites.

Best-fit curves for multilane undivided roads were produced for pedestrian crashes (per million pedestrian crossings) at marked and unmarked crosswalks as a function of vehicle volume (ADT), as shown in figure 19. The data points of figure 19 were obtained by aggregating sites into traffic volume categories. Since each marked crosswalk site and its matched comparison (unmarked) site usually had the same traffic volume, each traffic volume category usually contained the same number of marked and unmarked sites (there were a few exceptions). Pedestrian crash rates were computed based on total pedestrian crashes and total pedestrian crossings within each traffic volume category. In figure 19, these rates are plotted at the midpoints of the traffic volume categories. Smooth curves were then fit to the data points. Similar analyses were conducted for multilane divided roads. A final negative binomial model was also developed. The analysis for multilane undivided roads revealed that:

- For traffic volumes (ADTs) of about 10,000 or less, pedestrian crash rates were about the same (i.e., less than 0.25 pedestrian crashes per million pedestrian crossings) between marked and unmarked crosswalks.

- For ADTs greater than 10,000, the pedestrian crash rate for marked crosswalks became increasingly higher as the ADTs increased. The pedestrian crash rate at unmarked crossings increased only slightly as the ADTs increased.

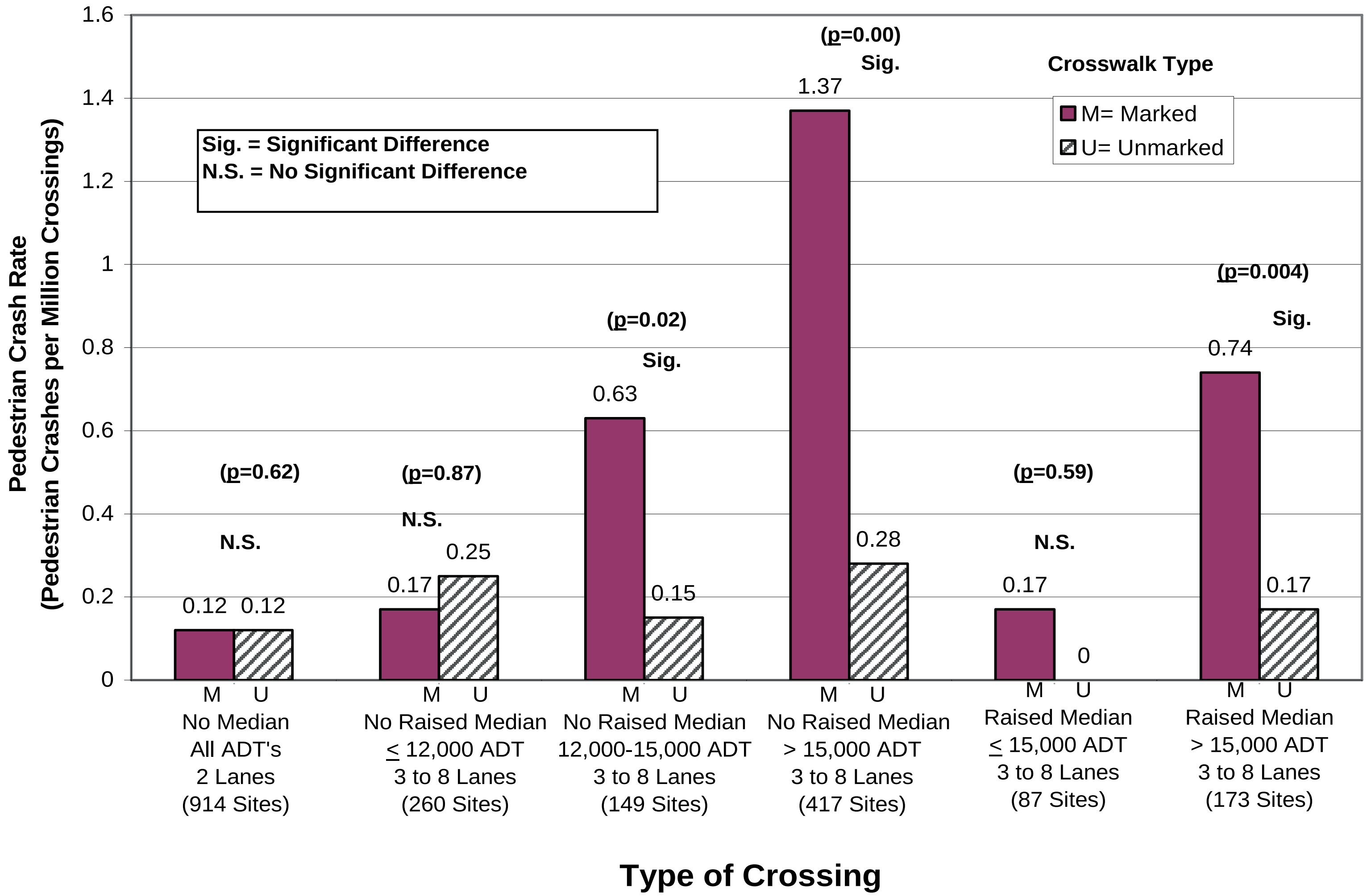


Figure 18. Pedestrian crash rate versus type of crossing.

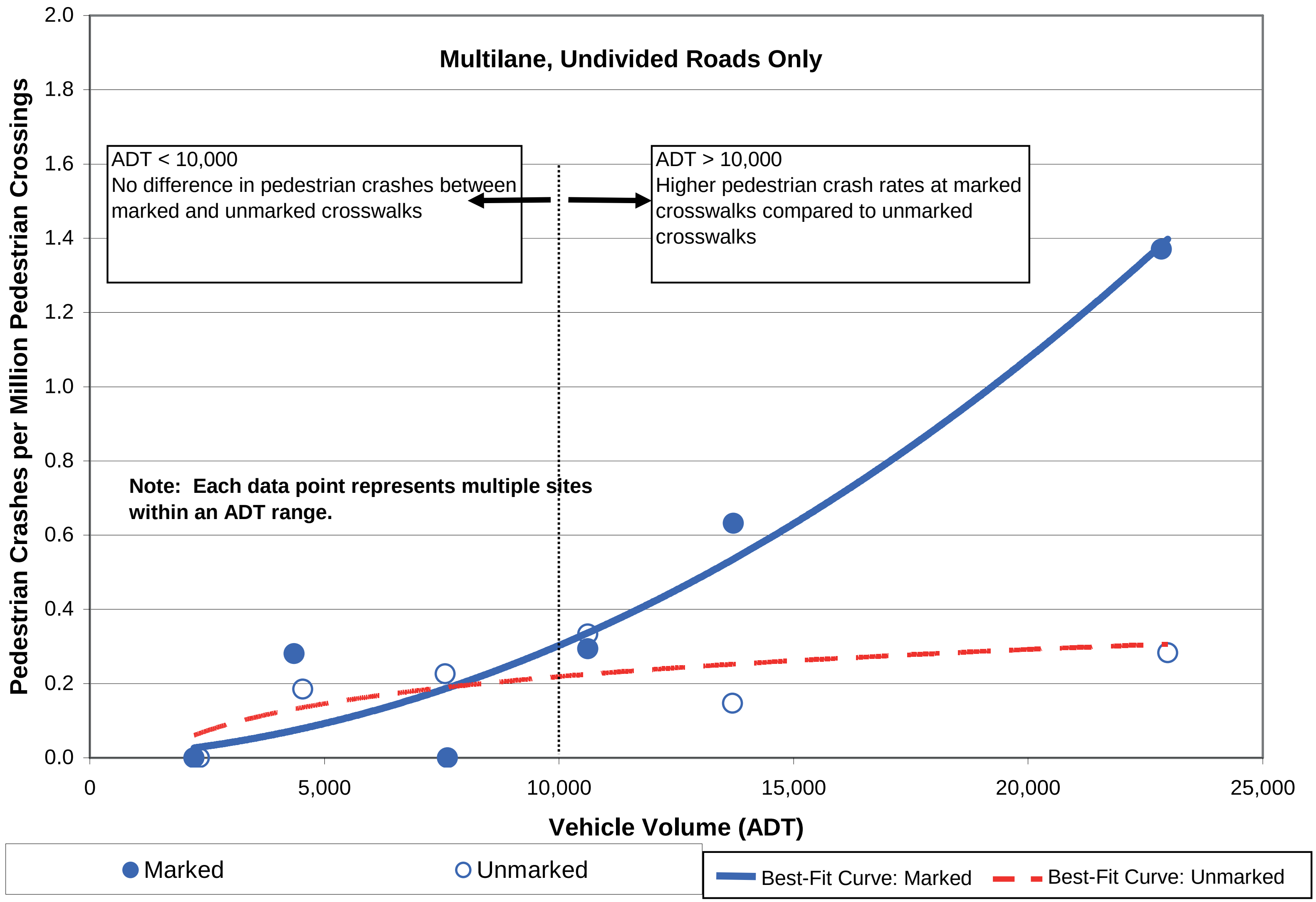


Figure 19. Pedestrian crash rates by traffic volume for multilane crossings with no raised medians—marked versus unmarked crosswalks.

Note that each point on the graph in figure 19 represents dozens of sites, that is, all of the sites corresponding to the given ADT group. For example, the data point for marked crosswalks with ADTs greater than 15,000 corresponds to more than 400 sites. All analyses in this study took into account differences in pedestrian crossing volume, traffic volume, and other important site variables.

These results may be somewhat expected. Wide, multilane streets are difficult for many pedestrians to cross, particularly if there is an insufficient number of adequate gaps in traffic due to heavy traffic volume and high vehicle speed. Furthermore, while marked crosswalks in themselves may not increase measurable unsafe pedestrian or motorist behavior (based on the Knoblauch et al. and Knoblauch and Raymond studies(13,14)) one possible explanation is that installing a marked crosswalk may increase the number of at-risk pedestrians (particularly children and older adults) who choose to cross at the uncontrolled location instead of at the nearest traffic signal.

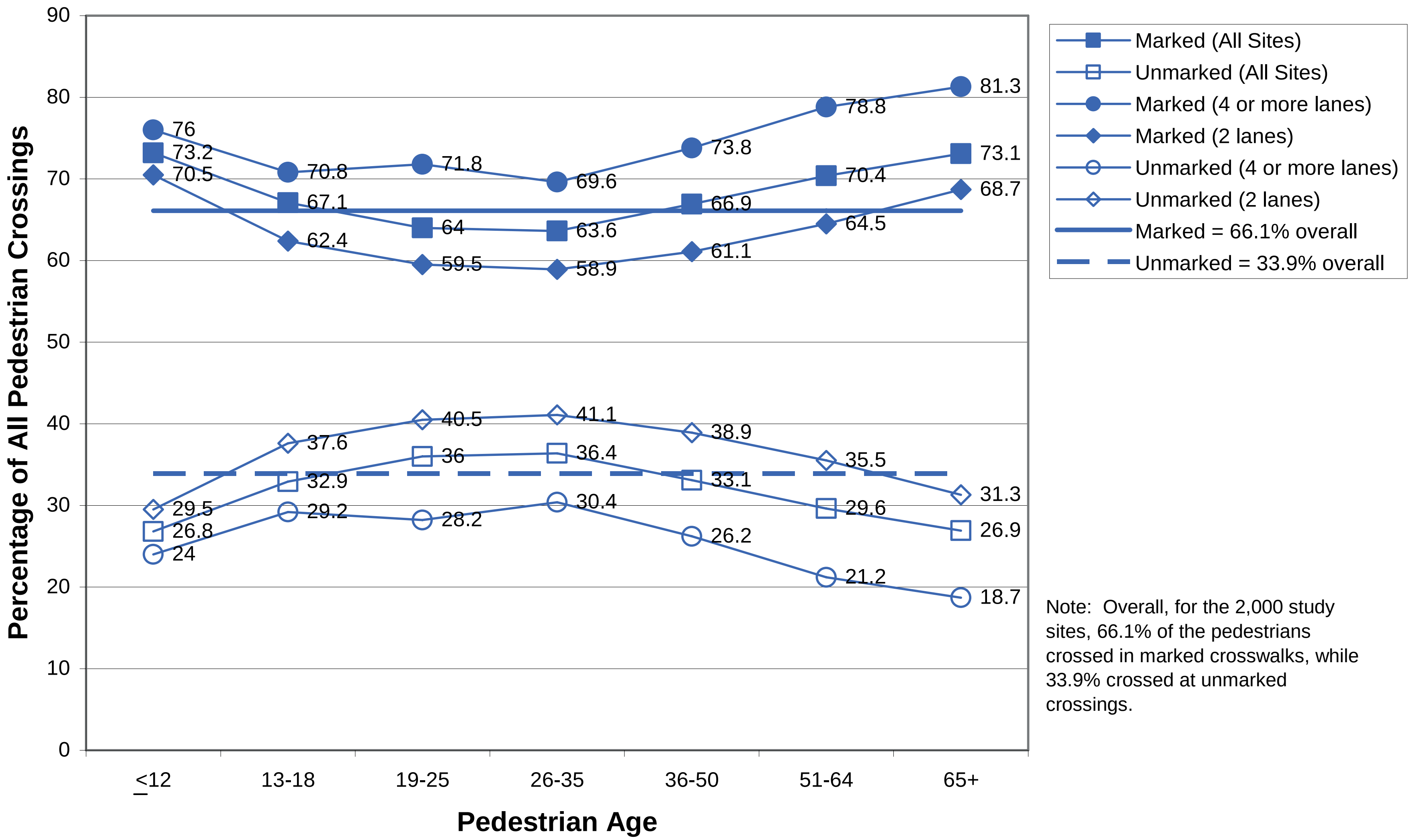
The pedestrian crossing counts at the 1,000 marked crosswalks and 1,000 unmarked comparison crossings in this study may partially explain the difference. Overall, 66.1 percent of the observed pedestrians crossed at marked crosswalks, compared to 33.9 percent at unmarked crossings. More than 70 percent of pedestrians under age 12 and above age 64 crossed at marked crosswalks, while about 35 percent of pedestrians in the 19- to 35-year-old range crossed at unmarked crossings, as shown in figure 20. The age group of pedestrians was estimated based on site observation.

An even greater percentage of older adults (81.3 percent) and young children (76.0 percent) chose to cross in marked crosswalks on multilane roads compared to two-lane roads. Thus, installing a marked crosswalk at an already undesirable crossing location (e.g., wide, high-volume street) may increase the chance of a pedestrian crash occurring at such a site if a few at-risk pedestrians are encouraged to cross where other adequate crossing facilities are not provided. This explanation might be evidenced by the many calls to traffic engineers from citizens who state, “Please install a marked crosswalk so that we can cross the dangerous street near our house.” Unfortunately, simply installing a marked crosswalk without other more substantial crossing facilities often does not result in the majority of motorists stopping and yielding to pedestrians, contrary to the expectations of many pedestrians.

On three-lane roads (i.e., one lane in each direction with a center two-way left-turn lane), the crash risk was slightly higher for marked crosswalks compared to unmarked crosswalks, but this difference was not significant (based on a sample size of 148 sites).

CRASH TYPES

The greatest difference in pedestrian crash types that occurred at marked and unmarked crosswalks involved multiple-threat crashes. A multiple-threat crash involves a driver stopping in one lane of a multilane road to permit pedestrians to cross, and an oncoming vehicle (in the same direction) strikes the pedestrian who is crossing in front of the stopped vehicle. This crash type involves both the pedestrian and driver failing to see each other in time to avoid the collision (see figure 21). To avoid multiple-threat collisions, drivers should slow down and look around stopped vehicles in the adjacent travel lane, and pedestrians should stop at the outer edge of a stopped vehicle and look into the oncoming lane for approaching vehicles before stepping into the lane.



Note: Overall, for the 2,000 study sites, 66.1% of the pedestrians crossed in marked crosswalks, while 33.9% crossed at unmarked crossings.

Figure 20. Percentage of pedestrians crossing at marked and unmarked crosswalks by age group and road type.

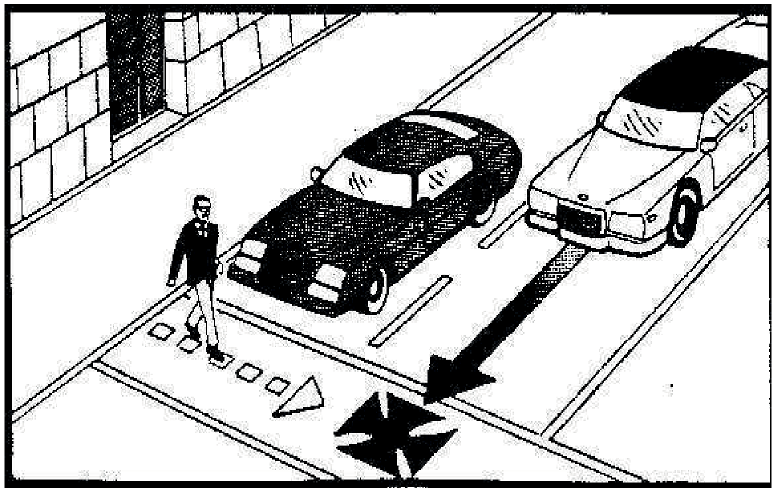


Figure 21. Illustration of multiple-threat pedestrian crash.

A total of 17.6 percent (33 out of 188) of the pedestrian crashes in marked crosswalks were classified as multiple threat. None of the 41 pedestrian crashes in unmarked crosswalks was a multiple-threat crash. This finding may be the result of one or more of the following factors:

- Drivers may be more likely to stop and yield to pedestrians in marked crosswalks compared to unmarked crossings, since at least one motorist must stop for a pedestrian to set up a multiple-threat pedestrian collision. Also, pedestrians may be more likely to step out in front of oncoming traffic in a marked crosswalk than at an unmarked location in some instances.

- A second explanation is related to the fact that most of the total pedestrians who are crossing multilane roads are crossing in a marked crosswalk (66.1 percent), as shown earlier in figure 14. Furthermore, of the pedestrian age groups most at risk (the young and the old), an even greater proportion of these pedestrians are choosing to cross multilane roads in marked crosswalks (76 percent and 81.3 percent, respectively).

- Another possible explanation could be that some pedestrians crossing in a marked crosswalk may be less likely to search properly for vehicles (compared to an unmarked crossing) when stepping out past a stopped vehicle and into an adjacent lane (i.e., pedestrians not realizing that they need to search for other oncoming vehicles after one motorist stops for them).

Further research on pedestrian and motorist behavior could help to gain a better understanding of the causes and potential effects of countermeasures (e.g., advance stop lines) related to these crashes. There is also a need to examine the current laws and level of police enforcement (and a possible need for changes in the laws) on motorist responsibility to yield to pedestrians and how these laws differ between States. A distribution of pedestrian crash types, which includes all of the 229 pedestrian collisions at the 2,000 study sites, is shown in figure 22.

Motorists failing to yield (on through movements) represented a large percentage of pedestrian crashes in marked crosswalks (41.5 percent) and unmarked crosswalks (31.7 percent). Likewise, vehicle turn and merge crashes, also generally the fault of the driver, accounted for 19.2 percent (marked crosswalks) and 12.2 percent (unmarked crosswalks) of such crashes (see figure 22). These results indicate a strong need for improved driver enforcement and education programs that emphasize the importance of yielding or stopping for pedestrians. More pedestrian-friendly roadway designs may also be helpful in reducing such crashes by slowing vehicles, providing pedestrian refuge (e.g., raised medians), and/or better warning to motorists about pedestrian crossings.

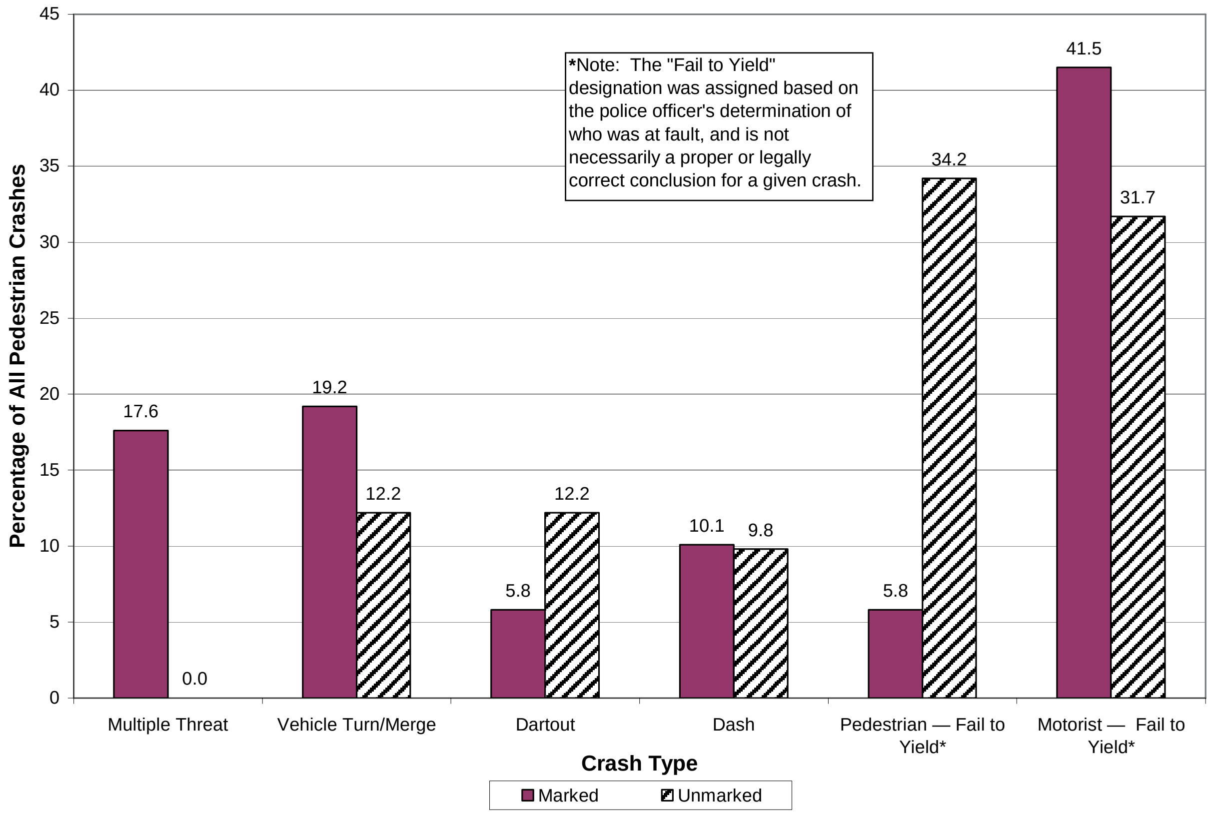


Figure 22. Pedestrian crash types at marked and unmarked crosswalks.

A substantial proportion of pedestrian crashes involved dartout, dash, and other types of crashes in which the pedestrian stepped or ran in front of an oncoming vehicle at unmarked crosswalks (23 of 41, or 56.1 percent) and a lesser proportion occurred at marked crosswalks (41 of 188, or 21.8 percent). Police officers sometimes unjustifiably assign fault to the pedestrian, which suggests the need for more police training. Specifically, it may be questioned why so many pedestrian crashes were designated by the police officer as "pedestrian fails to yield," since in most States, motorists are required legally to yield the right-of-way to pedestrians who are crossing in marked or unmarked crosswalks. Of course, some State ordinances do specify that pedestrians also bear some responsibility for avoiding a collision by not stepping out into the street directly into the path of an oncoming motorist who is too close to the crosswalk to stop in time to avoid a collision. It is likely that police officers often rely largely on the statement of the motorist (e.g., "the pedestrian ran out in front of me" or "came out of nowhere") in determining fault in such crashes, particularly when the driver was not paying proper attention to the road, the pedestrian is unconscious, and there are no other witnesses at the scene. However, it is also true that a major contributing factor is the unsafe behavior of pedestrians. Dartouts, dashes, and failure of the pedestrians to yield were indicated by police officers as contributing causes in 27.9 percent (64 of 229) of the pedestrian crashes at the study sites. These results are indicative of a need for improved pedestrian educational programs, which is in agreement with recommendations in other important studies related to improving the safety of vulnerable road users.[33] Furthermore, speeding drivers often contribute to dartout crashes, in addition to unsafe pedestrian behaviors. Creating more pedestrian-friendly crossings by including curb extensions, traffic-calming measures, and other features may also be useful in reducing many of these crashes. It should be mentioned that alcohol use by pedestrians and motorists may also contribute to pedestrian crash experience. However, reliable information on alcohol involvement was not available from local crash reports; therefore, such analysis was not possible for this study.

CRASH SEVERITY

An analysis was conducted to compare pedestrian crash severity on marked and unmarked crosswalks (figure 23). Crash severity did not differ significantly between marked and unmarked crosswalks on two-lane roads. On multilane roads, there was evidence of more fatal (type K) and type A injury pedestrian crashes at marked crosswalks compared to unmarked crosswalks, although the sample sizes were too small for statistical reliability. This result probably is due to older pedestrians being more likely than other age groups to walk in marked rather than unmarked crosswalks. Furthermore, older pedestrians are much more likely to sustain fatal and serious injuries than younger pedestrians. As mentioned earlier, speed limits of 56.3 km/h (35 mi/h) and higher were associated with a greater percentage of fatal and/or type A injuries (43 percent), whereas sites with lower speed limits had 23 percent of pedestrian crashes resulting in fatal and/or type A injuries.

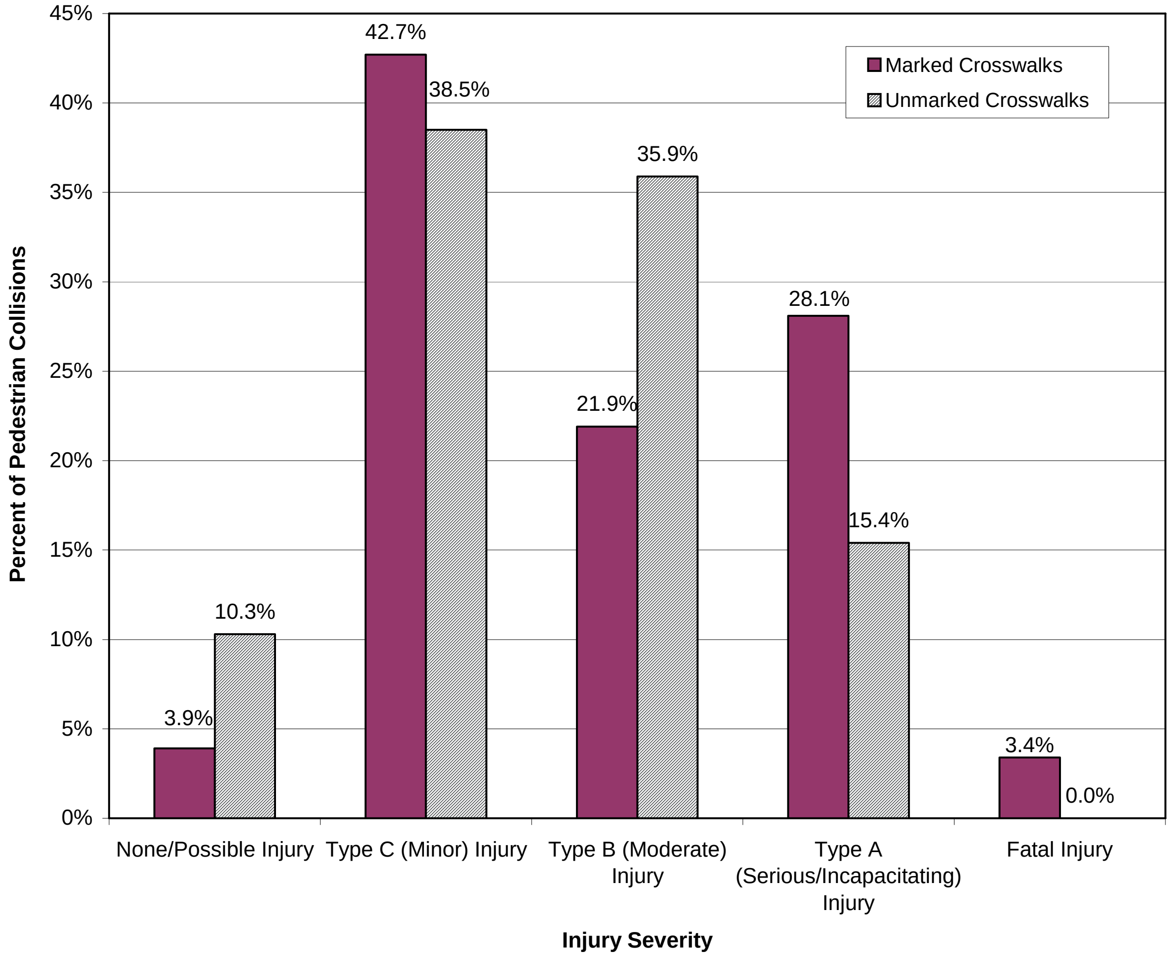


Figure 23. Severity distribution of pedestrian collisions for marked and unmarked crosswalks.

LIGHTING AND TIME OF DAY

Nighttime pedestrian crash percentages were about the same at marked and unmarked crosswalks (approximately 30 percent). In terms of time of day, the percentage of pedestrian crashes in marked crosswalks tended to be higher than for unmarked crosswalks during the morning (6 to 10 a.m.) and afternoon (3 to 7 p.m.) peak periods, but lower in the midday (10 a.m. to 3 p.m.) and evening (7 p.m. to midnight) periods (figure 24). This is probably because pedestrians are more likely to cross in marked crosswalks than in unmarked crossings during peak traffic periods (e.g., walking to and from work) than at other times. As shown in figure 25, little difference is noticeable between pedestrian collisions for marked and unmarked crosswalks with respect to light condition. However, it is apparent that adequate nighttime lighting should be provided at marked crosswalks to enhance the safety of pedestrians crossing at night.

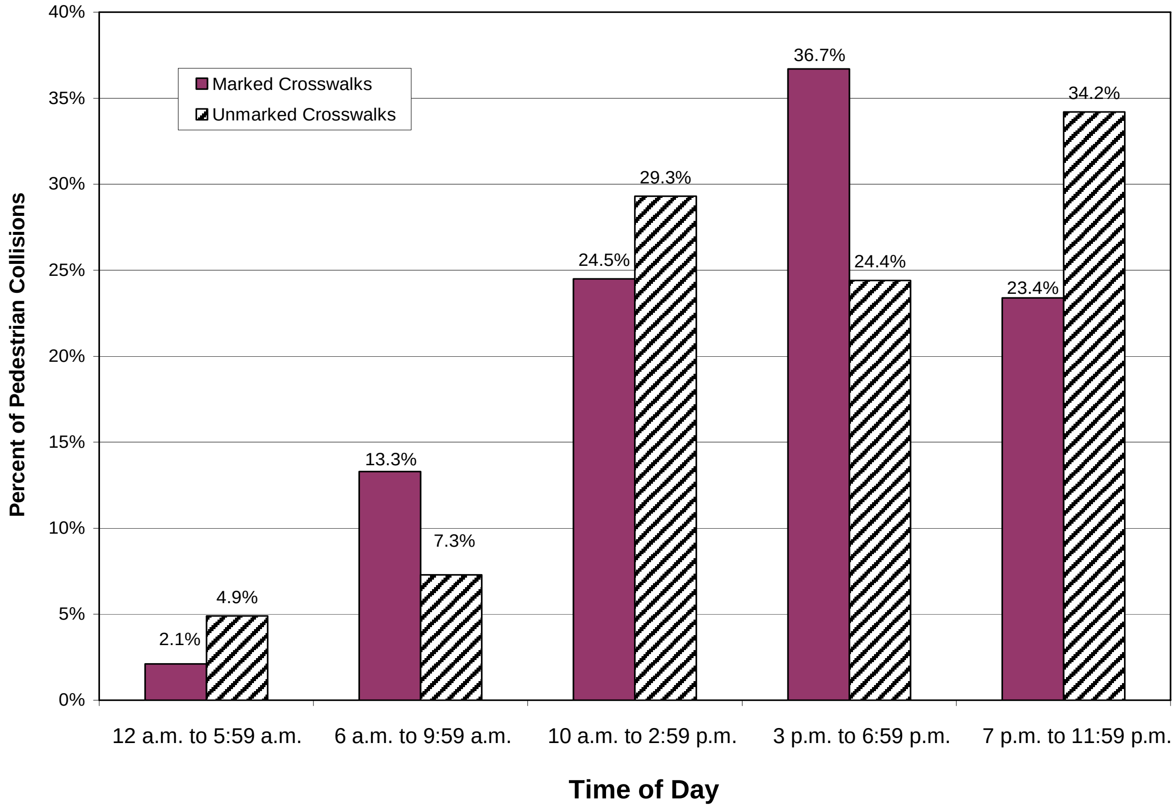


Figure 24. Distribution of pedestrian collisions by time of day for marked and unmarked crosswalks.

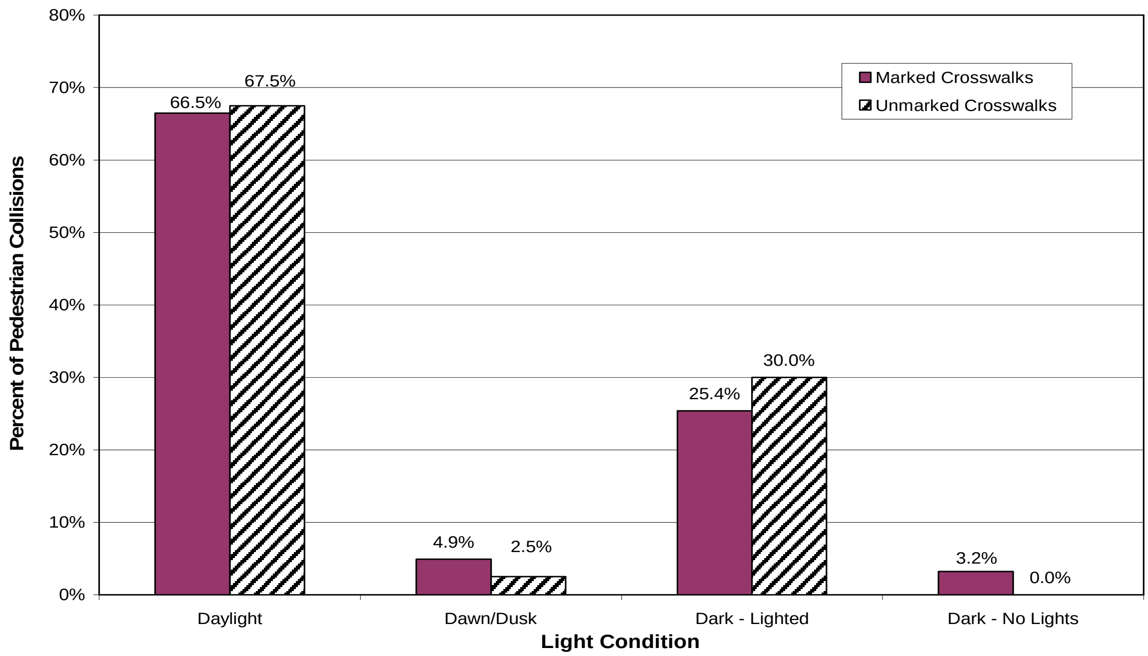


Figure 25. Pedestrian collisions by light condition for marked and unmarked crosswalks.

AGE EFFECTS

A separate analysis of pedestrian crashes and crossing volumes by age of pedestrian was conducted (figure 26). For virtually every situation studied, pedestrians age 65 and older were overrepresented in pedestrian crashes compared to their relative crossing volumes. Figures 27–30 show the relative proportion of crashes and exposure for various age groups for marked crosswalks on two-lane and multilane roads. For a given age group, when the proportion of crashes exceeds the proportion of exposure, then crashes are overrepresented; that is, pedestrians in that population group are at greater risk of being in a pedestrian crash than would be expected from their volume alone.

The pedestrian age groups younger than 65 showed no clear increase in crash risk compared to their crossing volumes. One possible reason that young pedestrians were not overly involved in crash occurrences is the fact that many crashes involving young pedestrians (particularly ages 5 to 9) occur on residential streets, whereas this study did not include school crossings; most sites were drawn from collector and arterial streets (where marked crosswalks exist) that are less likely to be frequented by unescorted young children. Also, some of the young children counted in this study were crossing with their parents or other adults, which may have reduced their risk of a crash. Some of the possible reasons that older pedestrians are at greater risk when crossing streets compared to other age groups are that older adults are more likely (as an overall group) than younger pedestrians to have:

- Slower walking speeds (and thus greater exposure time).
- Visual and/or hearing impairments.

- Difficulty in judging the distance and speed of oncoming traffic.

- More difficulty keeping track of vehicles coming from different directions, including turning vehicles.

- Inability to react (e.g., stop, dodge, or run) as quickly as younger pedestrians in order to avoid a collision under emergency conditions.

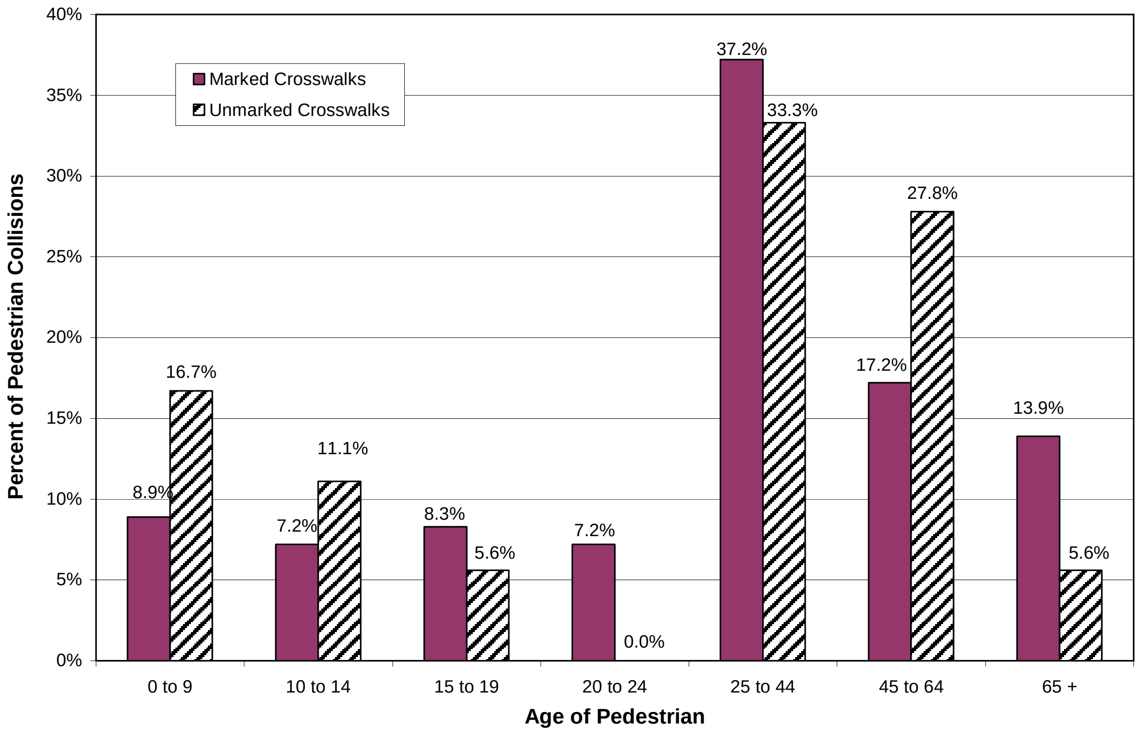


Figure 26. Age distribution of pedestrian collisions for marked and unmarked crosswalks.

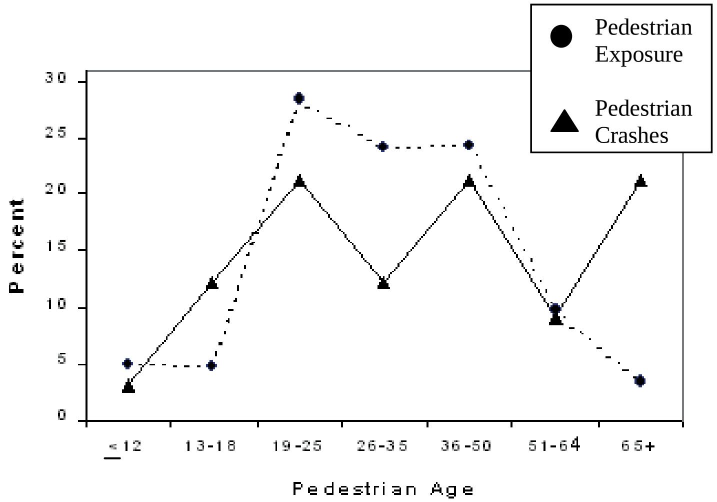


Figure 27. Two-Lane Roads, Marked Crosswalks.

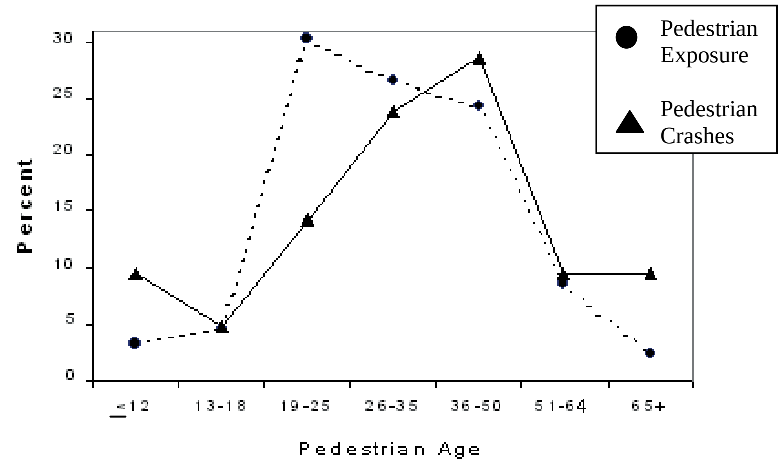


Figure 28. Two-Lane Roads, Unmarked Crosswalks.

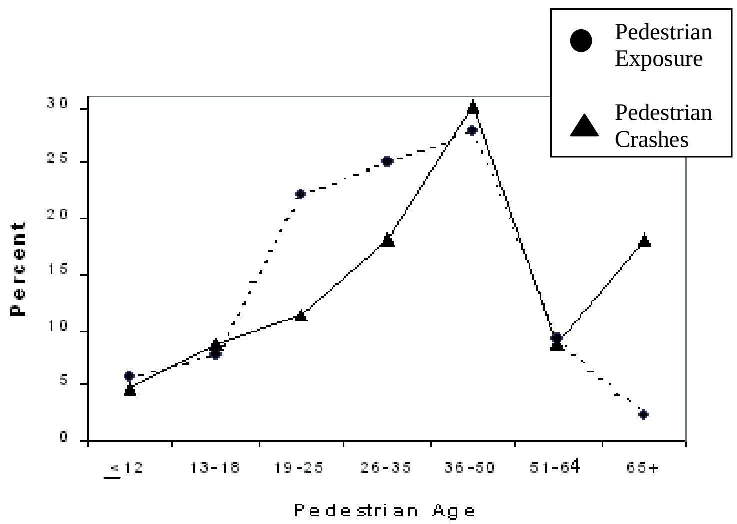


Figure 29. Multilane Roads, Marked Crosswalks.

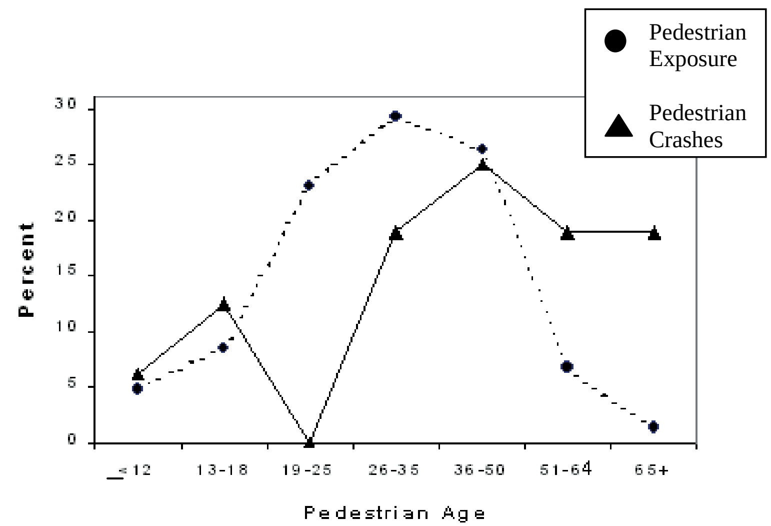


Figure 30. Multilane Roads, Unmarked Crosswalks.

Figures 27–30. Percentage of crashes and exposure by pedestrian age group and roadway type at uncontrolled marked and unmarked crosswalks.

DRIVER AND PEDESTRIAN BEHAVIOR AT CROSSWALKS

A companion study was conducted by Knoblauch et al. on pedestrian and motorist behavior and on vehicle speed before and after crosswalk installation at sites in Minnesota, New York, and Virginia (on two-lane and three-lane streets) to help gain a better understanding of the effects of marked crosswalks versus unmarked crosswalks.(13) The study results revealed that very few motorists stopped or yielded to pedestrians either before or after marked crosswalks were installed. After marked crosswalks were installed, there was a small increase in pedestrian scanning behavior before stepping out into the street. Also, there was approximately a 1.6-km/h (1-mi/h) reduction in vehicle speed after the marked crosswalks were installed.(13) These behavioral results tend to contradict the false sense of security claims attributed to marked crosswalks, since observed pedestrian behavior actually improved after marked crosswalks were installed at the study sites. However, measures such as pedestrian awareness and an expectation that motorists will stop for them cannot be collected by field observation alone. Installing marked crosswalks or other measures can affect pedestrian level of service if the measures increase the number of motorists who stop and yield to pedestrians. Furthermore, a greater likelihood of motorist stopping can also setup more multiple threat crashes on multilane roads. Future studies using focus groups of pedestrians and questionnaires completed by pedestrians in the field could shed light on such measures.

CHAPTER 4. CONCLUSIONS AND RECOMMENDATIONS

Pedestrians are legitimate users of the transportation system, and their needs should be identified routinely —and appropriate solutions selected—to improve pedestrian safety and access. Deciding where to mark crosswalks is only one consideration in meeting that objective.

The study results revealed that under no condition was the presence of a marked crosswalk alone at an uncontrolled location associated with a significantly lower pedestrian crash rate compared to an unmarked crosswalk. Furthermore, on multilane roads with traffic volumes greater than 12,000 vehicles per day, having a marked crosswalk was associated with a higher pedestrian crash rate (after controlling for other site factors) compared to an unmarked crosswalk. Therefore, adding marked crosswalks alone (i.e., with no engineering, enforcement, or education enhancement) is not expected to reduce pedestrian crashes for any of the conditions included in the study. On many roadways, particularly multilane and high-speed crossing locations, more substantial improvements often are needed for safer pedestrian crossings, such as providing raised medians, installing traffic signals (with pedestrian signals) when warranted, implementing speed-reducing measures, and/or other practices. In addition, development patterns that reduce the speed and number of multilane roads should be encouraged.

Street crossing locations should be routinely reviewed to consider the three following available options:

1. No special provisions needed.

2. Provide a marked crosswalk alone.

3. Install other crossing improvements (with or without a marked crosswalk) to reduce vehicle speeds, shorten the crossing distance, or increase the likelihood of motorists stopping and yielding.

GUIDELINES FOR CROSSWALK INSTALLATION

Marked pedestrian crosswalks may be used to delineate preferred pedestrian paths across roadways under the following conditions:

- At locations with stop signs or traffic signals to direct pedestrians to those crossing locations and to prevent vehicular traffic from blocking the pedestrian path when stopping for a stop sign or red light.

- At nonsignalized street crossing locations in designated school zones. Use of adult crossing guards, school signs and markings, and/or traffic signals with pedestrian signals (when warranted) should be considered in conjunction with the marked crosswalk, as needed.

- At nonsignalized locations where engineering judgment dictates that the number of motor vehicle lanes, pedestrian exposure, average daily traffic (ADT), posted speed limit, and geometry of the location would make the use of specially designated crosswalks desirable for traffic/pedestrian safety and mobility.

Marked crosswalks alone (i.e., without traffic-calming treatments, traffic signals and pedestrian signals when warranted, or other substantial crossing improvement) are insufficient and should not be used under the following conditions:

- Where the speed limit exceeds 64.4 km/h (40 mi/h).

- On a roadway with four or more lanes without a raised median or crossing island that has (or will soon have) an ADT of 12,000 or greater.

- On a roadway with four or more lanes with a raised median or crossing island that has (or soon will have) an ADT of 15,000 or greater.

GENERAL SAFETY CONSIDERATIONS

Since sites in this study were confined to those having no traffic signal or stop sign on the main street approaches to the crosswalk, it follows that these results do not apply to crossings controlled by traffic signals, stop or yield signs, traffic-calming treatments, or other devices. These results also do not apply to school crossings, since such sites were purposely excluded from the site selection process.

The results of this study have some clear implications on the placement of marked crosswalks and the design of safer pedestrian crossings at uncontrolled locations.

Pedestrian crashes are relatively rare at uncontrolled pedestrian crossings (1 crash every 43.7 years per site in this study); however, the certainty of injury to the pedestrian and the high likelihood of a severe or fatal injury in a high-speed crash make it critical to provide a pedestrian-friendly transportation network.

Marked crosswalks alone (i.e., without traffic-calming treatments, traffic signals with pedestrian signals when warranted, or other substantial improvement) are not recommended at uncontrolled crossing locations on multilane roads (i.e., four or more lanes) where traffic volume exceeds approximately 12,000 vehicles per day (with no raised medians) or approximately 15,000 ADT (with raised medians that serve as refuge areas). This recommendation is based on the analysis of pedestrian crash experience, as well as exposure data and site conditions described earlier. To add a margin of safety and/or to account for future increases in traffic volume, the authors recommend against installing marked crosswalks alone on two-lane roads with ADTs greater than 12,000 or on multilane roads with ADTs greater than 9,000 (with no raised median). This study also recommends against installing marked crosswalks alone on roadways with speed limits higher than 64.4 km/h (40 mi/h) based on the expected increase in driver stopping distance at higher speeds. (Few sites were found for this study having marked crosswalks where speed limits exceeded 64.4 km/h (40 mi/h).) Instead, enhanced crossing treatments (e.g., traffic-calming treatments, traffic and pedestrian signals when warranted, or other substantial improvement) are recommended. Specific recommendations are given in table 11 regarding installation of marked crosswalks and other crossing measures. It is important for motorists to understand their legal responsibility to yield to pedestrians at marked and unmarked crosswalks, which may vary from State to State. Also, pedestrians should use caution when crossing streets, regardless of who has the legal right-of-way, since it is the pedestrian who suffers the most physical injury in a collision with a motor vehicle.

On two-lane roads and lower volume multilane roads (ADTs less than 12,000), marked crosswalks were not found to have any positive or negative effect on pedestrian crash rates at the study sites. Marked crosswalks may encourage pedestrians to cross the street at such sites. However, it is recommended that crosswalks alone (without other crossing enhancements) not be installed at locations that may pose unusual safety risks to pedestrians. Pedestrians should not be encouraged to cross the street at sites with limited sight distance, complex or confusing designs, or at sites with certain vehicle mixes (many heavy trucks) or other dangers unless adequate design features and/or traffic control devices are in place.

At uncontrolled pedestrian crossing locations, installing marked crosswalks should not be regarded as a magic cure for pedestrian safety problems. However, marked crosswalks also should not be considered as a negative measure that will necessarily increase pedestrian crashes. Marked crosswalks are appropriate at some locations (e.g., at selected low-speed, two-lane streets at downtown crossing locations) to help channel pedestrians to preferred crossing locations, but other roadway improvements are also necessary (e.g., raised medians, traffic-calming treatments, traffic and pedestrian signals when warranted, or other substantial crossing improvement) when used at other locations. The guidelines presented in table 11 are intended to provide guidance for installing marked crosswalks and other pedestrian crossing facilities.

Note that speed limit was used in table 11 in addition to ADT, number of lanes, and presence of a median. In developing the table, roads with higher speed limits (higher than 64.4 km/h (40 mi/h)) were considered to be inappropriate for adding marked crosswalks alone. This is because virtually no uncontrolled, marked crosswalk sites where speed limits exceed 64.4 km/h (40 mi/h) were found in the 30 U.S. cities used in this study. Thus, these types of high-speed, uncontrolled marked crosswalks could not be included in the analysis. Also, high-speed roadways present added problems for pedestrians and thus require more substantial treatments in many cases. That may be why Germany, Finland, and Norway do not allow uncontrolled crosswalks on roads with high speed limits.(30)

For three-lane roads, adding marked crosswalks alone (without other substantial treatments) is generally not recommended for ADTs greater than 12,000, although exceptions may be allowed under certain conditions (e.g., lower speed limits).

If nothing else is done beyond marking crosswalks at an uncontrolled location, pedestrians will not experience increased safety (under any situations included in the analysis). This finding is in some ways consistent with the companion study by Knoblauch et al. that found that marking a crosswalk would not necessarily increase the number of motorists that will stop or yield to pedestrians.(13) Research from Europe shows the need for pedestrian improvements beyond uncontrolled crosswalks.(17,21)

Table 11. Recommendations for installing marked crosswalks and other needed pedestrian improvements at uncontrolled locations.*

Roadway Type (Number of Travel Lanes and Median Type)	Vehicle ADT ≤ 9,000			Vehicle ADT >9,000 to 12,000			Vehicle ADT >12,000–15,000			Vehicle ADT > 15,000		
	Speed Limit**											
	≤ 48.3 km/h (30 mi/h)	56.4 km/h (35 mi/h)	64.4 km/h (40 mi/h)	≤ 48.3 km/h (30 mi/h)	56.4 km/h (35 mi/h)	64.4 km/h (40 mi/h)	≤ 48.3 km/h (30 mi/h)	56.4 km/h (35 mi/h)	64.4 km/h (40 mi/h)	≤ 48.3 km/h (30 mi/h)	56.4 km/h (35 mi/h)	64.4 km/h (40 mi/h)
Two lanes	C	C	P	C	C	P	C	C	N	C	P	N
Three lanes	C	C	P	C	P	P	P	P	N	P	N	N
Multilane (four or more lanes) with raised median***	C	C	P	C	P	N	P	P	N	N	N	N
Multilane (four or more lanes) without raised median	C	P	N	P	P	N	N	N	N	N	N	N

* These guidelines include intersection and 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 center turn lane is not considered a median. Crosswalks should not be installed at locations that could present an increased safety risk to pedestrians, such as where there is poor sight distance, complex or confusing designs, a substantial volume of heavy trucks, or other dangers, without first providing adequate design features and/or traffic control devices. Adding crosswalks alone will not make crossings safer, nor will they necessarily result in more vehicles stopping for pedestrians. Whether or not marked crosswalks are installed, it is important to consider other pedestrian facility enhancements (e.g., raised median, traffic signal, roadway narrowing, enhanced overhead lighting, traffic-calming measures, curb extensions), as needed, to improve the safety of the crossing. These are general recommendations; good engineering judgment should be used in individual cases for deciding where to install crosswalks.

** Where the speed limit exceeds 64.4 km/h (40 mi/h), marked crosswalks alone should not be used at unsignalized locations.

*** The raised median or crossing island must be at least 1.2 m (4 ft) wide and 1.8 m (6 ft) long to serve adequately as a refuge area for pedestrians, in accordance with MUTCD and American Association of State Highway and Transportation Officials (AASHTO) guidelines.

C = Candidate sites for marked crosswalks. Marked crosswalks must be installed carefully and selectively. Before installing new marked crosswalks, an engineering study is needed to determine whether the location is suitable for a marked crosswalk. For an engineering study, a site review may be sufficient at some locations, while a more indepth study of pedestrian volume, vehicle speed, sight distance, vehicle mix, and other factors may be needed at other sites. It is recommended that a minimum utilization of 20 pedestrian crossings per peak hour (or 15 or more elderly and/or child pedestrians) be confirmed at a location before placing a high priority on the installation of a marked crosswalk alone.

P = Possible increase in pedestrian crash risk 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 by providing marked crosswalks alone. Consider using other treatments, such as traffic-calming treatments, traffic signals with pedestrian signals where warranted, or other substantial crossing improvement to improve crossing safety for pedestrians.

In some situations (e.g., low-speed, two-lane streets in downtown areas), installing a marked crosswalk may help consolidate multiple crossing points. Engineering judgment should be used to install crosswalks at preferred crossing locations (e.g., at a crossing location at a streetlight as opposed to an unlit crossing point nearby). While overuse of marked crossings at uncontrolled locations should be avoided, higher priority should be placed on providing crosswalk markings where pedestrian volume exceeds about 20 per peak hour (or 15 or more elderly pedestrians and/or children per peak hour).

Marked crosswalks and other pedestrian facilities (or lack of facilities) should be routinely monitored to determine what improvements are needed.

POSSIBLE MEASURES TO HELP PEDESTRIANS

Although simply installing marked crosswalks by themselves cannot solve pedestrian crossing problems, the safety needs of pedestrians must not be ignored. More substantial engineering and roadway treatments need to be considered, as well as enforcement and education programs and possibly new legislation to provide safer and easier crossings for pedestrians at problem locations. Transportation and safety engineers have a responsibility to consider all types of road users in roadway planning, design, and maintenance. Pedestrians must be provided with safe facilities for travel.

A variety of pedestrian facilities have been found to improve pedestrian safety and/or ability to cross the street under various conditions. (See references 16, 31, 32, 33, and 34.) Examples of pedestrian improvements include:

- Providing raised medians (figure 31) or intersection crossing islands on multilane roads, which can significantly reduce the pedestrian crash rate and also facilitate street crossing. Also, raised medians may provide aesthetic improvement and may control access to prevent unsafe turns out of driveways. Refuge islands should be at least 1.2 m (4 ft) wide (and preferably 1.8 to 2.4 m (6 to 8 ft) wide) and of adequate length to allow pedestrians to stand and wait for gaps in traffic before crossing the second half of the street. When built, the landscaping should be designed and maintained to provide good visibility between pedestrians and approaching motorists.

Figure 31. Raised medians and crossing islands can improve pedestrian safety on multilane roads.

- Installing traffic signals (with pedestrian signals), where warranted (see figures 32 and 33).

Figure 32. Pedestrian signals help accommodate pedestrian crossings on some high-volume or multilane roads.

Figure 33. Traffic signals are needed to improve pedestrian crossings on some high-volume or multilane roads.

- Reducing the effective street crossing distance for pedestrians by narrowing the roads or by providing curb extensions (figures 34 and 35) and/or raised pedestrian islands at intersections.

Figure 34. Curb extensions at midblock locations reduce crossing distance for pedestrians.

Figure 35. Curb extensions at intersections reduce crossing distance for pedestrians.

Another option is to reduce four-lane undivided road sections to two through-lanes with dual left-turn lanes or left-turn bays. Reducing the width of the lanes may result in slower speeds in some situations, which can benefit pedestrians who are attempting to cross the street. This creates enough space to provide median islands. The removal of a travel lane may also allow enough space for sidewalks and/or bike lanes.

- Installing traffic-calming measures may be appropriate on certain streets to slow vehicle speeds and/or reduce cut-through traffic, as described in a 1999 report titled *Traffic Calming: State of the Practice.*[24]

Traffic-calming measures include raised crossings (raised crosswalks, raised intersections) (see figure 36), street narrowing measures (chicanes, slow points, "skinny street" designs), and intersection designs (traffic minicircles, diagonal diverters). Note that some of these traffic-calming measures may not be appropriate on major collector or arterial streets.

Figure 36. Raised crosswalks can control vehicle speeds on local streets at pedestrian crossings.

- Providing adequate nighttime lighting for pedestrians (figure 37). Adequate nighttime lighting should be provided at marked crosswalks and areas near churches, schools, and community centers with nighttime pedestrian activity.

Figure 37. Adequate lighting can improve pedestrian safety at night.

- Designing safer intersections for pedestrians (e.g., crossing islands, tighter turn radii).

- Providing narrower widths and/or access management (e.g., consolidation of driveways).

- Constructing grade-separated crossings or pedestrian-only streets (see figure 38). Grade-separated crossings are very expensive and should only be considered in extreme situations, such as where pedestrian crossings are essential (e.g., school children need to cross a six-lane arterial street), street-crossing at-grade is not feasible for pedestrians, and no other measures are considered to be appropriate. Grade-separated crossings must also conform to Americans with Disabilities Act (ADA) requirements.

Figure 38. Grade-separated crossings sometimes are used when other measures are not feasible to provide safe pedestrian crossings.

- Using various pedestrian warning signs, flashers, and other traffic control devices to supplement marked crosswalks (figure 39). However, the effects of supplemental signs and other devices at marked crosswalks are not well known under various roadway conditions. According to the MUTCD, pedestrian crossing signs should only be used at locations that are unusually hazardous, where crossing activity is unexpected, or at locations where pedestrian crossing activity is not readily apparent.(2)

Figure 39. Pedestrian warning signs sometimes are used to supplement crosswalks.

- Building narrower streets in new communities to achieve desired vehicle speeds.

- Increasing the frequency of two-lane or three-lane arterials when designing new street networks so that fewer multilane arterials are required.

It is recommended that parking be eliminated on the approach to uncontrolled crosswalks to improve vision between pedestrians and motorists. The 2000 Uniform Vehicle Code specifies that parking should be prohibited within an intersection on a crosswalk, and within 6.1 m (20 ft) of a crosswalk at an intersection (which could be increased to 9.1 to 15.25 m (30 to 50 ft) in advance of a crosswalk on a high-speed road.(1)

Some agencies provide fences or railings in the raised medians of multilane roads that direct pedestrians to the right; this results in a two-stage crossing and increases the likelihood of pedestrians looking for vehicles coming from their right in the second half of the street (figures 40 and 41).

Figure 40. Fences or railings in the median direct pedestrians to the right and may reduce pedestrian crashes on the second half of the street.

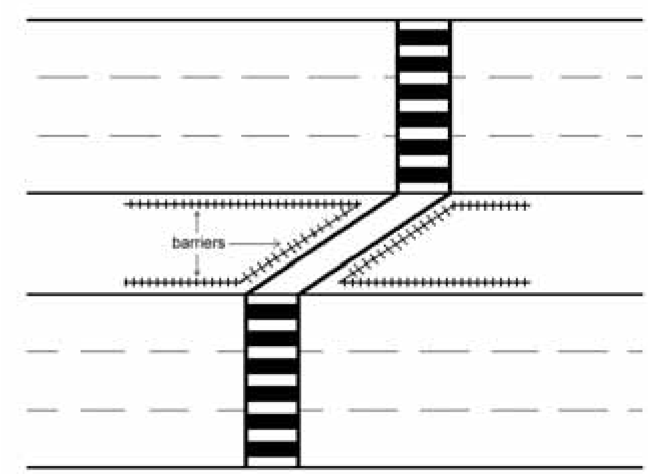


Figure 41. Angled crosswalks with barriers can direct pedestrians to face upstream and increase the pedestrian's awareness of traffic.

Proper planning and land use practices should be applied to benefit pedestrians. For example, busy arterial streets should be used as a boundary for school attendance or school busing. Major pedestrian destinations should not be separated from each other or from their parking facilities by a wide, busy street.

The MUTCD pedestrian signal warrant should be reviewed to determine whether the warrant should be modified to more easily allow for installing a traffic signal at locations where pedestrians cannot safely cross the street (and where no alternative safe crossings exist nearby).

Consideration must always include pedestrians with disabilities and proper accommodations must be provided to meet ADA requirements.

There should be continued research, development, and testing/explanation of innovative traffic control and roadway design alternatives that could provide improved access and safety for pedestrians attempting to cross streets. For example, in-pavement warning lights, variations in pedestrian warning and regulatory signs (including signs placed in the centerline to reinforce motorists yielding to pedestrians), roadway narrowing, traffic-calming measures, and automated speed-monitoring techniques deserve further research and development to determine their feasibility under various traffic and roadway conditions.

More details about these and other pedestrian facilities are contained in the *Pedestrian Facilities User's Guide: Providing Safety and Mobility*,(22) and in the Institute for Transportation Engineers (ITE) publications *Design and Safety of Pedestrian Facilities*(35) and *The Traffic Safety Toolbox* (chapter 19, "Designing for Pedestrians").(36)

Table 11 provides initial guidance on whether an uncontrolled location might be a candidate for a marked crosswalk alone and/or whether additional geometric and/or traffic control improvements are needed. As a part of the review process for pedestrian crossings, an engineering study should be used to analyze other factors, including (but not limited to), gaps in traffic, approach speed, sight distances, illumination, the needs of special populations, and the distance to the nearest traffic signal.

The spacing of marked crosswalks should also be considered so that they are not placed too close together. Overuse of marked crosswalks may breed driver disrespect for them, and a more conservative use of crosswalks generally is preferred. Thus, it is recommended that in situations where marked crosswalks alone are acceptable (see table 11) a higher priority be placed on their use at locations having a minimum of 20 pedestrian crossings per peak hour (or 15 or more elderly and/or child pedestrians per peak hour). In all cases, good engineering judgment must be applied.

OTHER CONSIDERATIONS

Distance of Marked Crosswalks from Signalized Intersections

Marked crosswalks should not be installed in close proximity to signalized intersections (which may or may not have marked crosswalks); instead, pedestrians should be encouraged to cross at the signal in most situations. The minimum distance from a signal for installing a marked crosswalk should be determined by local traffic engineers based on pedestrian crossing demand, type of roadway, traffic volume, and other factors. The objective of adding a marked crosswalk is to channel pedestrians to safer crossing points. It should be understood, however, that pedestrian crossing behavior may be difficult to control merely by adding marked crosswalks. The new marked crosswalk should not unduly restrict platooned traffic, and also should be consistent with marked crosswalks at other unsignalized locations in the area.

Alternative Treatments

In addition to installing marked crosswalks—or in some cases, instead of installing marked crosswalks—there are other treatments that should be considered to provide safer and easier crossings for pedestrians. Examples of these pedestrian improvements:

- Provide raised medians (or raised crossing islands) on multilane roads.

- Install traffic signals and pedestrian signals where warranted and where serious pedestrian crossing problems exist.

- Reduce the exposure crossing distance for pedestrians by:
  - Providing curb extensions.
  - Providing pedestrian median refuge islands.
  - Reducing four-lane undivided road sections to two through lanes with a left-turn bay (or a two-way left-turn lane), sidewalks, and bicycle lanes.

- Locate bus stops on the far side of uncontrolled marked crosswalks.

- Install traffic-calming measures to slow vehicle speeds and/or reduce cut-through traffic. Such measures may include:
  - Raised crossings (raised crosswalks, raised intersections).
  - Street-narrowing measures (chicanes, slow points, “skinny street” designs).
  - Intersection designs (traffic minicircles, diagonal diverters).
  - Other treatments are available; see *Traffic Calming: State of the Practice* for further details.(24)

  Some of these traffic-calming measures are better suited to local or neighborhood streets than to arterial streets.

- Provide adequate nighttime street lighting for pedestrians in areas with nighttime pedestrian activity where illumination is inadequate.

- Design safer intersections and driveways for pedestrians (e.g., crossing islands, tighter turn radii), which take into consideration the needs of pedestrians.

In developing the proposed U.S. guidelines for marked crosswalks and other pedestrian measures, consideration was given not only to the research results in this study, but also to crosswalk guidelines and related pedestrian safety research in Sweden, England, Canada, Australia, the Netherlands, Germany, Norway, and Hungary. (See references 17, 18, 19, 20, 21, 33, and 37.) More details on pedestrian facilities are given in the 2001 *Pedestrian Facilities User’s Guide: Providing Safety and Mobility*,(22) *Design and Safety of Pedestrian Facilities*,(35) *The Traffic Safety Toolbox*,(36) and *Making Streets That Work—Neighborhood Planning Tool*,(38) among others.

APPENDIX A. DETAILS OF DATA COLLECTION METHODS

This study evaluated the safety of marked and unmarked crosswalks at uncontrolled locations, that is, at crossings with no traffic signals or stop signs on the approach. Therefore, the data collection activities were undertaken to: (1) select suitable marked and unmarked crosswalks, and (2) obtain pedestrian crash and exposure data. Data collection was conducted in five steps, which are discussed below.

STEP 1—INVENTORY CROSSWALKS AND CONTROL SITES

Through conversations with city traffic engineers and pedestrian/bike coordinators, 28 cities and 2 counties were selected for crosswalk inventory. Either the Highway Safety Research Center (HSRC) staff or local data collectors performed the inventory by driving along selected streets in each city. These streets were in the downtown area, other commercial areas, and built-up residential areas, where marked crosswalks at uncontrolled locations were known or expected to be present. The inventory data collection form is shown in figure 41.

STEP 2—RECORD DATA ON INVENTORY SHEETS

For most cities, the inventory of crosswalk and comparison sites was recorded on videotape. An HSRC staff member watched the videotapes and completed a crosswalk inventory form (see figure 42). Several local data collectors filled out the inventory form directly and mailed the completed forms to HSRC. This process was used both to select unmarked crosswalks (i.e., matched comparison sites—see step 3) and to extract relevant information about the marked crosswalks.

Location Description

For record-keeping purposes, each marked crosswalk and matching comparison site was assigned a site number. Street or route refers to the main road that the pedestrian crosses, and intersecting street is the side street that crosses or forms a “T” with the main road. The leg (east, west, north, south) where the crosswalk or comparison site exists was recorded. If there were crosswalks on both legs (east and west or north and south) of the same intersection, they were assigned two site numbers and listed separately. Midblock location was noted when appropriate, along with the intersecting streets to either side. A total of 827 intersection and 173 midblock marked crosswalks were used in the analysis, with an equal number of matched comparison sites.

Number of Lanes

The total number of lanes, including any turn lanes, that a pedestrian must cross was recorded. Figure 43 shows the distribution of the 1,000 marked crosswalks that were used in the analysis according to the number of lanes. Nearly half (45.8 percent) of the sites were on two-lane roads, with about one third of the sites on four-lane roads.

Median Type

The median type was recorded as either none, raised, or painted. Two-way left-turn lanes were considered to be traffic lanes. There was no median for about two-thirds of the 1,000 marked (and unmarked) crosswalks that were used in the analysis. Raised medians were present for 14 percent of the marked (and unmarked) crosswalks, and painted medians, about 15 percent.

One-Way or Two-Way

About 86 percent of the crosswalks were on two-way streets, with 14 percent on one-way streets.

City/County: ____________ Data Recorder ____________ Date ____________

State: ____________

Site No.	Location Description: Street or Route	Location Description: Leg (N,E,S,W)	Location Description: Intersecting Street*	Location Description: Midblock Location	Number of Lanes	Median Type	1-way or 2-way	Type of Crosswalk/ Crossing Treatment	Condition of Crosswalk	Area Type: CBD	Area Type: Fringe	Area Type: Resid.	Estimated Ped. ADT (check one): <50	Estimated Ped. ADT (check one): 50-200	Estimated Ped. ADT (check one): >200	Speed Limit	Traffic ADT
a. Marked																	
b. Control								None	NA								
a. Marked																	
b. Control								None	NA								
a. Marked																	
b. Control								None	NA								
a. Marked																	
b. Control								None	NA								
a. Marked																	
b. Control								None	NA								
a. Marked																	
b. Control								None	NA								
a. Marked																	
b. Control								None	NA								
a. Marked																	
b. Control								None	NA								

*Use Only for Unsignalized Crossings at Intersections or Midblocks

Figure 42. Pedestrian crosswalk inventory form.

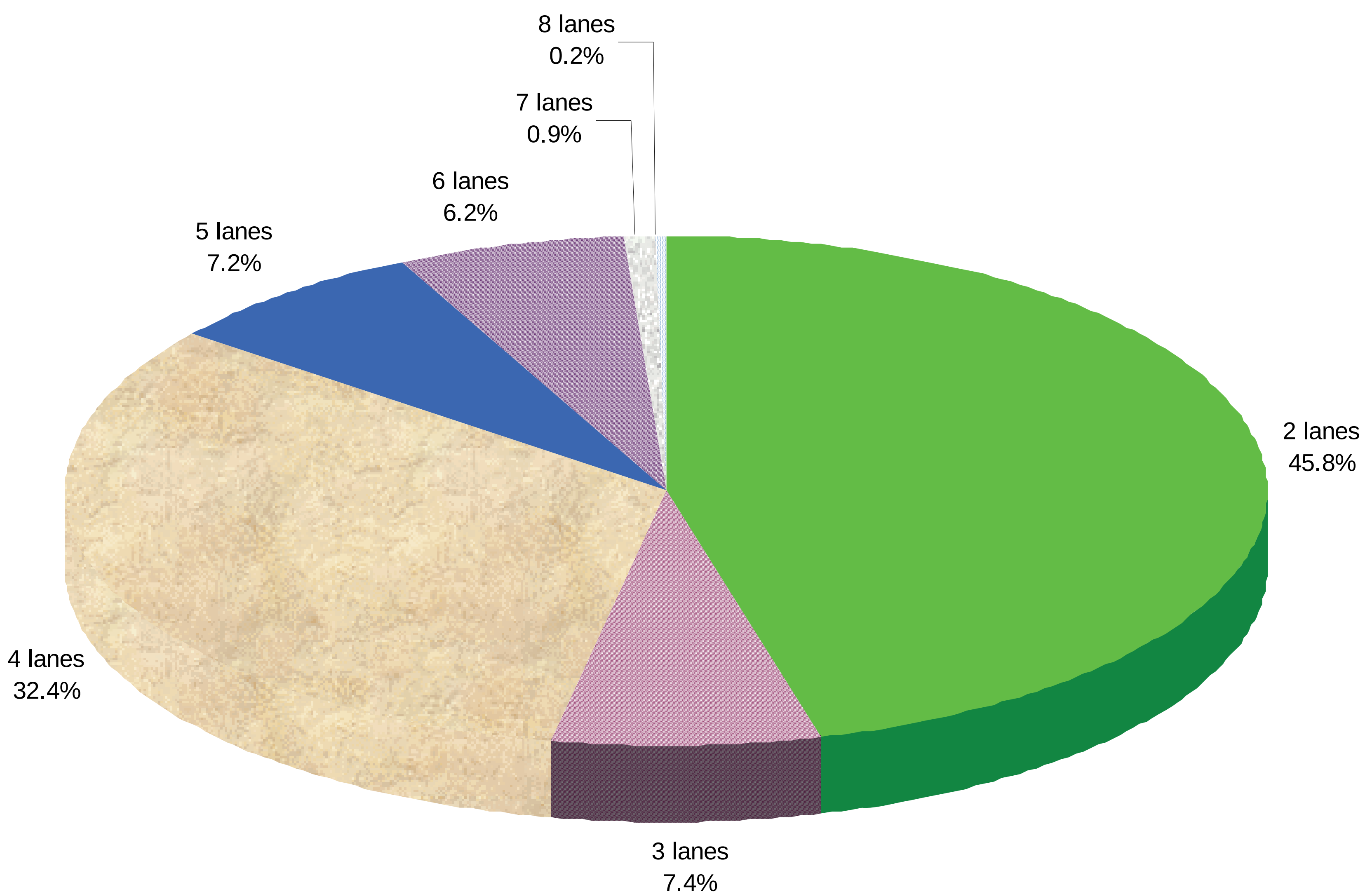


Figure 43. Number of lanes for marked crosswalks.

Type of Crosswalk

Crosswalks usually had standard markings (two parallel white lines). Various types of crosswalk markings are illustrated in figure 7 (shown in chapter 2).

The presence of any signs or beacons was also noted. Types of signs and beacons included:

Advanced Crosswalk Sign:	Mounted in advance of the crosswalk, to warn drivers that they are approaching a crosswalk.
Crosswalk Sign:	Placed at the crosswalk.
Overhead Sign:	An overhead pedestrian warning sign (in advance or at the crosswalk).
Flash:	A flashing beacon placed next to the crosswalk.
Overhead Flash:	A flashing beacon placed over the crosswalk.

Only 19 of the 2,000 sites (less than 1 percent) had any of these supplemental devices. Sites were selected to minimize the number of signs or beacons.

Condition of Crosswalk Markings

The condition of the marked crosswalk was recorded as excellent (E), good (G), fair (F), or poor (P). There was no way to determine the condition of the markings over the entire study period.

Area Type

Each crosswalk was in a central business district (CBD), fringe, or residential area.

CBD:	CBDs are downtown areas and are characterized by moderate to heavy pedestrian volumes, lower vehicle speeds, and dense commercial activity.
Fringe:	Fringe areas include suburban and commercial retail activity areas, and typically have moderate pedestrian volumes. These areas may also include high-rise apartments.
Residential:	Residential development would generally correspond to lower pedestrian volumes.

Of the 2,000 marked and unmarked crosswalks that were used in the analysis, 199 (10 percent) were in a CBD, 1,093 (54.7 percent) were in fringe areas, and 708 (35.4 percent) were in residential areas.

Estimated Pedestrian ADT

For each crosswalk and control site, the pedestrian ADT was based on expanding short-term pedestrian counts based on adjustment factors, as described below.

Pedestrians and motorists are out and about at all hours of the day and night. As a result, pedestrian crashes may happen at any hour. Therefore, to calculate crash rates, 24-hour daily pedestrian volumes are needed. It was not feasible to count pedestrians for every hour at each of the 1,000 marked crosswalks and 1,000 unmarked comparison sites. Instead, pedestrians were counted by 15-minute intervals for a total of 1 hour at each site. These counts were conducted on weekdays during daylight hours. The earliest count intervals started at 7 a.m., and the latest count intervals ended at 6 p.m.

Daily pedestrian volumes at each marked crosswalk and unmarked comparison site were then estimated from these 1-hour counts. If pedestrian activity were evenly distributed in each hour of the day, then each hour would comprise about 4.2 percent (100 percent ÷ 24 hours) of the daily total. The 1-hour count could simply be divided by an hourly adjustment factor of 4.2 percent (0.042) to get the all-day volume. In reality, though, hourly volumes vary throughout the day with greater pedestrian activity during certain peak periods. Suppose that 10 out of 100 (10 percent) of the day's pedestrians are counted between 5 p.m. and 6 p.m. If that hour's count were divided by 0.042, the true daily volume would be overestimated (10 / 4.2 percent = 238). Likewise, if 2 out of 100 (2 percent) are counted between 3 a.m. and 4 a.m., dividing that count by 4.2 percent would underestimate the true daily volume (2 / 0.042 = 48). Therefore, adjustment factors for each hour of the day are needed to obtain a more accurate estimate of the true daily volume.

The adjustment factors were derived from two data sets. First, all-day (8- to 12-hour) pedestrian counts were undertaken at 11 marked crosswalks and 11 unmarked comparison sites. Second, adjustments were calculated based on the method used by Zegeer et al. for 24-hour pedestrian counts in Seattle, WA.[39] They found that the 12-hour period from 7 a.m. to 7 p.m. represented 86 percent of the 24-hour daily pedestrian volume. Separate adjustment factors were used for each area type (CBD, fringe, and residential), because the area types have different patterns of hourly pedestrian volume. It was determined that crosswalks and comparison sites had similar pedestrian volume distributions by the time of day, so the same adjustment factor was used for a crosswalk and its matched comparison site.

The adjustment factors by time of day and area type appear in table 12. The 1-hour pedestrian counts at each crosswalk and comparison site were divided by the appropriate factor to obtain the 24-hour daily pedestrian volume. For example, suppose 100 pedestrians were counted between 9 a.m. and 10 a.m. at a CBD location. Then the daily pedestrian volume was estimated to be 100 / 4.9 percent = 2,041 pedestrians. At a fringe location, the daily volume would be 100 / 8.3 percent = 1,205 pedestrians. If the count interval was spread out over two periods, such as 9:30 a.m. to 10:30 a.m., then the adjustment factor for 9 a.m. to 10 a.m. was applied to the first part of the count, and the factor for 10 a.m. to 11 a.m. was applied to the second part of the count.

Table 12. Adjustment factors by time of day and area type used to obtain estimated pedestrian ADT.

Time of Day	Area Type		
	CBD (%)	Fringe (%)	Residential (%)
7 a.m. – 8 a.m.	2.4	6.9	4.8
8 a.m. – 9 a.m.	2.4	6.0	3.9
9 a.m. – 10 a.m.	4.9	8.3	5.7
10 a.m. – 11 a.m.	8.2	7.1	8.7
11 a.m. – 12 N	10.4	7.7	8.2
12 N – 1 p.m.	11.4	9.0	8.4
1 p.m. – 2 p.m.	11.6	6.3	6.9
2 p.m. – 3 p.m.	8.5	8.5	5.9
3 p.m. – 4 p.m.	16.2	8.1	7.4
4 p.m. – 5 p.m.	4.4	7.9	9.3
5 p.m. – 6 p.m.	3.5	8.1	11.4
Remaining 13 hours	16.0	16.0	19.5

At a few of the 2,000 sites, no pedestrians were observed during the crossing period. The pedestrian crash rate is computed as the number of pedestrian crashes divided by the pedestrian crossing volume. The pedestrian crossing volume is the product of the pedestrian ADT times the number of years times 365 days per year. Thus, assuming a zero hourly pedestrian volume is not only questionable, but also results in a pedestrian exposure of 0. Since it is not possible to use 0 as a value of exposure in computing pedestrian crash rates (i.e., since dividing by zero yields a rate of infinity), a count of 0.25 was substituted for 0 as the hourly pedestrian count for computing pedestrian ADT for use in computing pedestrian crash rates.

Unmarked crosswalks (the control sites) tended to have lower pedestrian volumes than marked crosswalks. This may be the result of pedestrians being drawn to marked crosswalks and/or due to crosswalks being marked at locations with more pedestrian activity.

Speed Limit

Speed limits were obtained from local traffic engineers, local data collectors in the field, and watching videotapes of the crosswalk inventory. The most common speed limits were 48.3 km/h (30 mi/h) (37.4 percent), 40.25 km/h (25 mi/h) (33.0 percent), and 56.35km/h (35 mi/h) (22.8 percent).

Traffic ADT

Traffic volumes were obtained from local traffic engineers. Figure 44 shows that marked crosswalks had similar traffic volumes to the unmarked crosswalks (the comparison sites). This was to be expected, because the comparison sites were chosen to be close to, and similar to, their matching marked crosswalks.

STEP 3—IDENTIFY SUITABLE CONTROL SITES

Each crosswalk was matched with a control site that was close to the crosswalk and had similar characteristics (such as number of lanes, area type, estimated traffic and pedestrian volumes, and one-way or two-way traffic flow), but which did not have crosswalk markings, stop sign, or traffic signal. This was done either by watching the video or in the field. For example, if a marked crosswalk was present on the east leg of an intersection but not on the west leg, then the west leg was often a good control site. If the east and west legs of an intersection had marked crosswalks, then the east and west legs of a nearby intersection along the same main road were often good control sites. The data items described in step 2 were recorded for the control sites.

Some marked crosswalks were excluded because suitable control sites could not be found, or they were school crossings. A total of 1,000 marked crosswalks, each matched with a control site (for a total of 1,000 control sites), was used in the analysis. The number of crosswalks by city is given in table 13.

STEP 4—COUNT PEDESTRIANS

Local data collectors were hired to count the number of pedestrians at the crosswalks and their corresponding control sites. Each location was counted in 15-minute intervals for one hour. At 11 crosswalks and 11 control sites, pedestrians were counted for 8 to 12 hours. These longer, all-day counts were used as the basis from which daily pedestrian volumes at each crosswalk and control site were estimated from the one-hour counts. All counts were done on weekdays.

STEP 5—OBTAIN CRASH DATA

Local city contacts provided crash data and hard-copy police reports for vehicle-pedestrian crashes that occurred at or near the crosswalks and comparison sites, for an average of about 5 years per site. Some cities had more than 5 years of crash data available, while other cities had 6 years of data that was available for use.

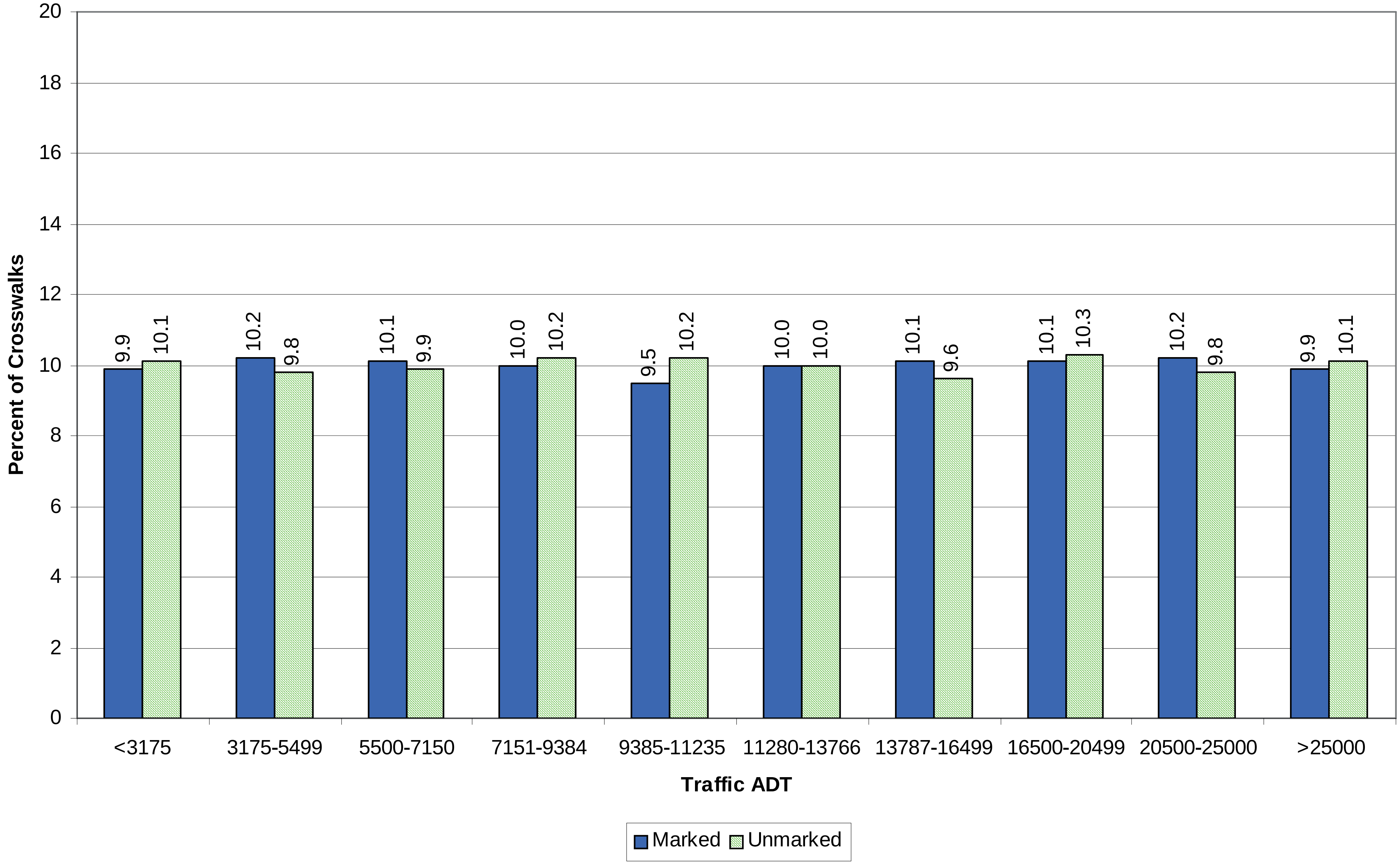


Figure 44. Marked and unmarked crosswalks had similar traffic ADT distributions.

Table 13. The number of marked crosswalks that were used in this study, by city or county.

City or County	Number of Crosswalks		City or County	Number of Crosswalks	
	Marked	Unmarked		Marked	Unmarked
Austin, TX	24	24	Orlando, FL	20	20
Baltimore, MD	30	30	Phoenix, AZ	36	36
Baltimore County, MD	11	11	Pittsburgh, PA	18	18
Cambridge, MA	46	46	Portland, OR	32	32
Cincinnati, OH	42	42	Raleigh, NC	14	14
Cleveland, OH	55	55	Salt Lake City, UT	18	18
Durham, NC	11	11	San Francisco, CA	91	91
Fort Worth, TX	28	28	Scottsdale, AZ	8	8
Gainesville, FL	45	45	Seattle, WA	102	102
Glendale, AZ	12	12	St. Louis, MO	15	15
Kansas City, MO	29	29	St. Louis County, MO	24	24
Madison, WI	29	29	Tempe, AZ	1	1
Milwaukee, WI	68	68	Topeka, KS	25	25
New Orleans, LA	80	80	Tucson, AZ	22	22
Oakland, CA	45	45	Winter Park, FL	19	19
			Totals (all cities)	**1,000**	**1,000**

Crash rates were normalized based on number of years of data. A total of 229 crashes (188 at marked crosswalks and 41 at control sites) occurred at the 2,000 sites and were used in the analysis.
Local traffic engineers and police departments provided crash data and hard-copy police crash reports for the marked and unmarked crosswalks. For each marked crosswalk and matching unmarked crosswalk, data and reports were obtained for the same 3- to 5- year period. The exact years varied from one city to another, depending on the data and reports that each city had available.

The crash reports were read to determine the crash type and to obtain information on other crash variables, such as pedestrian age, injury severity, and time of day. The crash type and other information were entered into a database for analysis.

Some crashes were eliminated because they did not occur at the crosswalks (or within 3 m (10 ft) of the crosswalk) of interest. For example, if a traffic engineer included Crash #1 among the crashes at Crosswalk #1, but it was later determined that Crash #1 actually occurred somewhere else, then Crash #1 would have been eliminated. The analysis resulted in the confirmation of 229 total pedestrian crashes. Of these, 188 occurred at marked crosswalks and 41 occurred at unmarked crosswalks.

APPENDIX B. STATISTICAL TESTING OF THE FINAL CRASH PREDICTION MODEL

To test the final crash prediction model in the terms of validity for the available database, several types of tests were conducted. These tests included:

- Goodness-of-fit.
- Test for functional form.
- Residuals.

GOODNESS-OF-FIT

Below is as excerpt from the PROC GENMOD output (table 14). In assessing the goodness-of-fit of the negative binomial regression model for crosswalks, we can see that the scaled deviance and the Pearson chi-square are small indicating that the model fits the data well.

Table 14. Criteria for assessing goodness-of-fit negative binomial regression model.

Criteria	DF	Value	Value/DF
Deviance	1990	609.5499	0.3063
Scaled Deviance	1990	609.5499	0.3063
Pearson chi-square	1990	2769.9029	1.3919
Scaled Pearson χ^2	1990	2769.9029	1.3919
Log Likelihood		−548.7469	

TEST FOR FUNCTIONAL FORM

We can test for overdispersion with a likelihood ratio test based on Poisson and negative binomial distributions. This test tests equality of the mean and the variance imposed by the Poisson distribution against the alternative that the variance exceeds the mean. For the negative binomial distribution, the variance = mean + k mean^2 (k> = 0, the negative binomial distribution reduces to Poisson when k = 0). The null hypothesis is: H_0: k = 0 and the alternative hypothesis is: H_a: k>0.

To test the functional form, we used the likelihood ratio test, that is, compute LR statistic, -2 (LL (Poisson) – LL (negative binomial)). The asymptotic distribution of the LR statistic has probability mass of one half at zero and one half – chi-square distribution with 1 df.[(40)] To test the null hypothesis at the significance level α, use the critical value of chi-square distribution corresponding to significance level 2α, that is reject H_0 if LR statistic > $\chi^2_{(1-2\alpha,\ 1\ df)}$.

Table 15 is an excerpt from the PROC GENMOD output for a Poisson regression model with the same independent variables are is the final negative binomial model.

Table 15. Criteria for assessing goodness-of-fit Poisson regression model.

Criteria	DF	Value	Value/DF
Deviance	1990	881.5022	0.4430
Scaled Deviance	1990	881.5022	0.4430
Pearson Chi-Square	1990	3432.5818	1.7249
Scaled Pearson X2	1990	3432.5818	1.7249
Log Likelihood		−568.4558	

−2 (LL (Poisson) - LL (negative binomial)) =
−2* (−568.4558 − (−548.7469)) =
2* (568.4558 − 548.7469) = 39.4178

Thus, the null hypothesis is rejected for $\alpha = 0.01$, and we conclude that the Poisson distribution is inadequate for this model.[40]

RESIDUALS

Because generalized estimating equations (GEE) were used, the interpretation of residuals is problematic and no residual analysis was undertaken.

MULTICOLLINEARITY

Certainly multicollinearity is an issue, because the marked crosswalk and the unmarked crosswalk were matched on geographic terms, thus the number of lanes, median type, and traffic ADT are distributed very similarly in the marked and the unmarked crosswalks.

Multicollinearity was explored using the regression diagnostics suggested by Belsley, Kuh, and Welsch.[41] They suggest two different measures: variance inflation factor (VIF) and the proportion of variation. VIF gauges the influence potential near dependencies may have on the estimation of the standard error of the estimate of the regression parameters. The proportion of variation is a diagnostic which permits the detection of morel complex dependencies. For the final model with predictor variables, the values were: an indicator for marked versus unmarked, pedestrian ADT, and traffic ADT; two indicators for number of lanes; two indicators for type of median; an interaction between the indicator for marked versus unmarked and pedestrian ADT; and an interaction between indicator for marked versus unmarked and traffic ADT. The largest VIF was 4.0; this is not high (VIF < 10), however, it is more than the suggested criterion of VIF > 1.55. Thus, the VIF for indicator for marked versus unmarked VIF = 3.5, traffic ADT, VIF = 2.5, and the interaction of these two predictor variables VIF = 4.0. There is some variance inflation in this model. Since none of the VIF are greater than 10, we can conclude that the model has not been degraded by collinearity. We should interpret the results with some care, because three predictors have VIFs greater than 1.55.

The proportion of variation suggested by Belsley, Kuh, and Welsch with a condition index of 9.4 suggests a weak dependency between the three predictors: indicator for marked versus unmarked, traffic ADT, and the interaction of these two predictor variables. It is not surprising that an interaction is correlated with the main factors.

In conclusion, the model does have a weak dependency among the predictor variables. This does not inflate the variance too much; thus, reasonable tests may be conducted. The mild nature of the collinearity does not present a threat to the interpretability of the model.[41]

APPENDIX C. PLOTS OF EXPECTED PEDESTRIAN CRASHES BASED ON THE FINAL NEGATIVE BINOMIAL PREDICTION MODEL

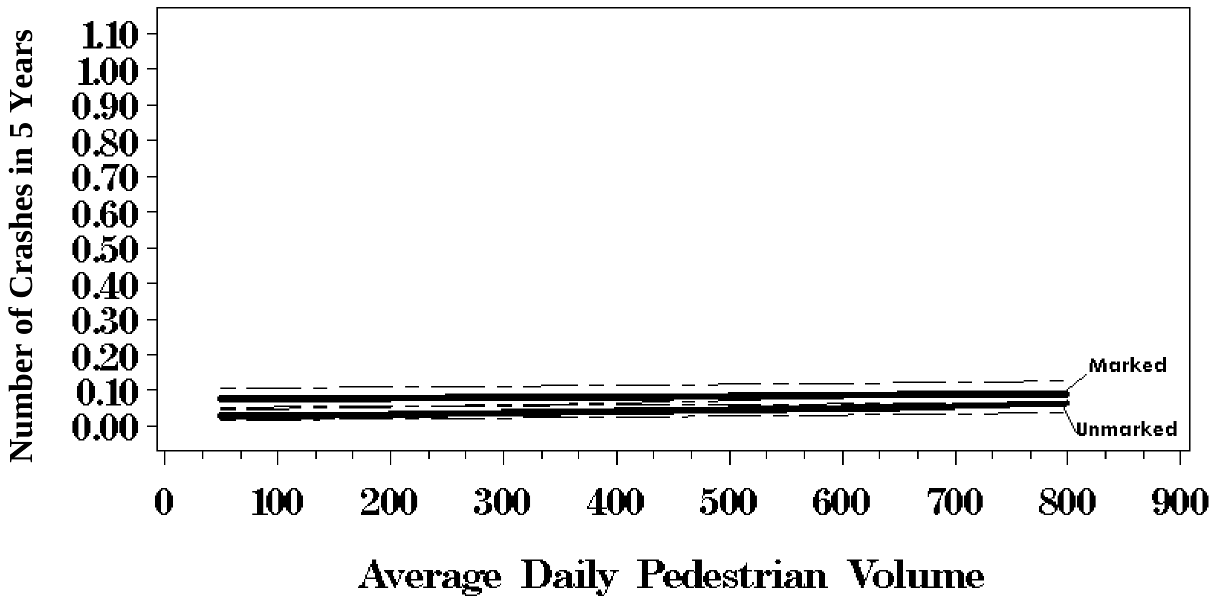


Figure 45. Response curves with 95 percent confidence intervals based on negative binomial regression model, two lanes with no median, average daily motor vehicle traffic = 10,000.

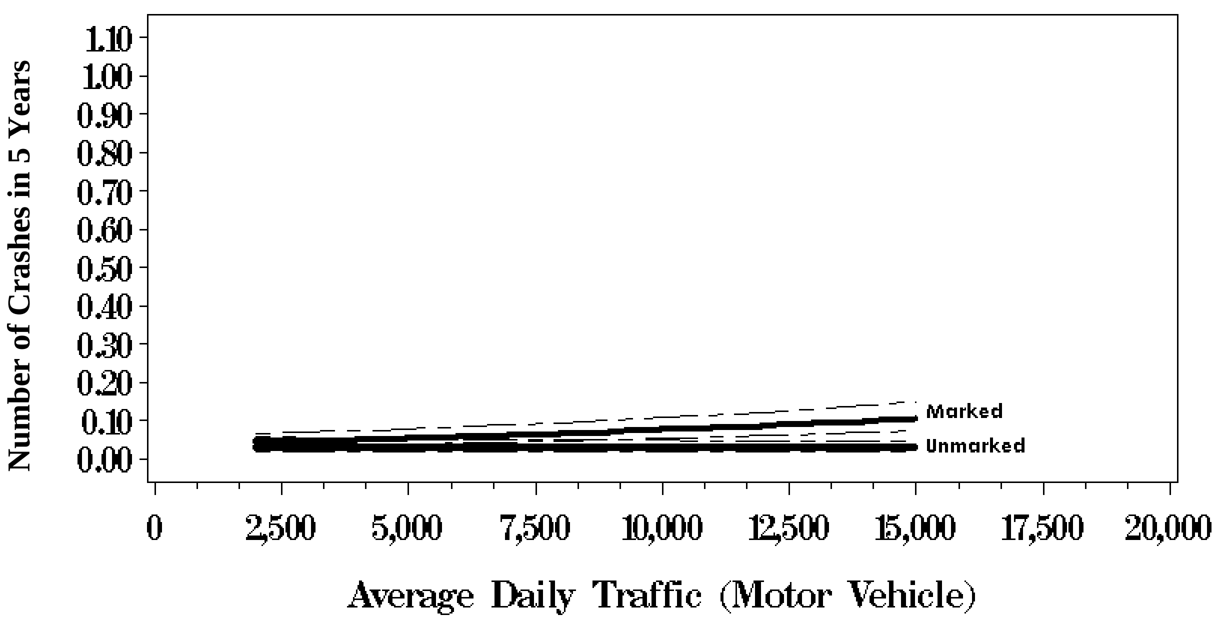


Figure 46. Response curves with 95 percent confidence intervals based on negative binomial regression model, two lanes with no median, average daily pedestrian volume = 100.

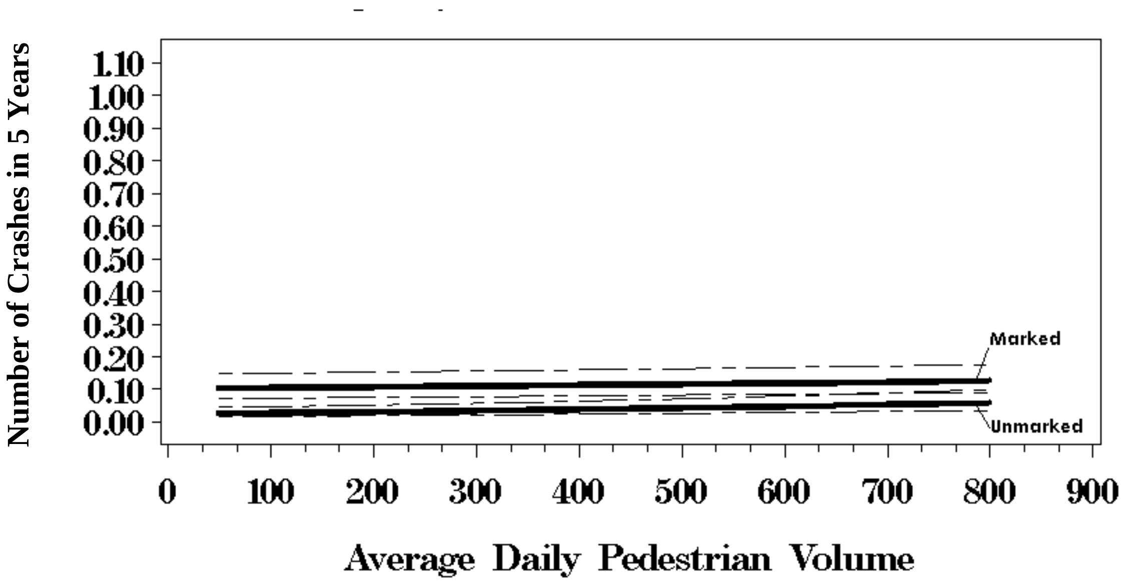


Figure 47. Response curves with 95 percent confidence intervals based on negative binomial regression model, two lanes with no median, average daily motor vehicle traffic = 15,000.

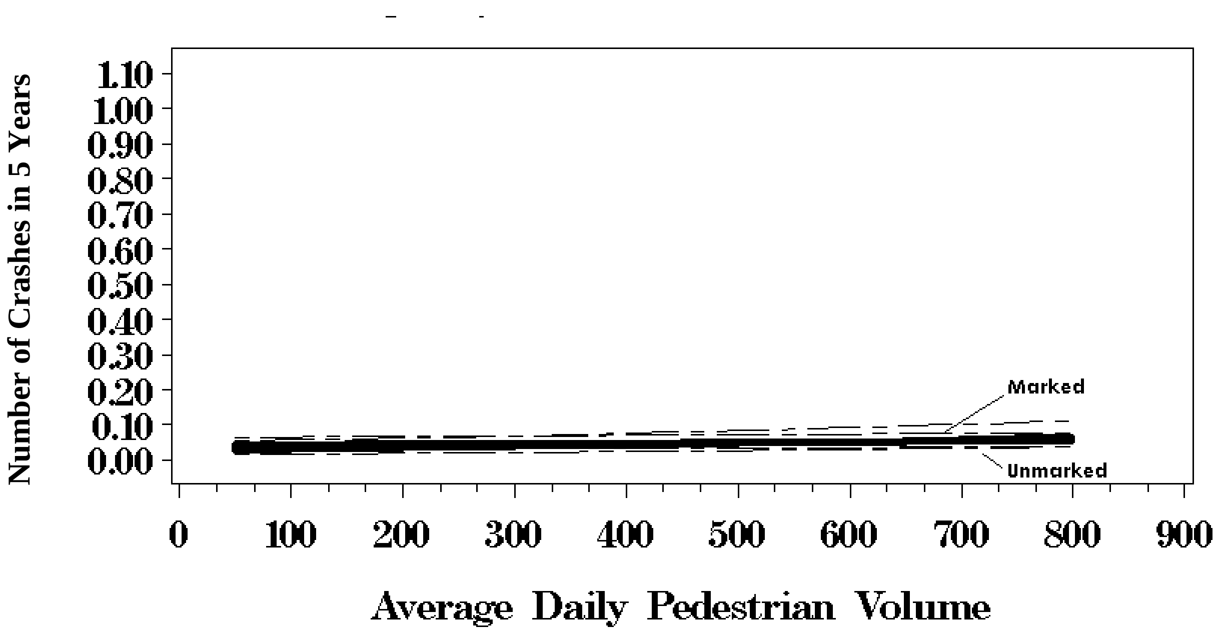


Figure 48. Response curves with 95 percent confidence intervals based on negative binomial regression model, two lanes with no median, average daily motor vehicle traffic = 2,000.

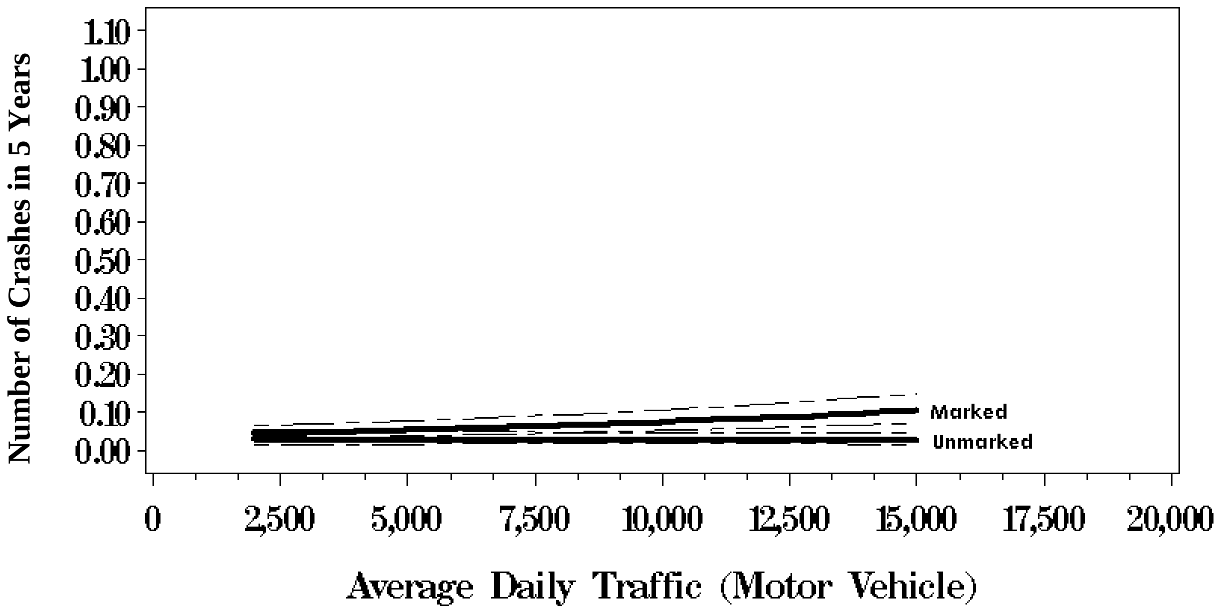


Figure 49 Response curves with 95 percent confidence intervals based on negative binomial regression model, two lanes with no median, average daily pedestrian volume = 50.

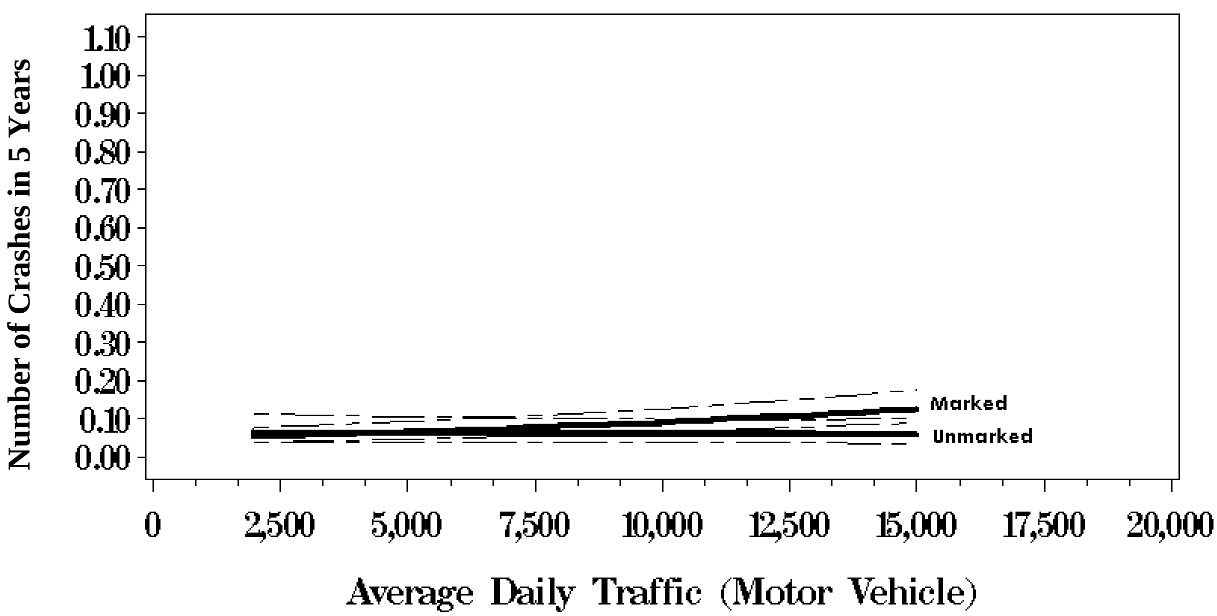


Figure 50. Response curves with 95 percent confidence intervals based on negative binomial regression model, two lanes with no median, average daily pedestrian volume = 800.

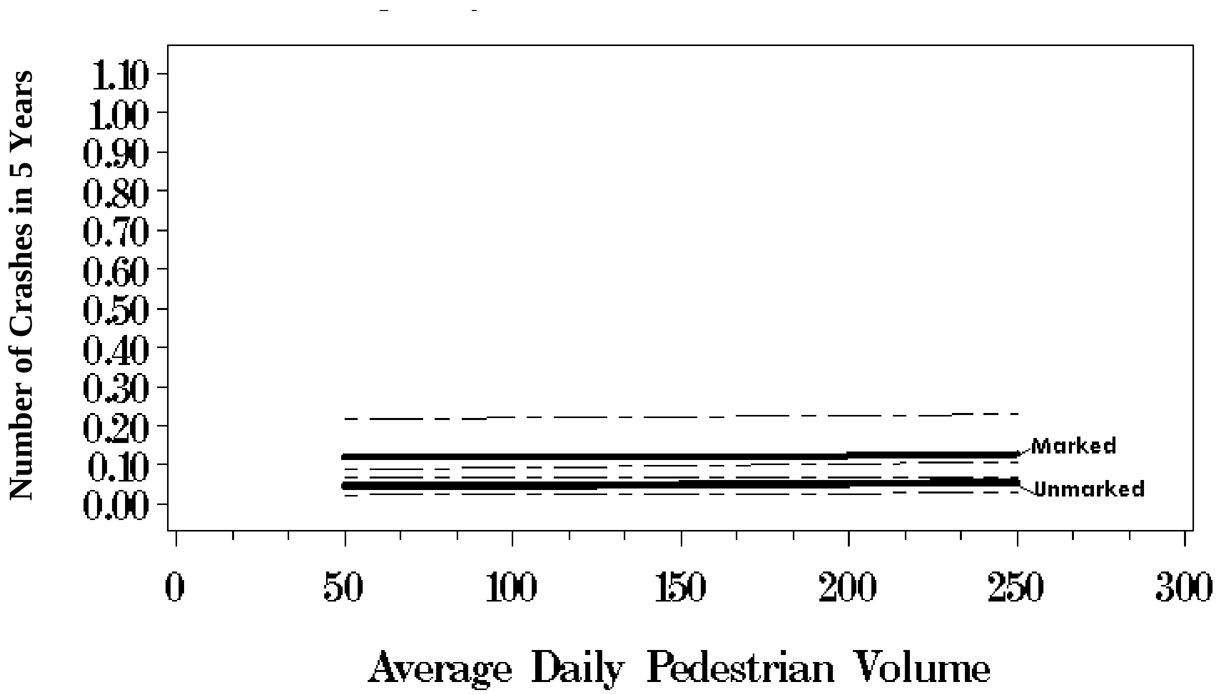


Figure 51. Response curves with 95 percent confidence intervals based on negative binomial regression model, five lanes with no median, average daily motor vehicle traffic = 10,000.

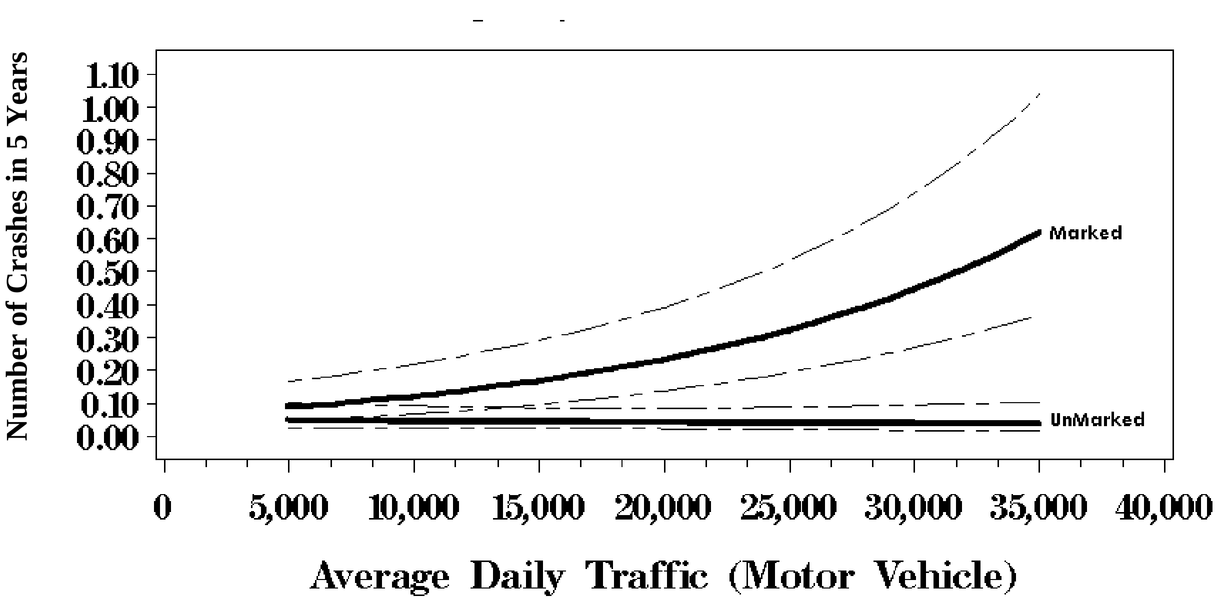


Figure 52. Response curves with 95 percent confidence intervals based on negative binomial regression model, five lanes with no median, average daily pedestrian volume = 100.

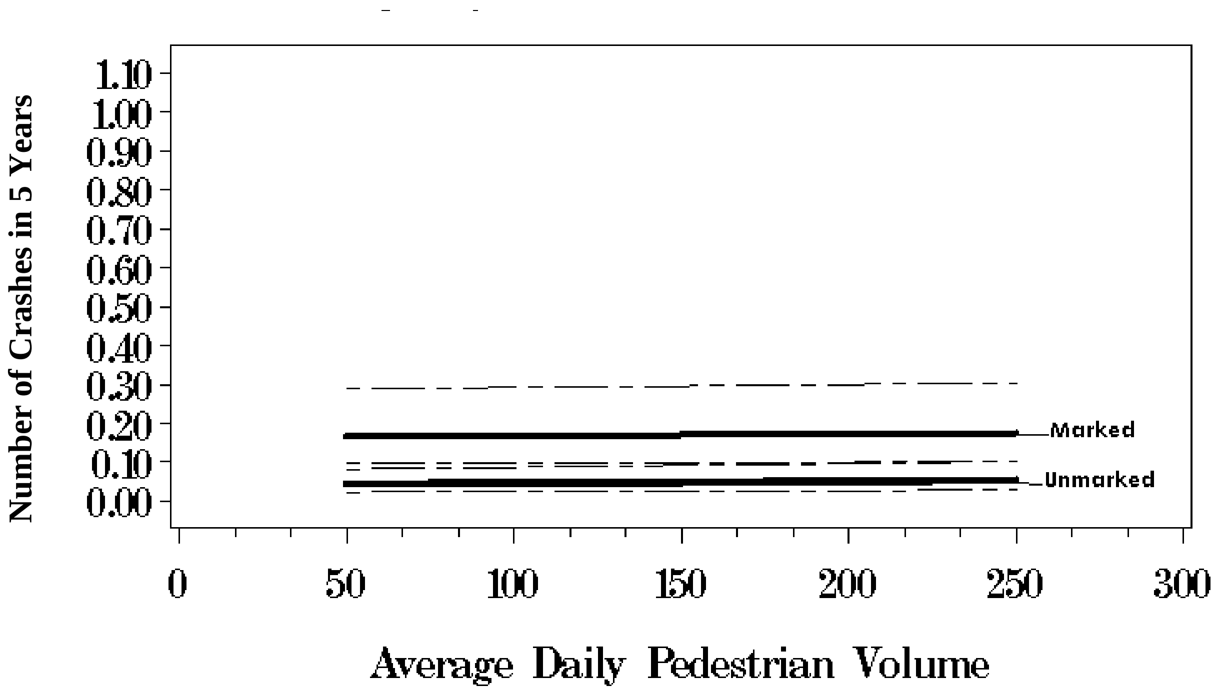


Figure 53. Response curves with 95 percent confidence intervals based on negative binomial regression model, five lanes with no median, average daily motor vehicle traffic = 15,000.

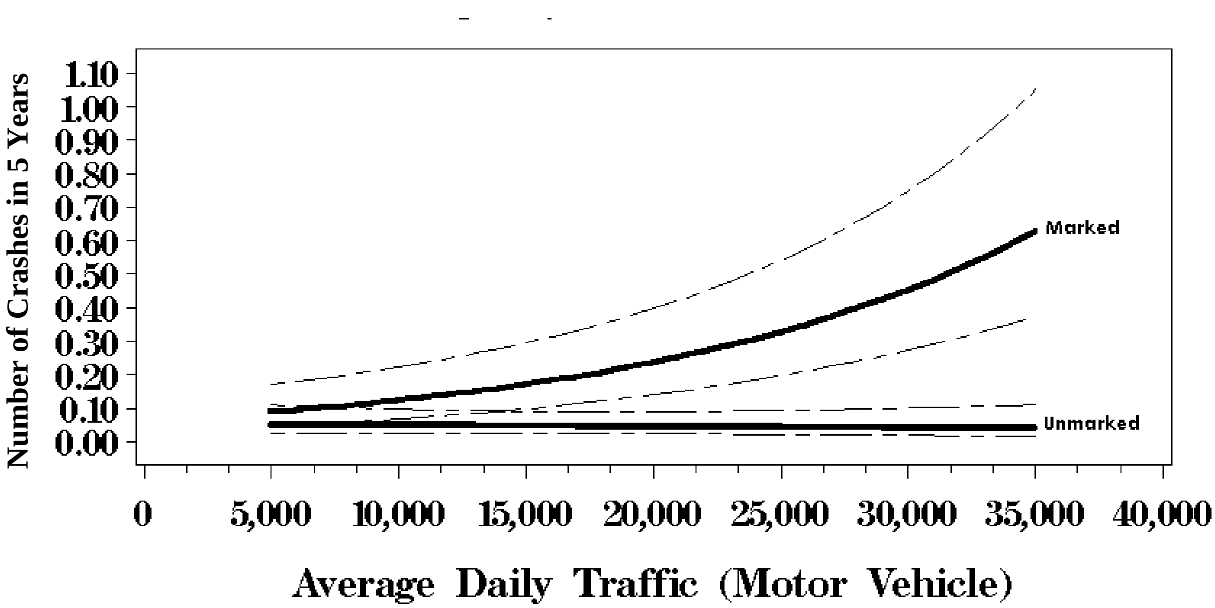


Figure 54. Response curves with 95 percent confidence intervals based on negative binomial regression model, five lanes with no median, average daily pedestrian volume = 150.

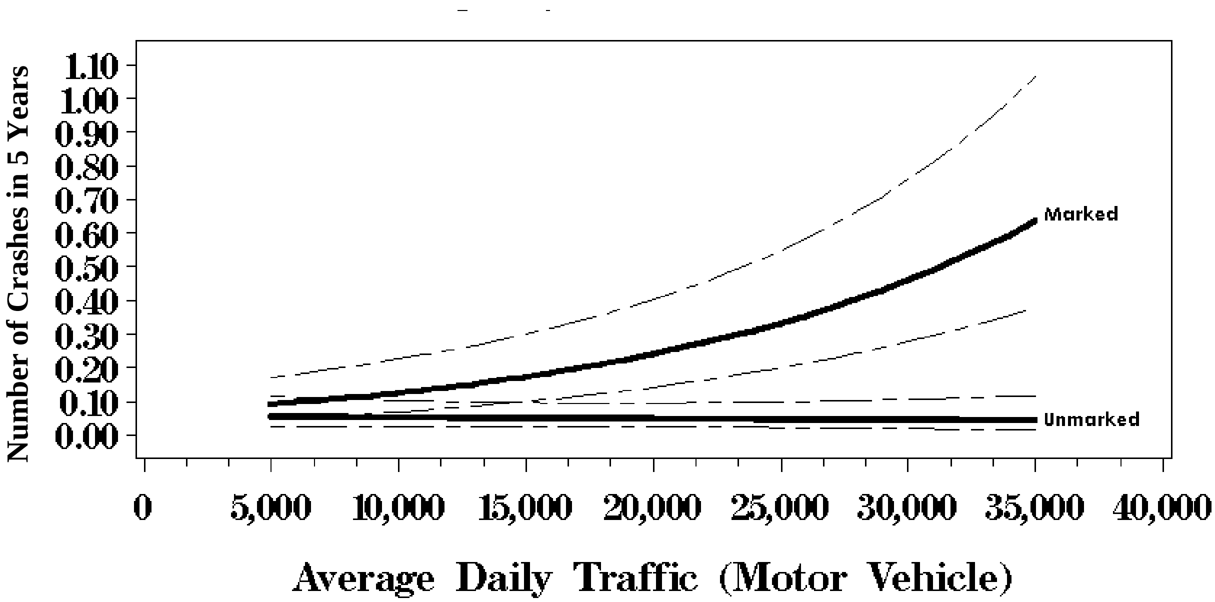


Figure 55. Response curves with 95 percent confidence intervals based on negative binomial regression model, five lanes with no median, average daily pedestrian volume = 200.

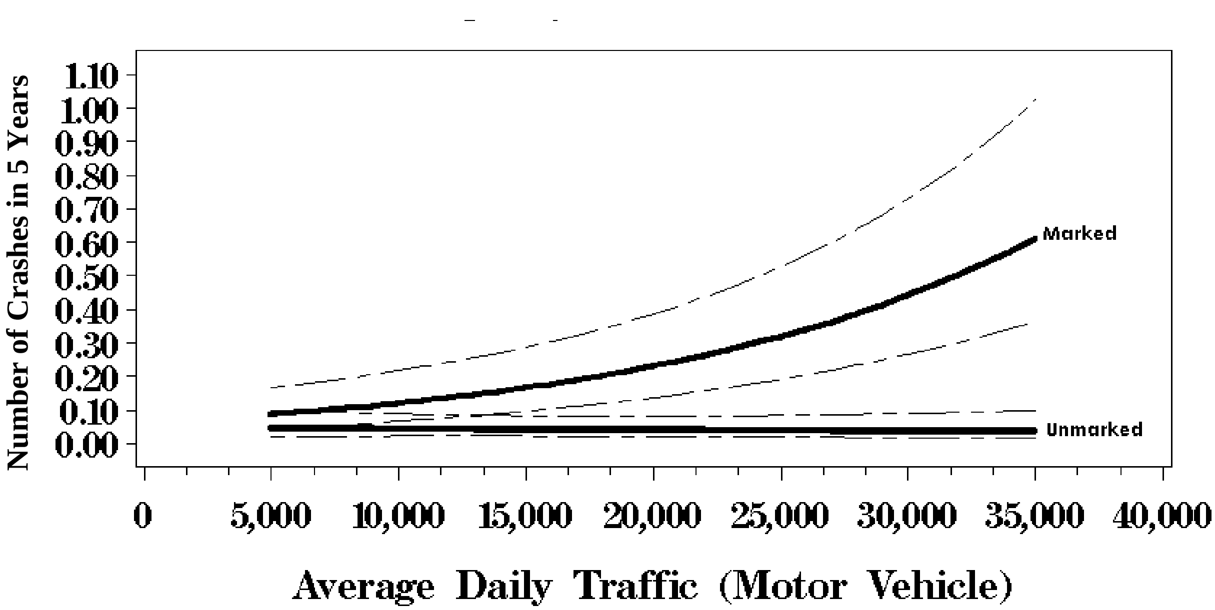


Figure 56. Response curves with 95 percent confidence intervals based on negative binomial regression model, five lanes with no median, average daily pedestrian volume = 50.

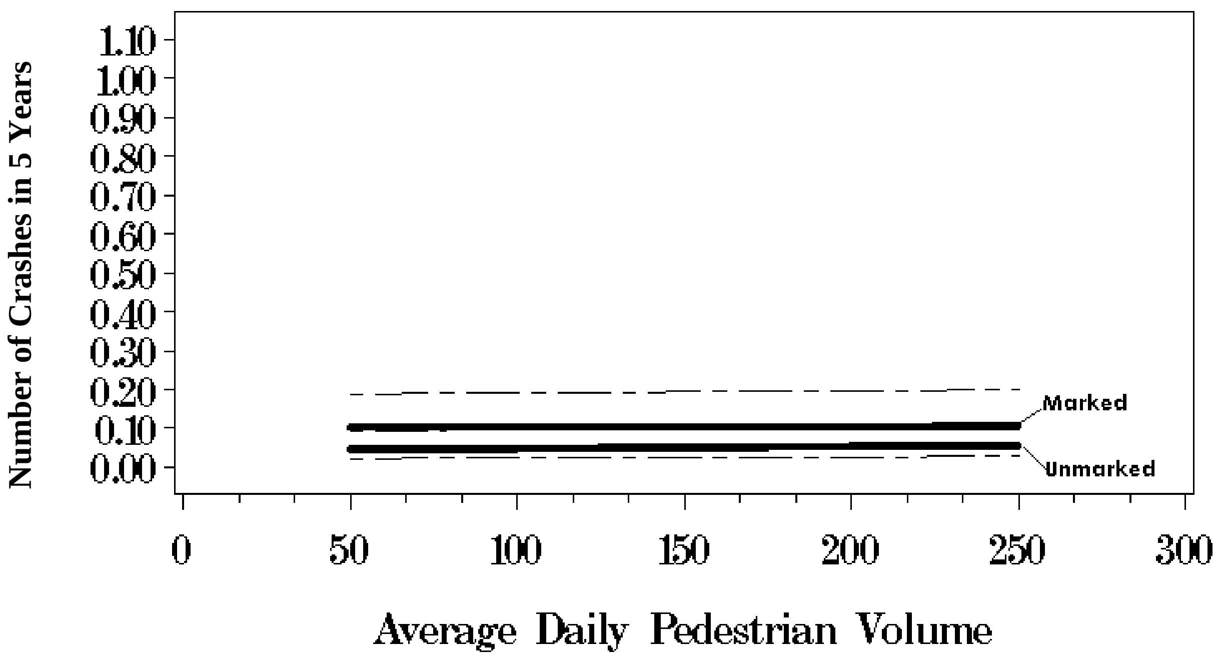


Figure 57. Response curves with 95 percent confidence intervals based on negative binomial regression model, five lanes with no median, average daily motor vehicle traffic = 7,500.

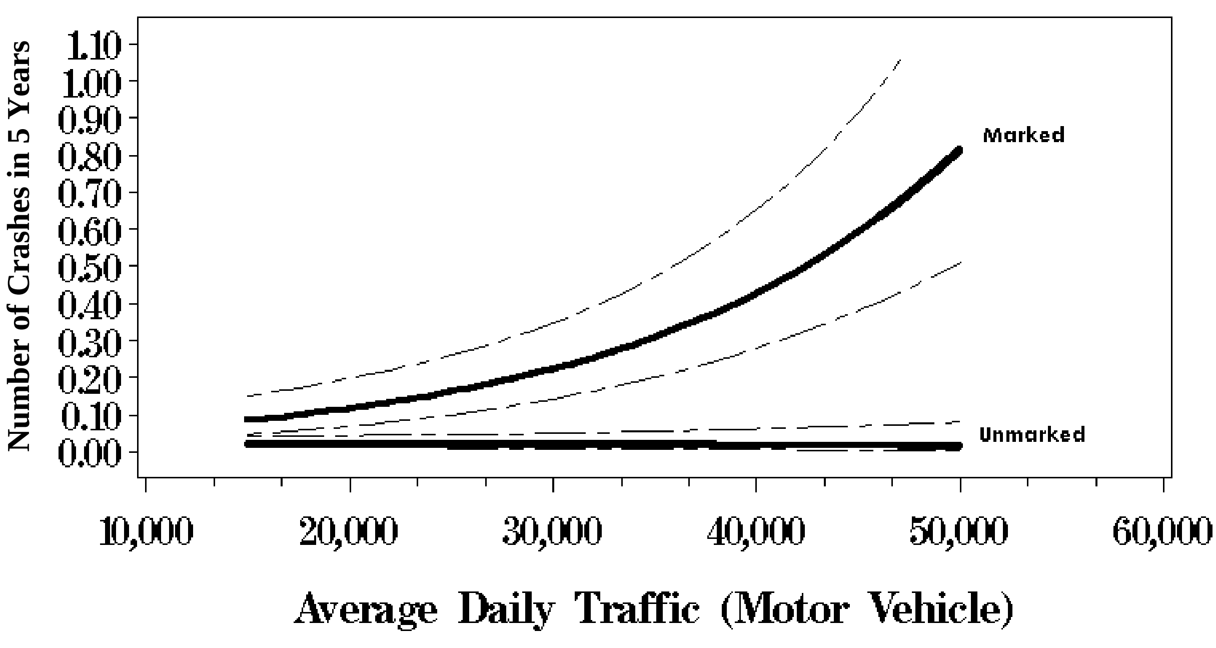


Figure 58. Response curves with 95 percent confidence intervals based on negative binomial regression model, five lanes with median, average daily pedestrian volume = 100.

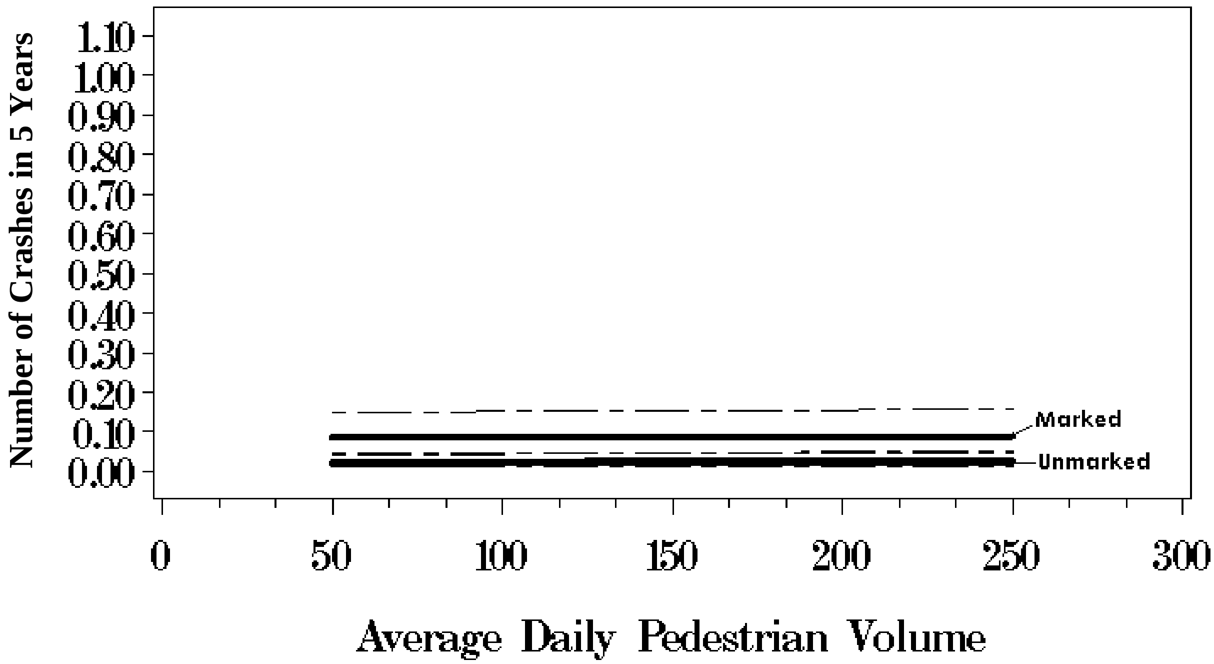


Figure 59. Response curves with 95 percent confidence intervals based on negative binomial regression model, five lanes with median, average daily motor vehicle traffic = 15,000.

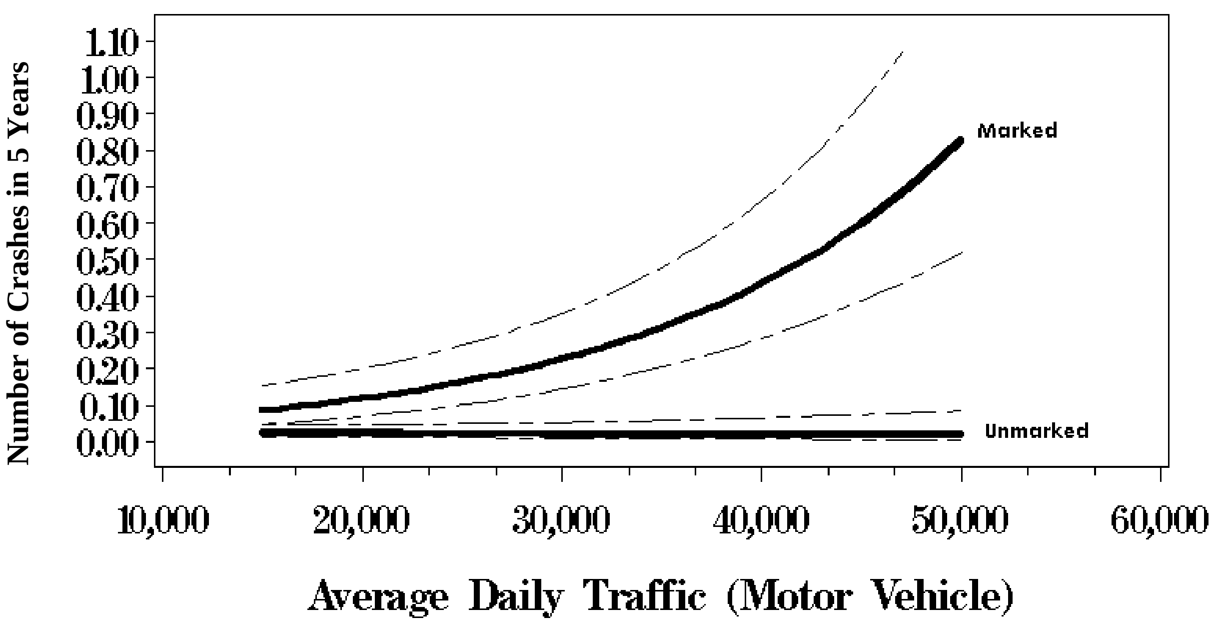


Figure 60. Response curves with 95 percent confidence intervals based on negative binomial regression model, five lanes with median, average daily pedestrian volume = 150.

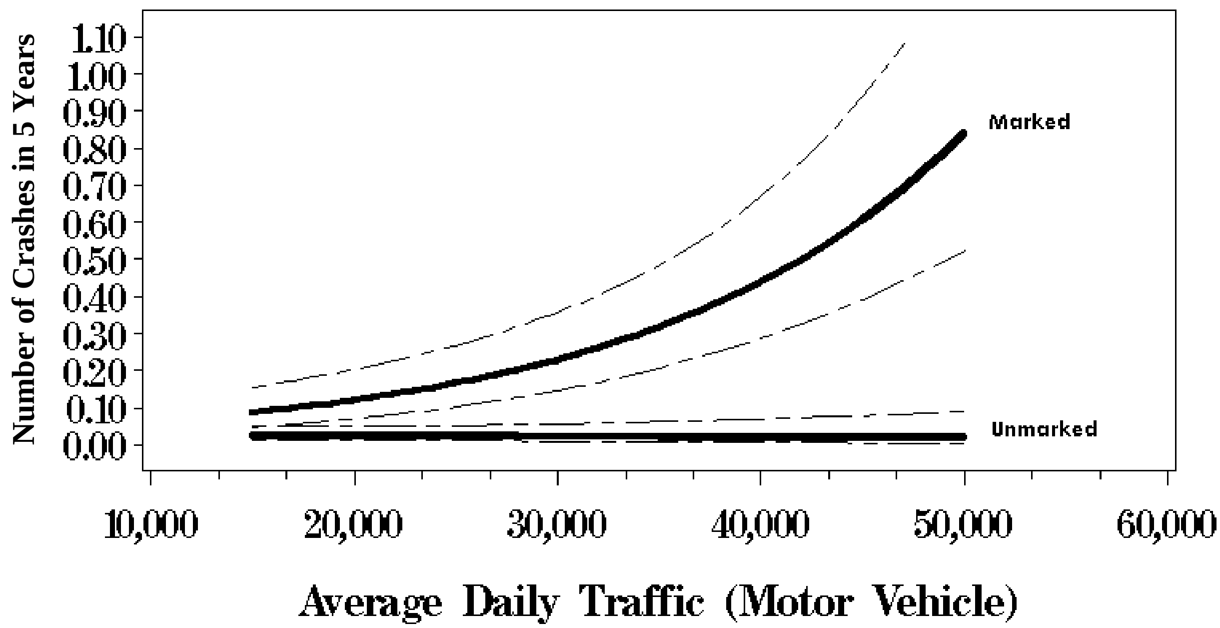


Figure 61. Response curves with 95 percent confidence intervals based on negative binomial regression model, five lanes with median, average daily pedestrian volume = 200.

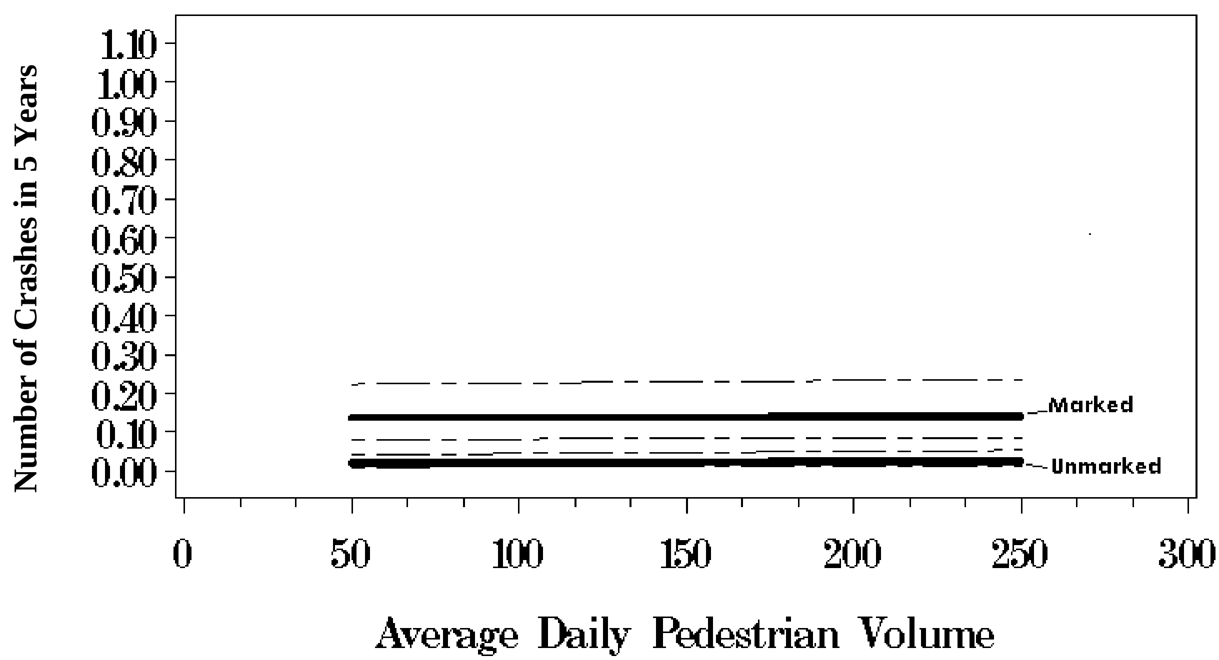


Figure 62. Response curves with 95 percent confidence intervals based on negative binomial regression model, five lanes with median, average daily motor vehicle traffic = 22,500.

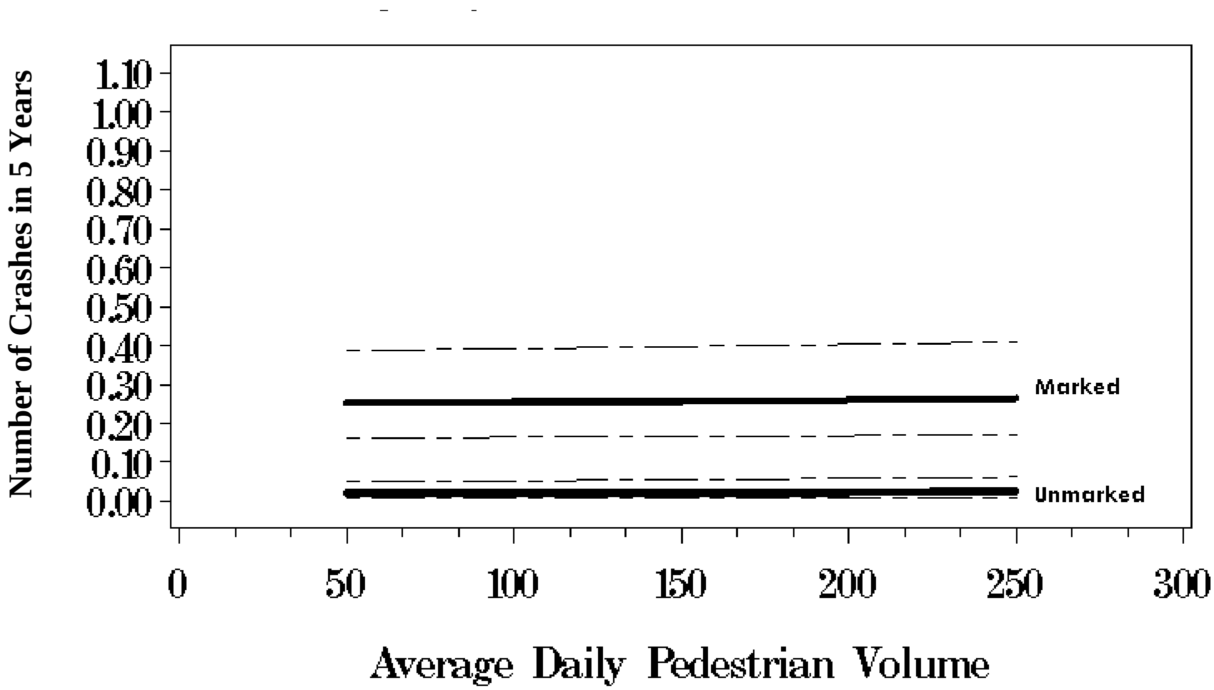


Figure 63. Response curves with 95 percent confidence intervals based on negative binomial regression model, five lanes with median, average daily motor vehicle traffic = 32,000.

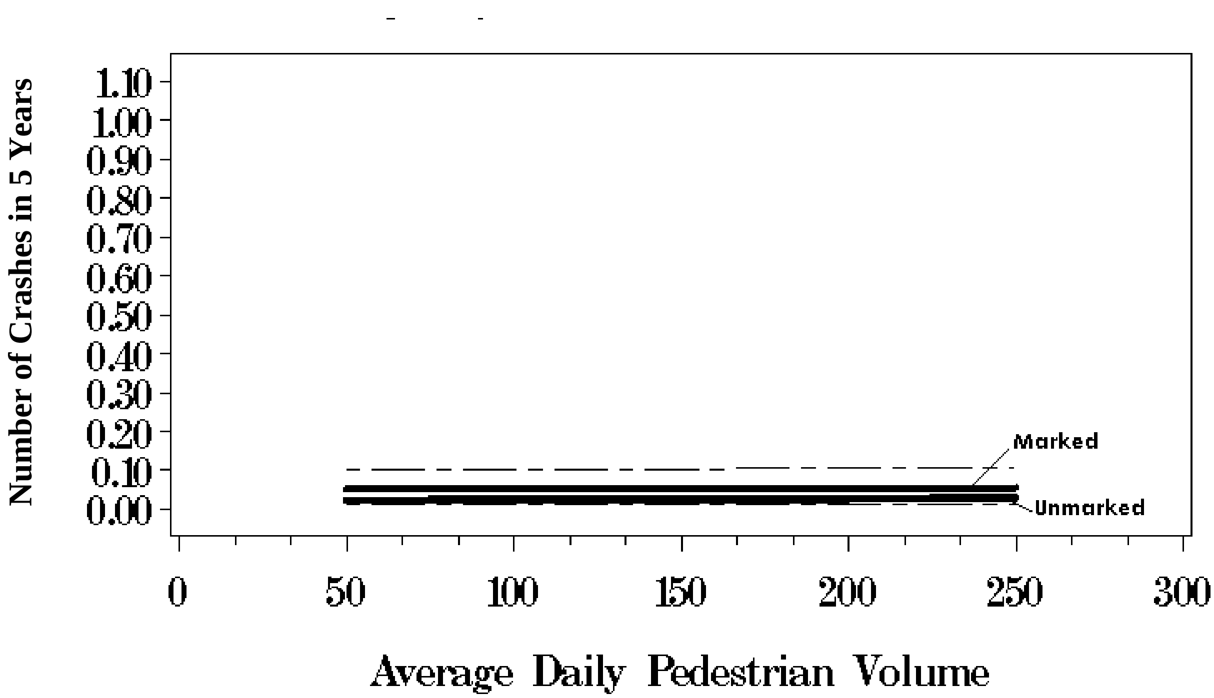


Figure 64. Response curves with 95 percent confidence intervals based on negative binomial regression model, five lanes with median, average daily motor vehicle traffic = 7,500.

APPENDIX D. ESTIMATED NUMBER OF PEDESTRIAN CRASHES (IN 5 YEARS) BASED ON THE FINAL NEGATIVE BINOMIAL PREDICTION MODEL

Estimated Number of Pedestrian Crashes in Five Years 1
Based on Negative Binominal Model
18:02 Tuesday, September 16, 2003
Two Lanes with No Median

Average Daily Pedestrian Volume	Average Daily Traffic (Motor Vehicle)	Unmarked Lower 95%	Unmarked Predicted	Unmarked Upper 95%	Marked Lower 95%	Marked Predicted	Marked Upper 95%
50	2000	0.02	0.03	0.05	0.03	0.04	0.06
50	3000	0.02	0.03	0.05	0.03	0.05	0.07
50	4000	0.02	0.03	0.05	0.03	0.05	0.07
50	5000	0.02	0.03	0.05	0.04	0.05	0.08
50	6000	0.02	0.03	0.05	0.04	0.06	0.08
50	7000	0.02	0.03	0.05	0.04	0.06	0.09
50	8000	0.02	0.03	0.05	0.05	0.07	0.09
50	9000	0.02	0.03	0.05	0.05	0.07	0.10
50	10000	0.02	0.03	0.05	0.05	0.07	0.11
50	11000	0.02	0.03	0.05	0.06	0.08	0.11
50	12000	0.02	0.03	0.04	0.06	0.08	0.12
50	13000	0.02	0.03	0.04	0.06	0.09	0.13
50	14000	0.02	0.03	0.04	0.07	0.10	0.14
50	15000	0.02	0.03	0.04	0.07	0.10	0.15
100	2000	0.02	0.03	0.06	0.03	0.04	0.07
100	3000	0.02	0.03	0.06	0.03	0.05	0.07
100	4000	0.02	0.03	0.05	0.04	0.05	0.07
100	5000	0.02	0.03	0.05	0.04	0.05	0.08
100	6000	0.02	0.03	0.05	0.04	0.06	0.08
100	7000	0.02	0.03	0.05	0.04	0.06	0.09
100	8000	0.02	0.03	0.05	0.05	0.07	0.09
100	9000	0.02	0.03	0.05	0.05	0.07	0.10
100	10000	0.02	0.03	0.05	0.05	0.08	0.11
100	11000	0.02	0.03	0.05	0.06	0.08	0.11
100	12000	0.02	0.03	0.05	0.06	0.09	0.12
100	13000	0.02	0.03	0.05	0.06	0.09	0.13
100	14000	0.02	0.03	0.05	0.07	0.10	0.14
100	15000	0.02	0.03	0.05	0.07	0.10	0.15
150	2000	0.02	0.03	0.06	0.03	0.05	0.07
150	3000	0.02	0.03	0.06	0.03	0.05	0.07
150	4000	0.02	0.03	0.06	0.04	0.05	0.07
150	5000	0.02	0.03	0.06	0.04	0.06	0.08

Based on Negative Binominal Model
18:02 Tuesday, September 16, 2003
Two Lanes with No Median

Average Daily Pedestrian Volume	Average Daily Traffic (Motor Vehicle)	Unmarked Lower 95%	Unmarked Predicted	Unmarked Upper 95%	Marked Lower 95%	Marked Predicted	Marked Upper 95%
150	6000	0.02	0.03	0.05	0.04	0.06	0.08
150	7000	0.02	0.03	0.05	0.04	0.06	0.09
150	8000	0.02	0.03	0.05	0.05	0.07	0.10
150	9000	0.02	0.03	0.05	0.05	0.07	0.10
150	10000	0.02	0.03	0.05	0.05	0.08	0.11
150	11000	0.02	0.03	0.05	0.06	0.08	0.12
150	12000	0.02	0.03	0.05	0.06	0.09	0.12
150	13000	0.02	0.03	0.05	0.07	0.09	0.13
150	14000	0.02	0.03	0.05	0.07	0.10	0.14
150	15000	0.02	0.03	0.05	0.07	0.11	0.15
200	2000	0.02	0.03	0.06	0.03	0.05	0.07
200	3000	0.02	0.03	0.06	0.03	0.05	0.07
200	4000	0.02	0.03	0.06	0.04	0.05	0.08
200	5000	0.02	0.03	0.06	0.04	0.06	0.08
200	6000	0.02	0.03	0.06	0.04	0.06	0.08
200	7000	0.02	0.03	0.06	0.04	0.06	0.09
200	8000	0.02	0.03	0.05	0.05	0.07	0.10
200	9000	0.02	0.03	0.05	0.05	0.07	0.10
200	10000	0.02	0.03	0.05	0.05	0.08	0.11
200	11000	0.02	0.03	0.05	0.06	0.08	0.12
200	12000	0.02	0.03	0.05	0.06	0.09	0.12
200	13000	0.02	0.03	0.05	0.07	0.09	0.13
200	14000	0.02	0.03	0.05	0.07	0.10	0.14
200	15000	0.02	0.03	0.05	0.08	0.11	0.15
250	2000	0.02	0.04	0.07	0.03	0.05	0.07
250	3000	0.02	0.04	0.06	0.03	0.05	0.07
250	4000	0.02	0.04	0.06	0.04	0.05	0.08
250	5000	0.02	0.04	0.06	0.04	0.06	0.08
250	6000	0.02	0.04	0.06	0.04	0.06	0.09
250	7000	0.02	0.04	0.06	0.05	0.06	0.09
250	8000	0.02	0.03	0.06	0.05	0.07	0.10
250	9000	0.02	0.03	0.06	0.05	0.07	0.10

Estimated Number of Pedestrian Crashes in Five Years
Based on Negative Binominal Model
18:02 Tuesday, September 16, 2003
Two Lanes with No Median

Average Daily Pedestrian Volume	Average Daily Traffic (Motor Vehicle)	Unmarked Lower 95%	Unmarked Predicted	Unmarked Upper 95%	Marked Lower 95%	Marked Predicted	Marked Upper 95%
250	10000	0.02	0.03	0.06	0.06	0.08	0.11
250	11000	0.02	0.03	0.05	0.06	0.08	0.12
250	12000	0.02	0.03	0.05	0.06	0.09	0.13
250	13000	0.02	0.03	0.05	0.07	0.10	0.13
250	14000	0.02	0.03	0.05	0.07	0.10	0.14
250	15000	0.02	0.03	0.05	0.08	0.11	0.15
300	2000	0.02	0.04	0.07	0.03	0.05	0.07
300	3000	0.02	0.04	0.07	0.03	0.05	0.07
300	4000	0.02	0.04	0.06	0.04	0.05	0.08
300	5000	0.02	0.04	0.06	0.04	0.06	0.08
300	6000	0.02	0.04	0.06	0.04	0.06	0.09
300	7000	0.02	0.04	0.06	0.05	0.07	0.09
300	8000	0.02	0.04	0.06	0.05	0.07	0.10
300	9000	0.02	0.04	0.06	0.05	0.07	0.10
300	10000	0.02	0.04	0.06	0.06	0.08	0.11
300	11000	0.02	0.04	0.06	0.06	0.08	0.12
300	12000	0.02	0.04	0.06	0.06	0.09	0.13
300	13000	0.02	0.04	0.06	0.07	0.10	0.14
300	14000	0.02	0.04	0.06	0.07	0.10	0.15
300	15000	0.02	0.03	0.06	0.08	0.11	0.16
350	2000	0.02	0.04	0.07	0.03	0.05	0.07
350	3000	0.02	0.04	0.07	0.04	0.05	0.07
350	4000	0.02	0.04	0.07	0.04	0.05	0.08
350	5000	0.02	0.04	0.07	0.04	0.06	0.08
350	6000	0.02	0.04	0.06	0.04	0.06	0.09
350	7000	0.02	0.04	0.06	0.05	0.07	0.09
350	8000	0.02	0.04	0.06	0.05	0.07	0.10
350	9000	0.02	0.04	0.06	0.05	0.08	0.11
350	10000	0.02	0.04	0.06	0.06	0.08	0.11
350	11000	0.02	0.04	0.06	0.06	0.09	0.12
350	12000	0.02	0.04	0.06	0.07	0.09	0.13
350	13000	0.02	0.04	0.06	0.07	0.10	0.14

Two Lanes with No Median

Average Daily Pedestrian Volume	Average Daily Traffic (Motor Vehicle)	Unmarked Lower 95%	Unmarked Predicted	Unmarked Upper 95%	Marked Lower 95%	Marked Predicted	Marked Upper 95%
350	14000	0.02	0.04	0.06	0.07	0.10	0.15
350	15000	0.02	0.04	0.06	0.08	0.11	0.16
400	2000	0.02	0.04	0.08	0.03	0.05	0.07
400	3000	0.02	0.04	0.07	0.04	0.05	0.07
400	4000	0.02	0.04	0.07	0.04	0.06	0.08
400	5000	0.02	0.04	0.07	0.04	0.06	0.08
400	6000	0.03	0.04	0.07	0.04	0.06	0.09
400	7000	0.03	0.04	0.07	0.05	0.07	0.09
400	8000	0.03	0.04	0.07	0.05	0.07	0.10
400	9000	0.03	0.04	0.06	0.05	0.08	0.11
400	10000	0.03	0.04	0.06	0.06	0.08	0.11
400	11000	0.03	0.04	0.06	0.06	0.09	0.12
400	12000	0.02	0.04	0.06	0.07	0.09	0.13
400	13000	0.02	0.04	0.06	0.07	0.10	0.14
400	14000	0.02	0.04	0.06	0.08	0.11	0.15
400	15000	0.02	0.04	0.06	0.08	0.11	0.16
450	2000	0.03	0.04	0.08	0.03	0.05	0.07
450	3000	0.03	0.04	0.08	0.04	0.05	0.08
450	4000	0.03	0.04	0.07	0.04	0.06	0.08
450	5000	0.03	0.04	0.07	0.04	0.06	0.08
450	6000	0.03	0.04	0.07	0.05	0.06	0.09
450	7000	0.03	0.04	0.07	0.05	0.07	0.10
450	8000	0.03	0.04	0.07	0.05	0.07	0.10
450	9000	0.03	0.04	0.07	0.06	0.08	0.11
450	10000	0.03	0.04	0.07	0.06	0.08	0.12
450	11000	0.03	0.04	0.07	0.06	0.09	0.12
450	12000	0.03	0.04	0.07	0.07	0.09	0.13
450	13000	0.03	0.04	0.07	0.07	0.10	0.14
450	14000	0.03	0.04	0.07	0.08	0.11	0.15
450	15000	0.03	0.04	0.07	0.08	0.11	0.16
500	2000	0.03	0.05	0.08	0.03	0.05	0.07
500	3000	0.03	0.05	0.08	0.04	0.05	0.08

Estimated Number of Pedestrian Crashes in Five Years
Based on Negative Binominal Model
18:02 Tuesday, September 16, 2003
Two Lanes with No Median

Average Daily Pedestrian Volume	Average Daily Traffic (Motor Vehicle)	Unmarked Lower 95%	Unmarked Predicted	Unmarked Upper 95%	Marked Lower 95%	Marked Predicted	Marked Upper 95%
500	4000	0.03	0.05	0.08	0.04	0.06	0.08
500	5000	0.03	0.05	0.08	0.04	0.06	0.09
500	6000	0.03	0.05	0.08	0.05	0.06	0.09
500	7000	0.03	0.05	0.07	0.05	0.07	0.10
500	8000	0.03	0.05	0.07	0.05	0.07	0.10
500	9000	0.03	0.05	0.07	0.06	0.08	0.11
500	10000	0.03	0.04	0.07	0.06	0.08	0.12
500	11000	0.03	0.04	0.07	0.06	0.09	0.12
500	12000	0.03	0.04	0.07	0.07	0.10	0.13
500	13000	0.03	0.04	0.07	0.07	0.10	0.14
500	14000	0.03	0.04	0.07	0.08	0.11	0.15
500	15000	0.03	0.04	0.07	0.08	0.12	0.16
550	2000	0.03	0.05	0.09	0.03	0.05	0.07
550	3000	0.03	0.05	0.08	0.04	0.05	0.08
550	4000	0.03	0.05	0.08	0.04	0.06	0.08
550	5000	0.03	0.05	0.08	0.04	0.06	0.09
550	6000	0.03	0.05	0.08	0.05	0.07	0.09
550	7000	0.03	0.05	0.08	0.05	0.07	0.10
550	8000	0.03	0.05	0.08	0.05	0.07	0.10
550	9000	0.03	0.05	0.08	0.06	0.08	0.11
550	10000	0.03	0.05	0.07	0.06	0.08	0.12
550	11000	0.03	0.05	0.07	0.06	0.09	0.13
550	12000	0.03	0.05	0.07	0.07	0.10	0.13
550	13000	0.03	0.05	0.07	0.07	0.10	0.14
550	14000	0.03	0.05	0.07	0.08	0.11	0.15
550	15000	0.03	0.05	0.07	0.08	0.12	0.17
600	2000	0.03	0.05	0.09	0.04	0.05	0.07
600	3000	0.03	0.05	0.09	0.04	0.05	0.08
600	4000	0.03	0.05	0.09	0.04	0.06	0.08
600	5000	0.03	0.05	0.08	0.04	0.06	0.09
600	6000	0.03	0.05	0.08	0.05	0.07	0.09
600	7000	0.03	0.05	0.08	0.05	0.07	0.10

Two Lanes with No Median

Average Daily Pedestrian Volume	Average Daily Traffic (Motor Vehicle)	Unmarked Lower 95%	Unmarked Predicted	Unmarked Upper 95%	Marked Lower 95%	Marked Predicted	Marked Upper 95%
600	8000	0.03	0.05	0.08	0.05	0.08	0.11
600	9000	0.03	0.05	0.08	0.06	0.08	0.11
600	10000	0.03	0.05	0.08	0.06	0.09	0.12
600	11000	0.03	0.05	0.08	0.07	0.09	0.13
600	12000	0.03	0.05	0.08	0.07	0.10	0.14
600	13000	0.03	0.05	0.08	0.07	0.10	0.15
600	14000	0.03	0.05	0.08	0.08	0.11	0.16
600	15000	0.03	0.05	0.08	0.08	0.12	0.17
650	2000	0.03	0.06	0.10	0.04	0.05	0.07
650	3000	0.03	0.05	0.09	0.04	0.06	0.08
650	4000	0.03	0.05	0.09	0.04	0.06	0.08
650	5000	0.03	0.05	0.09	0.04	0.06	0.09
650	6000	0.03	0.05	0.09	0.05	0.07	0.09
650	7000	0.03	0.05	0.09	0.05	0.07	0.10
650	8000	0.03	0.05	0.09	0.05	0.08	0.11
650	9000	0.03	0.05	0.08	0.06	0.08	0.11
650	10000	0.03	0.05	0.08	0.06	0.09	0.12
650	11000	0.03	0.05	0.08	0.07	0.09	0.13
650	12000	0.03	0.05	0.08	0.07	0.10	0.14
650	13000	0.03	0.05	0.08	0.08	0.11	0.15
650	14000	0.03	0.05	0.08	0.08	0.11	0.16
650	15000	0.03	0.05	0.08	0.09	0.12	0.17
700	2000	0.03	0.06	0.10	0.04	0.05	0.08
700	3000	0.03	0.06	0.10	0.04	0.06	0.08
700	4000	0.03	0.06	0.10	0.04	0.06	0.08
700	5000	0.03	0.06	0.09	0.05	0.06	0.09
700	6000	0.03	0.06	0.09	0.05	0.07	0.10
700	7000	0.03	0.06	0.09	0.05	0.07	0.10
700	8000	0.03	0.06	0.09	0.06	0.08	0.11
700	9000	0.03	0.06	0.09	0.06	0.08	0.12
700	10000	0.03	0.06	0.09	0.06	0.09	0.12
700	11000	0.03	0.05	0.09	0.07	0.09	0.13

Estimated Number of Pedestrian Crashes in Five Years
Based on Negative Binominal Model
18:02 Tuesday, September 16, 2003
Two Lanes with No Median

Average Daily Pedestrian Volume	Average Daily Traffic (Motor Vehicle)	Unmarked Lower 95%	Unmarked Predicted	Unmarked Upper 95%	Marked Lower 95%	Marked Predicted	Marked Upper 95%
700	12000	0.03	0.05	0.09	0.07	0.10	0.14
700	13000	0.03	0.05	0.09	0.08	0.11	0.15
700	14000	0.03	0.05	0.09	0.08	0.11	0.16
700	15000	0.03	0.05	0.09	0.09	0.12	0.17
750	2000	0.04	0.06	0.11	0.04	0.05	0.08
750	3000	0.04	0.06	0.10	0.04	0.06	0.08
750	4000	0.04	0.06	0.10	0.04	0.06	0.09
750	5000	0.04	0.06	0.10	0.05	0.06	0.09
750	6000	0.04	0.06	0.10	0.05	0.07	0.10
750	7000	0.04	0.06	0.10	0.05	0.07	0.10
750	8000	0.04	0.06	0.09	0.06	0.08	0.11
750	9000	0.04	0.06	0.09	0.06	0.08	0.12
750	10000	0.04	0.06	0.09	0.06	0.09	0.12
750	11000	0.04	0.06	0.09	0.07	0.10	0.13
750	12000	0.04	0.06	0.09	0.07	0.10	0.14
750	13000	0.03	0.06	0.09	0.08	0.11	0.15
750	14000	0.03	0.06	0.09	0.08	0.12	0.16
750	15000	0.03	0.06	0.09	0.09	0.12	0.17
800	2000	0.04	0.06	0.11	0.04	0.05	0.08
800	3000	0.04	0.06	0.11	0.04	0.06	0.08
800	4000	0.04	0.06	0.11	0.04	0.06	0.09
800	5000	0.04	0.06	0.10	0.05	0.07	0.09
800	6000	0.04	0.06	0.10	0.05	0.07	0.10
800	7000	0.04	0.06	0.10	0.05	0.07	0.10
800	8000	0.04	0.06	0.10	0.06	0.08	0.11
800	9000	0.04	0.06	0.10	0.06	0.08	0.12
800	10000	0.04	0.06	0.10	0.07	0.09	0.13
800	11000	0.04	0.06	0.10	0.07	0.10	0.13
800	12000	0.04	0.06	0.10	0.07	0.10	0.14
800	13000	0.04	0.06	0.10	0.08	0.11	0.15
800	14000	0.04	0.06	0.10	0.08	0.12	0.16
800	15000	0.04	0.06	0.10	0.09	0.13	0.18

Estimated Number of Pedestrian Crashes in Five Years
Based on Negative Binomial Model
18:02 Tuesday, September 16, 2003
Five Lanes with Median

Average Daily Pedestrian Volume	Average Daily Traffic (Motor Vehicle)	Unmarked Lower 95%	Unmarked Predicted	Unmarked Upper 95%	Marked Lower 95%	Marked Predicted	Marked Upper 95%
50	5000	0.01	0.02	0.05	0.02	0.04	0.09
50	6000	0.01	0.02	0.05	0.02	0.05	0.09
50	7000	0.01	0.02	0.05	0.02	0.05	0.10
50	8000	0.01	0.02	0.05	0.03	0.05	0.10
50	9000	0.01	0.02	0.04	0.03	0.06	0.11
50	10000	0.01	0.02	0.04	0.03	0.06	0.11
50	11000	0.01	0.02	0.04	0.03	0.06	0.12
50	12000	0.01	0.02	0.04	0.04	0.07	0.13
50	13000	0.01	0.02	0.04	0.04	0.07	0.13
50	14000	0.01	0.02	0.04	0.04	0.08	0.14
50	15000	0.01	0.02	0.04	0.05	0.08	0.15
50	16000	0.01	0.02	0.04	0.05	0.09	0.16
50	17000	0.01	0.02	0.04	0.05	0.09	0.17
50	18000	0.01	0.02	0.04	0.06	0.10	0.17
50	19000	0.01	0.02	0.04	0.06	0.11	0.18
50	20000	0.01	0.02	0.04	0.07	0.11	0.19
50	21000	0.01	0.02	0.04	0.07	0.12	0.21
50	22000	0.01	0.02	0.04	0.08	0.13	0.22
50	23000	0.01	0.02	0.04	0.08	0.14	0.23
50	24000	0.01	0.02	0.04	0.09	0.15	0.24
50	25000	0.01	0.02	0.04	0.10	0.16	0.26
50	26000	0.01	0.02	0.04	0.11	0.17	0.27
50	27000	0.01	0.02	0.04	0.11	0.18	0.29
50	28000	0.01	0.02	0.05	0.12	0.19	0.31
50	29000	0.01	0.02	0.05	0.13	0.21	0.32
50	30000	0.01	0.02	0.05	0.14	0.22	0.34
50	31000	0.01	0.02	0.05	0.15	0.23	0.36
50	32000	0.01	0.02	0.05	0.16	0.25	0.39
50	33000	0.01	0.02	0.05	0.17	0.27	0.41
50	34000	0.01	0.02	0.05	0.19	0.28	0.44
50	35000	0.01	0.02	0.05	0.20	0.30	0.47
50	36000	0.01	0.02	0.05	0.21	0.32	0.50

Based on Negative Binomial Model
18:02 Tuesday, September 16, 2003
Five Lanes with Median

Average Daily Pedestrian Volume	Average Daily Traffic (Motor Vehicle)	Unmarked Lower 95%	Unmarked Predicted	Unmarked Upper 95%	Marked Lower 95%	Marked Predicted	Marked Upper 95%
50	37000	0.01	0.02	0.05	0.23	0.35	0.53
50	38000	0.01	0.02	0.06	0.24	0.37	0.56
50	39000	0.01	0.02	0.06	0.26	0.39	0.60
50	40000	0.01	0.02	0.06	0.28	0.42	0.64
50	41000	0.01	0.02	0.06	0.29	0.45	0.69
50	42000	0.01	0.02	0.06	0.31	0.48	0.74
50	43000	0.01	0.02	0.06	0.33	0.51	0.79
50	44000	0.00	0.02	0.06	0.35	0.55	0.84
50	45000	0.00	0.02	0.07	0.38	0.58	0.90
50	46000	0.00	0.02	0.07	0.40	0.62	0.97
50	47000	0.00	0.02	0.07	0.42	0.66	1.04
50	48000	0.00	0.02	0.07	0.45	0.71	1.12
50	49000	0.00	0.02	0.07	0.48	0.76	1.20
50	50000	0.00	0.02	0.07	0.50	0.81	1.29
100	5000	0.01	0.02	0.05	0.02	0.04	0.09
100	6000	0.01	0.02	0.05	0.02	0.05	0.09
100	7000	0.01	0.02	0.05	0.02	0.05	0.10
100	8000	0.01	0.02	0.05	0.03	0.05	0.10
100	9000	0.01	0.02	0.05	0.03	0.06	0.11
100	10000	0.01	0.02	0.05	0.03	0.06	0.12
100	11000	0.01	0.02	0.05	0.03	0.06	0.12
100	12000	0.01	0.02	0.05	0.04	0.07	0.13
100	13000	0.01	0.02	0.04	0.04	0.07	0.14
100	14000	0.01	0.02	0.04	0.04	0.08	0.14
100	15000	0.01	0.02	0.04	0.05	0.08	0.15
100	16000	0.01	0.02	0.04	0.05	0.09	0.16
100	17000	0.01	0.02	0.04	0.05	0.10	0.17
100	18000	0.01	0.02	0.04	0.06	0.10	0.18
100	19000	0.01	0.02	0.04	0.06	0.11	0.19
100	20000	0.01	0.02	0.04	0.07	0.12	0.20
100	21000	0.01	0.02	0.04	0.07	0.12	0.21
100	22000	0.01	0.02	0.04	0.08	0.13	0.22

Five Lanes with Median

Average Daily Pedestrian Volume	Average Daily Traffic (Motor Vehicle)	Unmarked Lower 95%	Unmarked Predicted	Unmarked Upper 95%	Marked Lower 95%	Marked Predicted	Marked Upper 95%
100	23000	0.01	0.02	0.05	0.09	0.14	0.23
100	24000	0.01	0.02	0.05	0.09	0.15	0.25
100	25000	0.01	0.02	0.05	0.10	0.16	0.26
100	26000	0.01	0.02	0.05	0.11	0.17	0.28
100	27000	0.01	0.02	0.05	0.11	0.18	0.29
100	28000	0.01	0.02	0.05	0.12	0.20	0.31
100	29000	0.01	0.02	0.05	0.13	0.21	0.33
100	30000	0.01	0.02	0.05	0.14	0.22	0.35
100	31000	0.01	0.02	0.05	0.15	0.24	0.37
100	32000	0.01	0.02	0.05	0.16	0.25	0.39
100	33000	0.01	0.02	0.05	0.18	0.27	0.42
100	34000	0.01	0.02	0.05	0.19	0.29	0.44
100	35000	0.01	0.02	0.05	0.20	0.31	0.47
100	36000	0.01	0.02	0.06	0.22	0.33	0.50
100	37000	0.01	0.02	0.06	0.23	0.35	0.54
100	38000	0.01	0.02	0.06	0.25	0.37	0.57
100	39000	0.01	0.02	0.06	0.26	0.40	0.61
100	40000	0.01	0.02	0.06	0.28	0.43	0.65
100	41000	0.01	0.02	0.06	0.30	0.46	0.70
100	42000	0.01	0.02	0.06	0.32	0.49	0.74
100	43000	0.01	0.02	0.07	0.34	0.52	0.80
100	44000	0.01	0.02	0.07	0.36	0.55	0.85
100	45000	0.00	0.02	0.07	0.38	0.59	0.92
100	46000	0.00	0.02	0.07	0.40	0.63	0.98
100	47000	0.00	0.02	0.07	0.43	0.67	1.05
100	48000	0.00	0.02	0.07	0.46	0.72	1.13
100	49000	0.00	0.02	0.08	0.48	0.77	1.22
100	50000	0.00	0.02	0.08	0.51	0.82	1.31
150	5000	0.01	0.03	0.05	0.02	0.04	0.09
150	6000	0.01	0.03	0.05	0.02	0.05	0.10
150	7000	0.01	0.03	0.05	0.03	0.05	0.10
150	8000	0.01	0.03	0.05	0.03	0.05	0.11

Estimated Number of Pedestrian Crashes in Five Years
Based on Negative Binomial Model
18:02 Tuesday, September 16, 2003
Five Lanes with Median

Average Daily Pedestrian Volume	Average Daily Traffic (Motor Vehicle)	Unmarked Lower 95%	Unmarked Predicted	Unmarked Upper 95%	Marked Lower 95%	Marked Predicted	Marked Upper 95%
150	9000	0.01	0.03	0.05	0.03	0.06	0.11
150	10000	0.01	0.02	0.05	0.03	0.06	0.12
150	11000	0.01	0.02	0.05	0.03	0.07	0.12
150	12000	0.01	0.02	0.05	0.04	0.07	0.13
150	13000	0.01	0.02	0.05	0.04	0.07	0.14
150	14000	0.01	0.02	0.05	0.04	0.08	0.15
150	15000	0.01	0.02	0.05	0.05	0.08	0.15
150	16000	0.01	0.02	0.05	0.05	0.09	0.16
150	17000	0.01	0.02	0.05	0.06	0.10	0.17
150	18000	0.01	0.02	0.05	0.06	0.10	0.18
150	19000	0.01	0.02	0.05	0.06	0.11	0.19
150	20000	0.01	0.02	0.05	0.07	0.12	0.20
150	21000	0.01	0.02	0.05	0.07	0.13	0.21
150	22000	0.01	0.02	0.05	0.08	0.13	0.22
150	23000	0.01	0.02	0.05	0.09	0.14	0.24
150	24000	0.01	0.02	0.05	0.09	0.15	0.25
150	25000	0.01	0.02	0.05	0.10	0.16	0.26
150	26000	0.01	0.02	0.05	0.11	0.17	0.28
150	27000	0.01	0.02	0.05	0.12	0.19	0.30
150	28000	0.01	0.02	0.05	0.13	0.20	0.31
150	29000	0.01	0.02	0.05	0.13	0.21	0.33
150	30000	0.01	0.02	0.05	0.14	0.23	0.35
150	31000	0.01	0.02	0.05	0.15	0.24	0.37
150	32000	0.01	0.02	0.05	0.17	0.26	0.40
150	33000	0.01	0.02	0.06	0.18	0.27	0.42
150	34000	0.01	0.02	0.06	0.19	0.29	0.45
150	35000	0.01	0.02	0.06	0.20	0.31	0.48
150	36000	0.01	0.02	0.06	0.22	0.33	0.51
150	37000	0.01	0.02	0.06	0.23	0.36	0.54
150	38000	0.01	0.02	0.06	0.25	0.38	0.58
150	39000	0.01	0.02	0.06	0.27	0.40	0.62
150	40000	0.01	0.02	0.07	0.28	0.43	0.66

Five Lanes with Median

Average Daily Pedestrian Volume	Average Daily Traffic (Motor Vehicle)	Unmarked Lower 95%	Unmarked Predicted	Unmarked Upper 95%	Marked Lower 95%	Marked Predicted	Marked Upper 95%
150	41000	0.01	0.02	0.07	0.30	0.46	0.71
150	42000	0.01	0.02	0.07	0.32	0.49	0.75
150	43000	0.01	0.02	0.07	0.34	0.53	0.81
150	44000	0.01	0.02	0.07	0.36	0.56	0.87
150	45000	0.01	0.02	0.07	0.39	0.60	0.93
150	46000	0.00	0.02	0.08	0.41	0.64	1.00
150	47000	0.00	0.02	0.08	0.43	0.68	1.07
150	48000	0.00	0.02	0.08	0.46	0.73	1.15
150	49000	0.00	0.02	0.08	0.49	0.78	1.23
150	50000	0.00	0.02	0.08	0.52	0.83	1.33
200	5000	0.01	0.03	0.06	0.02	0.04	0.09
200	6000	0.01	0.03	0.06	0.02	0.05	0.10
200	7000	0.01	0.03	0.05	0.03	0.05	0.10
200	8000	0.01	0.03	0.05	0.03	0.05	0.11
200	9000	0.01	0.03	0.05	0.03	0.06	0.11
200	10000	0.01	0.03	0.05	0.03	0.06	0.12
200	11000	0.01	0.03	0.05	0.04	0.07	0.13
200	12000	0.01	0.03	0.05	0.04	0.07	0.13
200	13000	0.01	0.03	0.05	0.04	0.08	0.14
200	14000	0.01	0.03	0.05	0.04	0.08	0.15
200	15000	0.01	0.03	0.05	0.05	0.09	0.16
200	16000	0.01	0.03	0.05	0.05	0.09	0.16
200	17000	0.01	0.02	0.05	0.06	0.10	0.17
200	18000	0.01	0.02	0.05	0.06	0.10	0.18
200	19000	0.01	0.02	0.05	0.06	0.11	0.19
200	20000	0.01	0.02	0.05	0.07	0.12	0.20
200	21000	0.01	0.02	0.05	0.08	0.13	0.21
200	22000	0.01	0.02	0.05	0.08	0.14	0.23
200	23000	0.01	0.02	0.05	0.09	0.14	0.24
200	24000	0.01	0.02	0.05	0.09	0.15	0.25
200	25000	0.01	0.02	0.05	0.10	0.17	0.27
200	26000	0.01	0.02	0.05	0.11	0.18	0.28

Estimated Number of Pedestrian Crashes in Five Years
Based on Negative Binomial Model
18:02 Tuesday, September 16, 2003
Five Lanes with Median

Average Daily Pedestrian Volume	Average Daily Traffic (Motor Vehicle)	Unmarked Lower 95%	Unmarked Predicted	Unmarked Upper 95%	Marked Lower 95%	Marked Predicted	Marked Upper 95%
200	27000	0.01	0.02	0.05	0.12	0.19	0.30
200	28000	0.01	0.02	0.05	0.13	0.20	0.32
200	29000	0.01	0.02	0.05	0.14	0.21	0.34
200	30000	0.01	0.02	0.06	0.15	0.23	0.36
200	31000	0.01	0.02	0.06	0.16	0.24	0.38
200	32000	0.01	0.02	0.06	0.17	0.26	0.40
200	33000	0.01	0.02	0.06	0.18	0.28	0.43
200	34000	0.01	0.02	0.06	0.19	0.30	0.46
200	35000	0.01	0.02	0.06	0.21	0.32	0.48
200	36000	0.01	0.02	0.06	0.22	0.34	0.52
200	37000	0.01	0.02	0.06	0.24	0.36	0.55
200	38000	0.01	0.02	0.07	0.25	0.38	0.59
200	39000	0.01	0.02	0.07	0.27	0.41	0.63
200	40000	0.01	0.02	0.07	0.29	0.44	0.67
200	41000	0.01	0.02	0.07	0.31	0.47	0.71
200	42000	0.01	0.02	0.07	0.33	0.50	0.76
200	43000	0.01	0.02	0.07	0.35	0.53	0.82
200	44000	0.01	0.02	0.08	0.37	0.57	0.88
200	45000	0.01	0.02	0.08	0.39	0.61	0.94
200	46000	0.01	0.02	0.08	0.42	0.65	1.01
200	47000	0.00	0.02	0.08	0.44	0.69	1.08
200	48000	0.00	0.02	0.08	0.47	0.74	1.16
200	49000	0.00	0.02	0.09	0.50	0.79	1.25
200	50000	0.00	0.02	0.09	0.52	0.84	1.34
250	5000	0.01	0.03	0.06	0.02	0.05	0.09
250	6000	0.01	0.03	0.06	0.02	0.05	0.10
250	7000	0.01	0.03	0.06	0.03	0.05	0.10
250	8000	0.01	0.03	0.06	0.03	0.06	0.11
250	9000	0.01	0.03	0.06	0.03	0.06	0.11
250	10000	0.01	0.03	0.05	0.03	0.06	0.12
250	11000	0.01	0.03	0.05	0.04	0.07	0.13
250	12000	0.01	0.03	0.05	0.04	0.07	0.13

Five Lanes with Median

Average Daily Pedestrian Volume	Average Daily Traffic (Motor Vehicle)	Unmarked Lower 95%	Unmarked Predicted	Unmarked Upper 95%	Marked Lower 95%	Marked Predicted	Marked Upper 95%
250	13000	0.01	0.03	0.05	0.04	0.08	0.14
250	14000	0.01	0.03	0.05	0.04	0.08	0.15
250	15000	0.01	0.03	0.05	0.05	0.09	0.16
250	16000	0.01	0.03	0.05	0.05	0.09	0.17
250	17000	0.01	0.03	0.05	0.06	0.10	0.17
250	18000	0.01	0.03	0.05	0.06	0.11	0.18
250	19000	0.01	0.03	0.05	0.07	0.11	0.19
250	20000	0.01	0.03	0.05	0.07	0.12	0.21
250	21000	0.01	0.03	0.05	0.08	0.13	0.22
250	22000	0.01	0.03	0.05	0.08	0.14	0.23
250	23000	0.01	0.03	0.05	0.09	0.15	0.24
250	24000	0.01	0.03	0.05	0.10	0.16	0.26
250	25000	0.01	0.02	0.05	0.10	0.17	0.27
250	26000	0.01	0.02	0.06	0.11	0.18	0.29
250	27000	0.01	0.02	0.06	0.12	0.19	0.30
250	28000	0.01	0.02	0.06	0.13	0.20	0.32
250	29000	0.01	0.02	0.06	0.14	0.22	0.34
250	30000	0.01	0.02	0.06	0.15	0.23	0.36
250	31000	0.01	0.02	0.06	0.16	0.25	0.38
250	32000	0.01	0.02	0.06	0.17	0.26	0.41
250	33000	0.01	0.02	0.06	0.18	0.28	0.43
250	34000	0.01	0.02	0.06	0.20	0.30	0.46
250	35000	0.01	0.02	0.07	0.21	0.32	0.49
250	36000	0.01	0.02	0.07	0.22	0.34	0.52
250	37000	0.01	0.02	0.07	0.24	0.37	0.56
250	38000	0.01	0.02	0.07	0.26	0.39	0.59
250	39000	0.01	0.02	0.07	0.27	0.42	0.63
250	40000	0.01	0.02	0.07	0.29	0.44	0.68
250	41000	0.01	0.02	0.08	0.31	0.47	0.72
250	42000	0.01	0.02	0.08	0.33	0.51	0.78
250	43000	0.01	0.02	0.08	0.35	0.54	0.83
250	44000	0.01	0.02	0.08	0.37	0.58	0.89

Estimated Number of Pedestrian Crashes in Five Years
Based on Negative Binomial Model
18:02 Tuesday, September 16, 2003
Five Lanes with Median

Average Daily Pedestrian Volume	Average Daily Traffic (Motor Vehicle)	Unmarked Lower 95%	Unmarked Predicted	Unmarked Upper 95%	Marked Lower 95%	Marked Predicted	Marked Upper 95%
250	45000	0.01	0.02	0.08	0.40	0.61	0.95
250	46000	0.01	0.02	0.09	0.42	0.66	1.02
250	47000	0.01	0.02	0.09	0.45	0.70	1.10
250	48000	0.01	0.02	0.09	0.47	0.75	1.18
250	49000	0.00	0.02	0.09	0.50	0.80	1.27
250	50000	0.00	0.02	0.09	0.53	0.85	1.36

Estimated Number of Pedestrian Crashes in Five Years Based on Negative Binominal Model

17:25 Tuesday, September 16, 2003

Five Lanes with No Median

Average Daily Pedestrian Volume	Average Daily Traffic (Motor Vehicle)	Unmarked Lower 95%	Unmarked Predicted	Unmarked Upper 95%	Marked Lower 95%	Marked Predicted	Marked Upper 95%
50	5000	0.02	0.05	0.10	0.05	0.09	0.16
50	6000	0.02	0.05	0.10	0.05	0.09	0.17
50	7000	0.02	0.05	0.09	0.05	0.10	0.18
50	8000	0.02	0.05	0.09	0.06	0.11	0.19
50	9000	0.02	0.05	0.09	0.06	0.11	0.20
50	10000	0.02	0.04	0.09	0.07	0.12	0.22
50	11000	0.02	0.04	0.09	0.07	0.13	0.23
50	12000	0.02	0.04	0.09	0.08	0.14	0.24
50	13000	0.02	0.04	0.08	0.08	0.15	0.26
50	14000	0.02	0.04	0.08	0.09	0.16	0.27
50	15000	0.02	0.04	0.08	0.10	0.17	0.29
50	16000	0.02	0.04	0.08	0.10	0.18	0.31
50	17000	0.02	0.04	0.08	0.11	0.19	0.32
50	18000	0.02	0.04	0.08	0.12	0.20	0.34
50	19000	0.02	0.04	0.08	0.13	0.22	0.36
50	20000	0.02	0.04	0.08	0.14	0.23	0.39
50	21000	0.02	0.04	0.08	0.15	0.25	0.41
50	22000	0.02	0.04	0.08	0.16	0.26	0.44
50	23000	0.02	0.04	0.08	0.17	0.28	0.47
50	24000	0.02	0.04	0.08	0.18	0.30	0.50
50	25000	0.02	0.04	0.08	0.19	0.32	0.53
50	26000	0.02	0.04	0.08	0.20	0.34	0.56
50	27000	0.02	0.04	0.09	0.22	0.36	0.60
50	28000	0.02	0.04	0.09	0.23	0.39	0.64
50	29000	0.02	0.04	0.09	0.25	0.41	0.68
50	30000	0.02	0.04	0.09	0.27	0.44	0.73
50	31000	0.02	0.04	0.09	0.28	0.47	0.78
50	32000	0.02	0.04	0.09	0.30	0.50	0.83
50	33000	0.02	0.04	0.09	0.32	0.54	0.89
50	34000	0.01	0.04	0.10	0.34	0.57	0.96
50	35000	0.01	0.04	0.10	0.36	0.61	1.02
100	5000	0.02	0.05	0.10	0.05	0.09	0.17

Estimated Number of Pedestrian Crashes in Five Years
Based on Negative Binominal Model
17:25 Tuesday, September 16, 2003
Five Lanes with No Median

Average Daily Pedestrian Volume	Average Daily Traffic (Motor Vehicle)	Unmarked Lower 95%	Unmarked Predicted	Unmarked Upper 95%	Marked Lower 95%	Marked Predicted	Marked Upper 95%
100	6000	0.02	0.05	0.10	0.05	0.09	0.18
100	7000	0.02	0.05	0.10	0.05	0.10	0.19
100	8000	0.02	0.05	0.10	0.06	0.11	0.20
100	9000	0.02	0.05	0.09	0.06	0.11	0.21
100	10000	0.02	0.05	0.09	0.07	0.12	0.22
100	11000	0.02	0.05	0.09	0.07	0.13	0.23
100	12000	0.02	0.05	0.09	0.08	0.14	0.25
100	13000	0.02	0.05	0.09	0.08	0.15	0.26
100	14000	0.02	0.05	0.09	0.09	0.16	0.28
100	15000	0.02	0.05	0.09	0.10	0.17	0.29
100	16000	0.02	0.05	0.09	0.10	0.18	0.31
100	17000	0.02	0.04	0.09	0.11	0.19	0.33
100	18000	0.02	0.04	0.09	0.12	0.20	0.35
100	19000	0.02	0.04	0.09	0.13	0.22	0.37
100	20000	0.02	0.04	0.09	0.14	0.23	0.39
100	21000	0.02	0.04	0.09	0.15	0.25	0.42
100	22000	0.02	0.04	0.09	0.16	0.27	0.44
100	23000	0.02	0.04	0.09	0.17	0.28	0.47
100	24000	0.02	0.04	0.09	0.18	0.30	0.50
100	25000	0.02	0.04	0.09	0.19	0.32	0.53
100	26000	0.02	0.04	0.09	0.21	0.34	0.57
100	27000	0.02	0.04	0.09	0.22	0.37	0.61
100	28000	0.02	0.04	0.09	0.24	0.39	0.65
100	29000	0.02	0.04	0.09	0.25	0.42	0.69
100	30000	0.02	0.04	0.09	0.27	0.45	0.74
100	31000	0.02	0.04	0.10	0.29	0.48	0.79
100	32000	0.02	0.04	0.10	0.31	0.51	0.84
100	33000	0.02	0.04	0.10	0.33	0.54	0.90
100	34000	0.02	0.04	0.10	0.35	0.58	0.97
100	35000	0.02	0.04	0.10	0.37	0.62	1.04
150	5000	0.02	0.05	0.11	0.05	0.09	0.17
150	6000	0.02	0.05	0.11	0.05	0.09	0.18

Estimated Number of Pedestrian Crashes in Five Years
Based on Negative Binominal Model
17:25 Tuesday, September 16, 2003
Five Lanes with No Median

Average Daily Pedestrian Volume	Average Daily Traffic (Motor Vehicle)	Unmarked Lower 95%	Unmarked Predicted	Unmarked Upper 95%	Marked Lower 95%	Marked Predicted	Marked Upper 95%
150	7000	0.02	0.05	0.10	0.05	0.10	0.19
150	8000	0.03	0.05	0.10	0.06	0.11	0.20
150	9000	0.03	0.05	0.10	0.06	0.12	0.21
150	10000	0.03	0.05	0.10	0.07	0.12	0.22
150	11000	0.03	0.05	0.10	0.07	0.13	0.24
150	12000	0.03	0.05	0.09	0.08	0.14	0.25
150	13000	0.03	0.05	0.09	0.08	0.15	0.26
150	14000	0.03	0.05	0.09	0.09	0.16	0.28
150	15000	0.03	0.05	0.09	0.10	0.17	0.30
150	16000	0.03	0.05	0.09	0.11	0.18	0.31
150	17000	0.02	0.05	0.09	0.11	0.19	0.33
150	18000	0.02	0.05	0.09	0.12	0.21	0.35
150	19000	0.02	0.05	0.09	0.13	0.22	0.37
150	20000	0.02	0.05	0.09	0.14	0.24	0.40
150	21000	0.02	0.05	0.09	0.15	0.25	0.42
150	22000	0.02	0.05	0.09	0.16	0.27	0.45
150	23000	0.02	0.05	0.09	0.17	0.29	0.48
150	24000	0.02	0.05	0.09	0.18	0.31	0.51
150	25000	0.02	0.04	0.09	0.20	0.33	0.54
150	26000	0.02	0.04	0.09	0.21	0.35	0.58
150	27000	0.02	0.04	0.10	0.22	0.37	0.61
150	28000	0.02	0.04	0.10	0.24	0.40	0.66
150	29000	0.02	0.04	0.10	0.26	0.42	0.70
150	30000	0.02	0.04	0.10	0.27	0.45	0.75
150	31000	0.02	0.04	0.10	0.29	0.48	0.80
150	32000	0.02	0.04	0.10	0.31	0.51	0.86
150	33000	0.02	0.04	0.11	0.33	0.55	0.92
150	34000	0.02	0.04	0.11	0.35	0.59	0.98
150	35000	0.02	0.04	0.11	0.37	0.63	1.05
200	5000	0.03	0.05	0.11	0.05	0.09	0.17
200	6000	0.03	0.05	0.11	0.05	0.10	0.18
200	7000	0.03	0.05	0.11	0.06	0.10	0.19

Estimated Number of Pedestrian Crashes in Five Years
Based on Negative Binominal Model
17:25 Tuesday, September 16, 2003
Five Lanes with No Median

Average Daily Pedestrian Volume	Average Daily Traffic (Motor Vehicle)	Unmarked Lower 95%	Unmarked Predicted	Unmarked Upper 95%	Marked Lower 95%	Marked Predicted	Marked Upper 95%
200	8000	0.03	0.05	0.11	0.06	0.11	0.20
200	9000	0.03	0.05	0.10	0.06	0.12	0.21
200	10000	0.03	0.05	0.10	0.07	0.12	0.23
200	11000	0.03	0.05	0.10	0.07	0.13	0.24
200	12000	0.03	0.05	0.10	0.08	0.14	0.25
200	13000	0.03	0.05	0.10	0.09	0.15	0.27
200	14000	0.03	0.05	0.10	0.09	0.16	0.28
200	15000	0.03	0.05	0.10	0.10	0.17	0.30
200	16000	0.03	0.05	0.10	0.11	0.18	0.32
200	17000	0.03	0.05	0.10	0.11	0.20	0.34
200	18000	0.03	0.05	0.10	0.12	0.21	0.36
200	19000	0.03	0.05	0.10	0.13	0.22	0.38
200	20000	0.03	0.05	0.10	0.14	0.24	0.40
200	21000	0.02	0.05	0.10	0.15	0.26	0.43
200	22000	0.02	0.05	0.10	0.16	0.27	0.45
200	23000	0.02	0.05	0.10	0.17	0.29	0.48
200	24000	0.02	0.05	0.10	0.19	0.31	0.51
200	25000	0.02	0.05	0.10	0.20	0.33	0.55
200	26000	0.02	0.05	0.10	0.21	0.35	0.58
200	27000	0.02	0.05	0.10	0.23	0.38	0.62
200	28000	0.02	0.05	0.10	0.24	0.40	0.66
200	29000	0.02	0.05	0.10	0.26	0.43	0.71
200	30000	0.02	0.05	0.11	0.28	0.46	0.76
200	31000	0.02	0.05	0.11	0.29	0.49	0.81
200	32000	0.02	0.05	0.11	0.31	0.52	0.87
200	33000	0.02	0.04	0.11	0.33	0.56	0.93
200	34000	0.02	0.04	0.11	0.36	0.59	0.99
200	35000	0.02	0.04	0.12	0.38	0.63	1.06
250	5000	0.03	0.06	0.12	0.05	0.09	0.17
250	6000	0.03	0.06	0.12	0.05	0.10	0.18
250	7000	0.03	0.06	0.11	0.06	0.10	0.19
250	8000	0.03	0.06	0.11	0.06	0.11	0.20

Estimated Number of Pedestrian Crashes in Five Years
5

Based on Negative Binominal Model
17:25 Tuesday, September 16, 2003
Five Lanes with No Median

Average Daily Pedestrian Volume	Average Daily Traffic (Motor Vehicle)	Unmarked Lower 95%	Unmarked Predicted	Unmarked Upper 95%	Marked Lower 95%	Marked Predicted	Marked Upper 95%
250	9000	0.03	0.06	0.11	0.06	0.12	0.22
250	10000	0.03	0.06	0.11	0.07	0.13	0.23
250	11000	0.03	0.05	0.11	0.08	0.13	0.24
250	12000	0.03	0.05	0.10	0.08	0.14	0.26
250	13000	0.03	0.05	0.10	0.09	0.15	0.27
250	14000	0.03	0.05	0.10	0.09	0.16	0.29
250	15000	0.03	0.05	0.10	0.10	0.17	0.30
250	16000	0.03	0.05	0.10	0.11	0.19	0.32
250	17000	0.03	0.05	0.10	0.12	0.20	0.34
250	18000	0.03	0.05	0.10	0.12	0.21	0.36
250	19000	0.03	0.05	0.10	0.13	0.23	0.38
250	20000	0.03	0.05	0.10	0.14	0.24	0.41
250	21000	0.03	0.05	0.10	0.15	0.26	0.43
250	22000	0.03	0.05	0.10	0.17	0.28	0.46
250	23000	0.02	0.05	0.10	0.18	0.29	0.49
250	24000	0.02	0.05	0.10	0.19	0.31	0.52
250	25000	0.02	0.05	0.10	0.20	0.34	0.56
250	26000	0.02	0.05	0.11	0.22	0.36	0.59
250	27000	0.02	0.05	0.11	0.23	0.38	0.63
250	28000	0.02	0.05	0.11	0.25	0.41	0.67
250	29000	0.02	0.05	0.11	0.26	0.43	0.72
250	30000	0.02	0.05	0.11	0.28	0.46	0.77
250	31000	0.02	0.05	0.11	0.30	0.50	0.82
250	32000	0.02	0.05	0.12	0.32	0.53	0.88
250	33000	0.02	0.05	0.12	0.34	0.56	0.94
250	34000	0.02	0.05	0.12	0.36	0.60	1.01
250	35000	0.02	0.05	0.12	0.38	0.64	1.08

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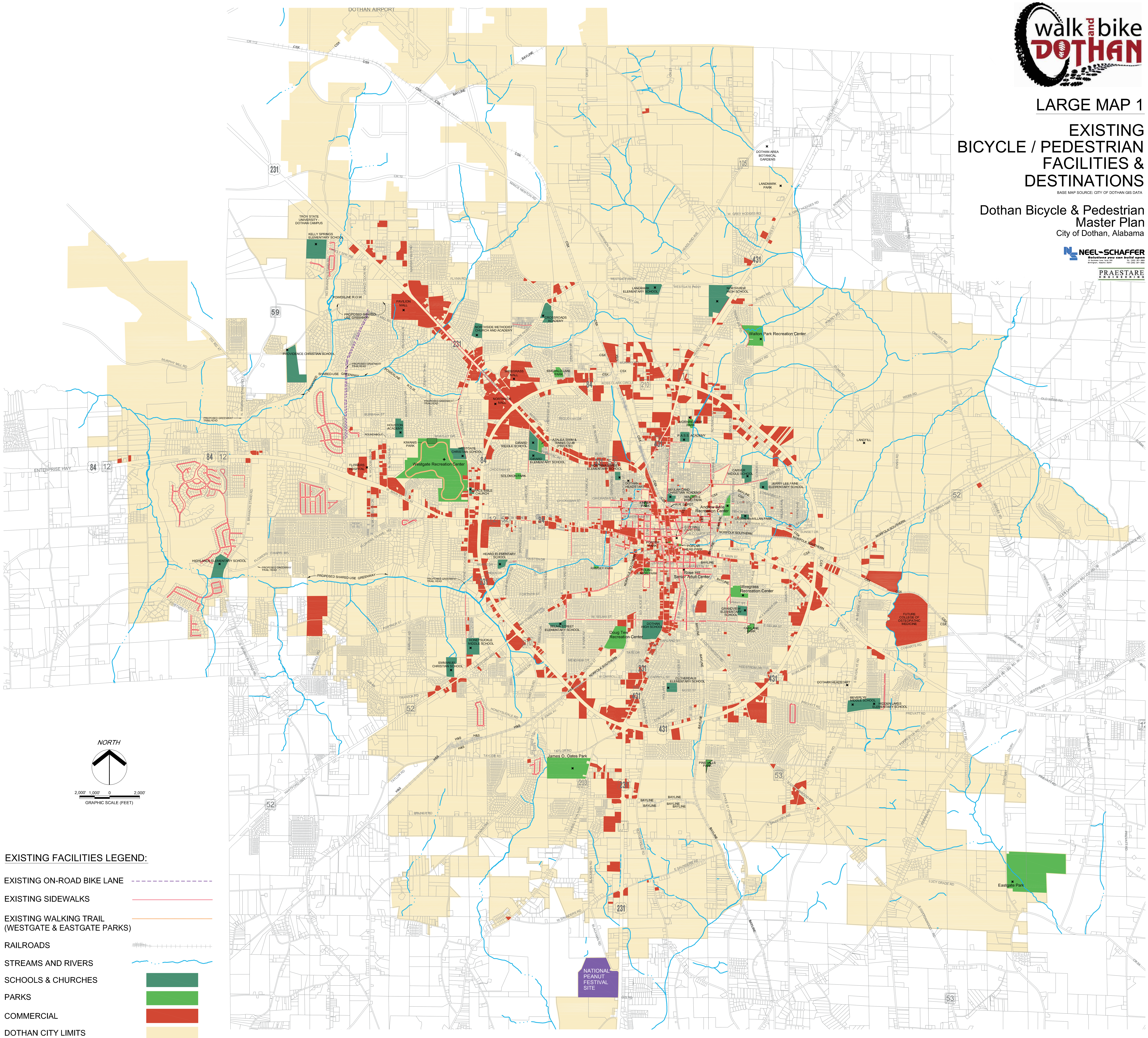
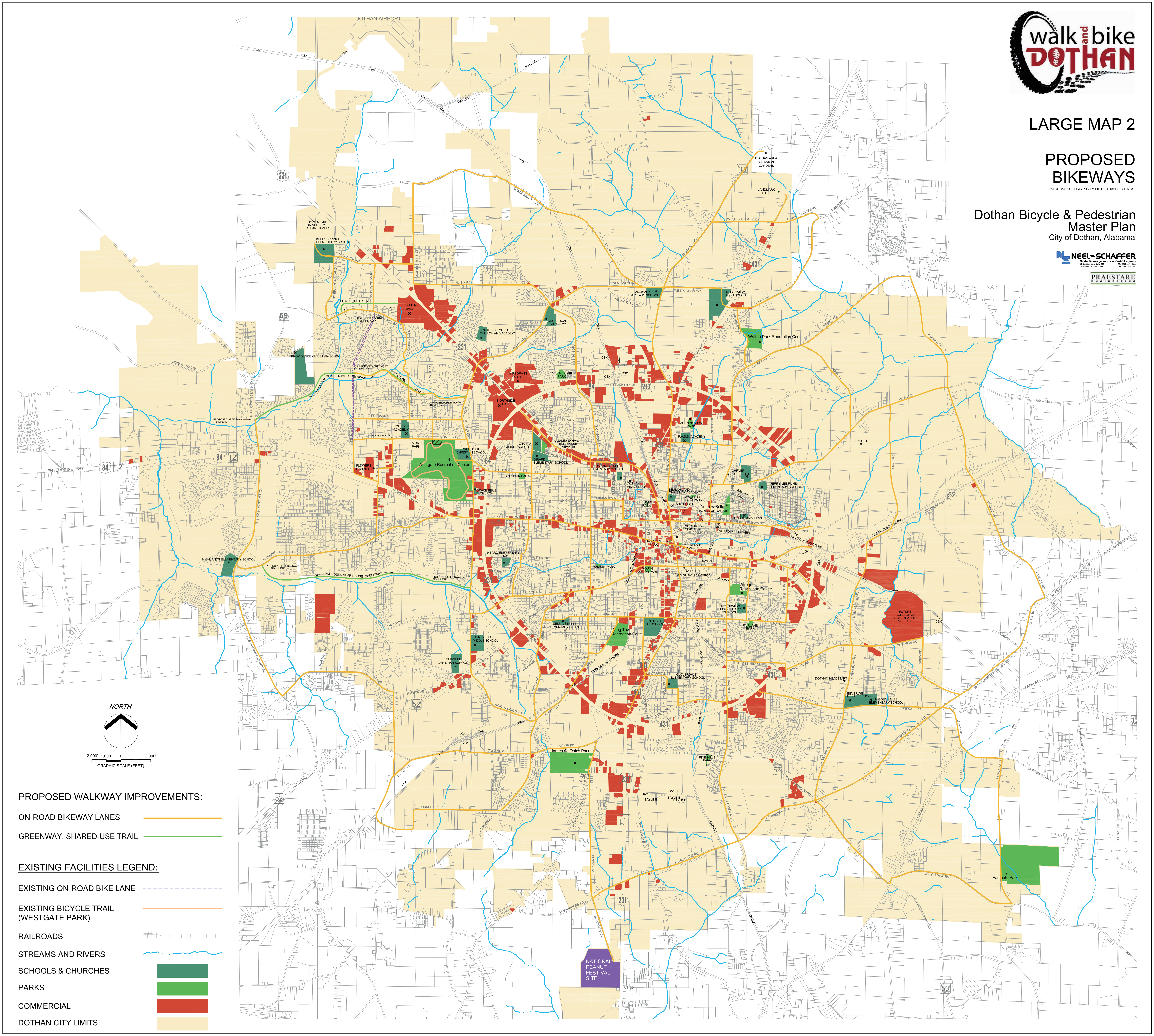
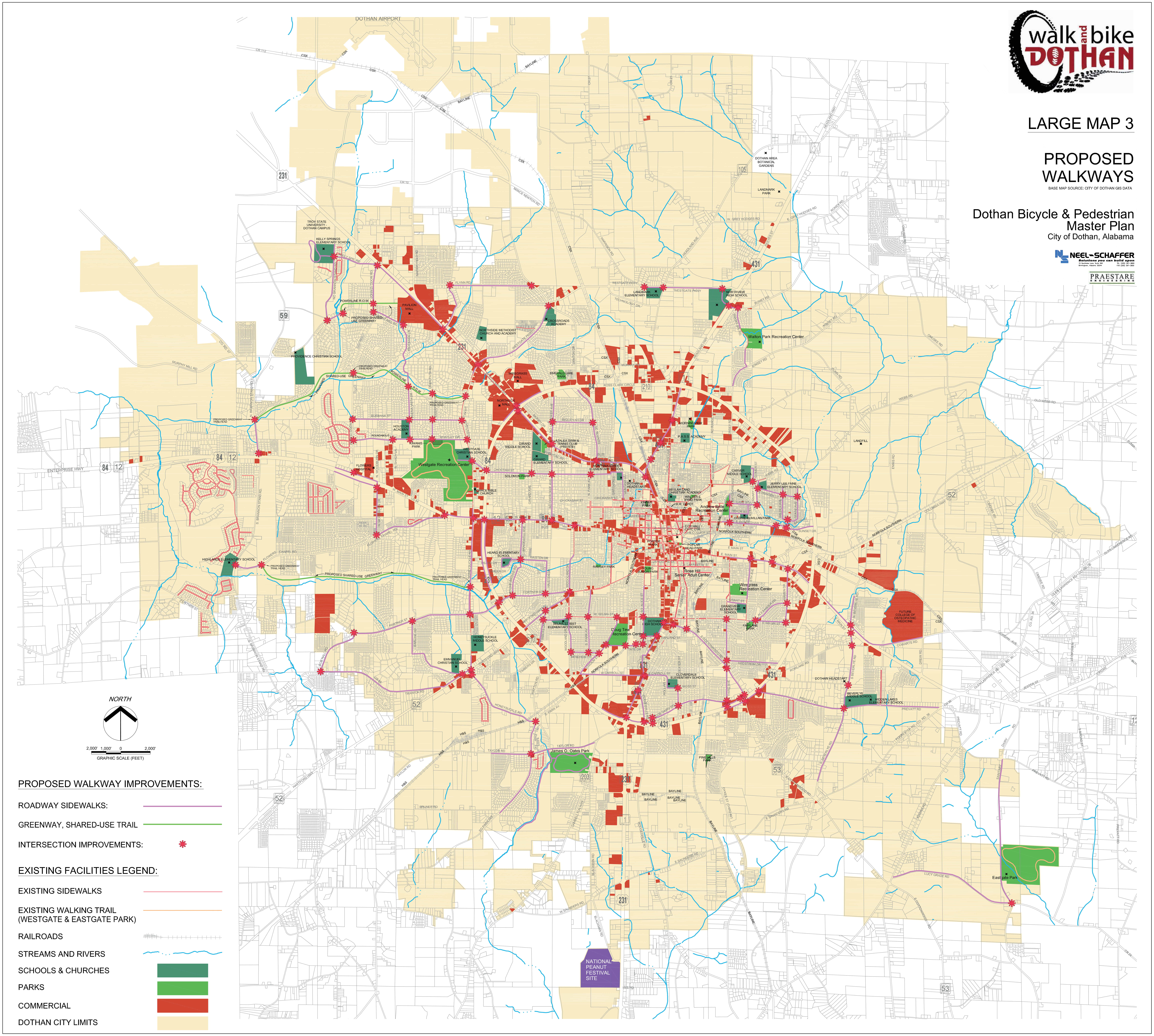
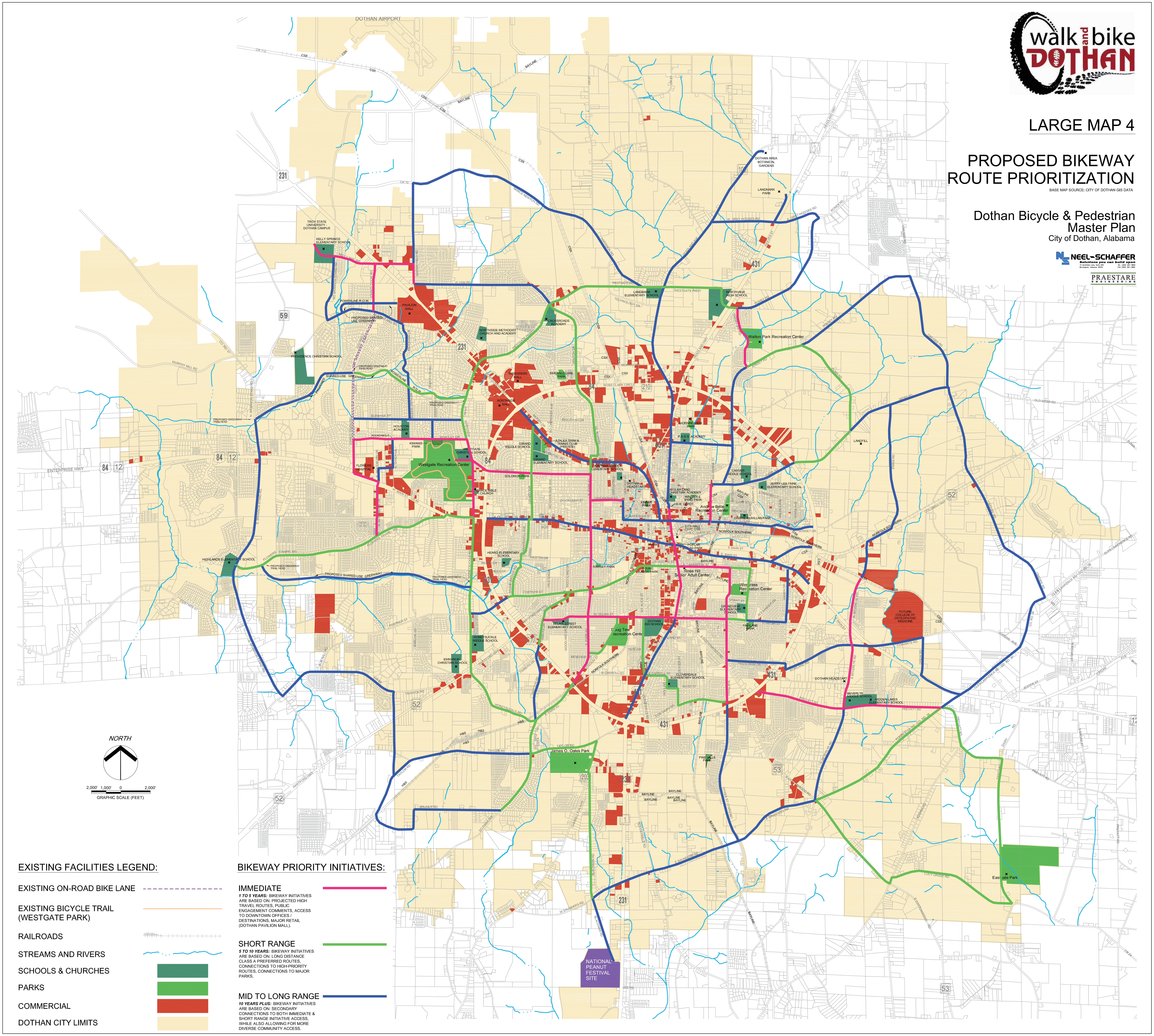

walk and bike DOTHAN
LARGE MAP 1
EXISTING BICYCLE / PEDESTRIAN FACILITIES & DESTINATIONS
BASE MAP SOURCE: CITY OF DOTHAN GIS DATA
Dothan Bicycle & Pedestrian Master Plan
City of Dothan, Alabama
NEEL-SCHAFFER
Solutions you can build upon
15 Southlake Lane, Suite 200
Birmingham, Alabama 35244
TEL. (205) 397-3800
FAX (205) 397-3900
PRAESTARE ENGINEERING
NORTH
2,000' 1,000' 0 2,000'
GRAPHIC SCALE (FEET)
EXISTING FACILITIES LEGEND:
EXISTING ON-ROAD BIKE LANE
EXISTING SIDEWALKS
EXISTING WALKING TRAIL (WESTGATE & EASTGATE PARKS)
RAILROADS
STREAMS AND RIVERS
SCHOOLS & CHURCHES
PARKS
COMMERCIAL
DOTHAN CITY LIMITS
DOTHAN AIRPORT
Westgate Recreation Center
Walton Park Recreation Center
Andrew Belle Recreation Center
Wiregrass Recreation Center
Rose Hill Senior Adult Center
Doug Tew Recreation Center
James O. Oates Park
Eastgate Park
NATIONAL PEANUT FESTIVAL SITE
FUTURE COLLEGE OF OSTEOPATHIC MEDICINE
ENTERPRISE HWY



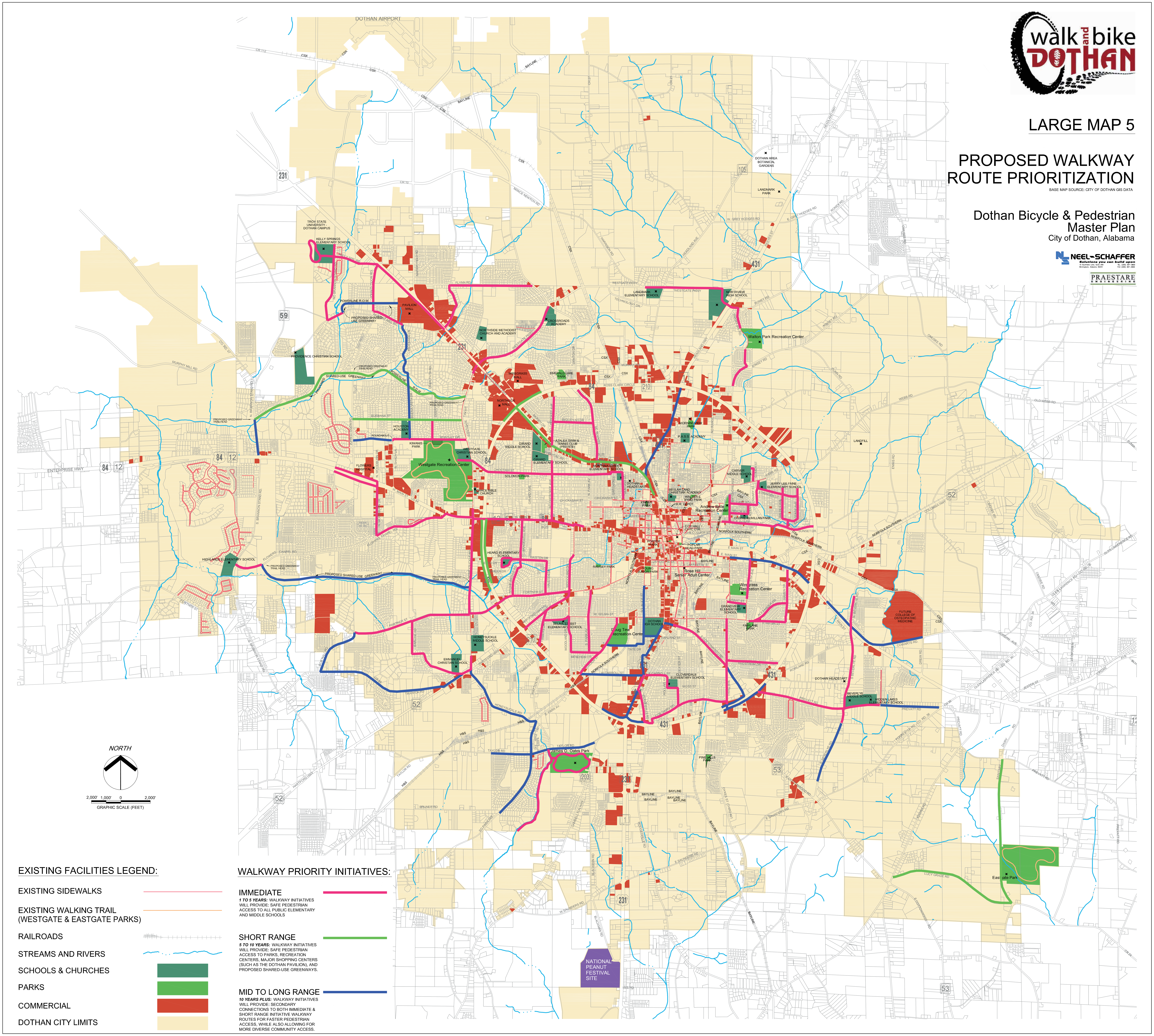
walk and bike DOTHAN
LARGE MAP 2
PROPOSED BIKEWAYS
BASE MAP SOURCE: CITY OF DOTHAN GIS DATA
Dothan Bicycle & Pedestrian Master Plan
City of Dothan, Alabama
NEEL-SCHAFFER
Solutions you can build upon
PRAESTARE ENGINEERING
NORTH
GRAPHIC SCALE (FEET)
PROPOSED WALKWAY IMPROVEMENTS:
ON-ROAD BIKEWAY LANES
GREENWAY, SHARED-USE TRAIL
EXISTING FACILITIES LEGEND:
EXISTING ON-ROAD BIKE LANE
EXISTING BICYCLE TRAIL (WESTGATE PARK)
RAILROADS
STREAMS AND RIVERS
SCHOOLS & CHURCHES
PARKS
COMMERCIAL
DOTHAN CITY LIMITS
DOTHAN AIRPORT
Westgate Recreation Center
Walton Park Recreation Center
Wiregrass Recreation Center
James O. Oates Park
Eastgate Park
NATIONAL PEANUT FESTIVAL SITE
FUTURE COLLEGE OF OSTEOPATHIC MEDICINE
Rose Hill Senior Adult Center
Andrew Belle Recreation Center
DOTHAN HIGH SCHOOL



walk and bike DOTHAN
LARGE MAP 3
PROPOSED WALKWAYS
BASE MAP SOURCE: CITY OF DOTHAN GIS DATA
Dothan Bicycle & Pedestrian Master Plan
City of Dothan, Alabama
NEEL-SCHAFFER
Solutions you can build upon
PRAESTARE
NORTH
GRAPHIC SCALE (FEET)
PROPOSED WALKWAY IMPROVEMENTS:
ROADWAY SIDEWALKS:
GREENWAY, SHARED-USE TRAIL
INTERSECTION IMPROVEMENTS:
EXISTING FACILITIES LEGEND:
EXISTING SIDEWALKS
EXISTING WALKING TRAIL (WESTGATE & EASTGATE PARK)
RAILROADS
STREAMS AND RIVERS
SCHOOLS & CHURCHES
PARKS
COMMERCIAL
DOTHAN CITY LIMITS
NATIONAL PEANUT FESTIVAL SITE
Westgate Recreation Center
Eastgate Park
James O. Oates Park
Walton Park Recreation Center
DOTHAN AIRPORT



walk and bike DOTHAN
LARGE MAP 4
PROPOSED BIKEWAY ROUTE PRIORITIZATION
BASE MAP SOURCE: CITY OF DOTHAN GIS DATA
Dothan Bicycle & Pedestrian Master Plan
City of Dothan, Alabama
NEEL-SCHAFFER
PRAESTARE ENGINEERING
NORTH
GRAPHIC SCALE (FEET)
EXISTING FACILITIES LEGEND:
EXISTING ON-ROAD BIKE LANE
EXISTING BICYCLE TRAIL (WESTGATE PARK)
RAILROADS
STREAMS AND RIVERS
SCHOOLS & CHURCHES
PARKS
COMMERCIAL
DOTHAN CITY LIMITS
BIKEWAY PRIORITY INITIATIVES:
IMMEDIATE
1 TO 5 YEARS: BIKEWAY INITIATIVES ARE BASED ON: PROJECTED HIGH TRAVEL ROUTES, PUBLIC ENGAGEMENT COMMENTS, ACCESS TO DOWNTOWN OFFICES / DESTINATIONS, MAJOR RETAIL (DOTHAN PAVILION MALL).
SHORT RANGE
5 TO 10 YEARS: BIKEWAY INITIATIVES ARE BASED ON: LONG DISTANCE CLASS A PREFERRED ROUTES, CONNECTIONS TO HIGH-PRIORITY ROUTES, CONNECTIONS TO MAJOR PARKS.
MID TO LONG RANGE
10 YEARS PLUS: BIKEWAY INITIATIVES ARE BASED ON: SECONDARY CONNECTIONS TO BOTH IMMEDIATE & SHORT RANGE INITIATIVE ACCESS, WHILE ALSO ALLOWING FOR MORE DIVERSE COMMUNITY ACCESS.
DOTHAN AIRPORT
Westgate Recreation Center
Walton Park Recreation Center
James O. Oates Park
Eastgate Park
NATIONAL PEANUT FESTIVAL SITE
FUTURE COLLEGE OF OSTEOPATHIC MEDICINE


walk and bike DOTHAN
LARGE MAP 5
PROPOSED WALKWAY ROUTE PRIORITIZATION
BASE MAP SOURCE: CITY OF DOTHAN GIS DATA
Dothan Bicycle & Pedestrian Master Plan
City of Dothan, Alabama
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EXISTING WALKING TRAIL (WESTGATE & EASTGATE PARKS)
RAILROADS
STREAMS AND RIVERS
SCHOOLS & CHURCHES
PARKS
COMMERCIAL
DOTHAN CITY LIMITS
WALKWAY PRIORITY INITIATIVES:
IMMEDIATE
1 TO 5 YEARS: WALKWAY INITIATIVES WILL PROVIDE: SAFE PEDESTRIAN ACCESS TO ALL PUBLIC ELEMENTARY AND MIDDLE SCHOOLS
SHORT RANGE
5 TO 10 YEARS: WALKWAY INITIATIVES WILL PROVIDE: SAFE PEDESTRIAN ACCESS TO PARKS, RECREATION CENTERS, MAJOR SHOPPING CENTERS (SUCH AS THE DOTHAN PAVILION), AND PROPOSED SHARED-USE GREENWAYS.
MID TO LONG RANGE
10 YEARS PLUS: WALKWAY INITIATIVES WILL PROVIDE: SECONDARY CONNECTIONS TO BOTH IMMEDIATE & SHORT RANGE INITIATIVE WALKWAY ROUTES FOR FASTER PEDESTRIAN ACCESS, WHILE ALSO ALLOWING FOR MORE DIVERSE COMMUNITY ACCESS.
DOTHAN AIRPORT
Westgate Recreation Center
Walton Park Recreation Center
Andrew Belle Recreation Center
Rose Hill Senior Adult Center
Wiregrass Recreation Center
Doug Tew Recreation Center
James O. Oates Park
Eastgate Park
NATIONAL PEANUT FESTIVAL SITE
FUTURE COLLEGE OF OSTEOPATHIC MEDICINE