APPENDIX B – PEDESTRIAN DEMAND INDEX

Kimley-Horn and Associates, Inc.

Pedestrian Demand Index for State Highway Facilities

Revised: May 29, 2007

Introduction

Kimley-Horn and Associates conducted a literature review of methodologies and techniques to estimate pedestrian demand in fulfillment of Task 2.1 and Task 2.2 of the ADOT Bicycle and Pedestrian Plan, Phase IV (Task Assignment 07-07) Scope of Work. This information serves as input to development of a methodology to estimate pedestrian demand for roadways within the Arizona State Highway system. Our scope of work reads:

- Task 2.1 - Kimley-Horn will utilize the internet and follow up phone calls to research methods utilized by other agencies to estimate pedestrian demand and set policy for pedestrian improvements and maintenance. A summary of the research will be prepared.
- Tasks 2.2 - Kimley-Horn will utilize GIS data readily available at ADOT and provided to Kimley-Horn in electronic format in order to prepare a map of pedestrian demand for roadways within the Arizona State Highway System. The resulting may include a high/medium/low demand ranking as compared to particular data.

Literature Review

The literature review revealed that agencies and jurisdictions that have estimated pedestrian demand have done so primarily at a localized level – for a particular corridor, district, or neighborhood. The literature search identified just a handful of pedestrian demand methodologies which agencies have implemented on a region-wide level. Highlights of pedestrian demand methodologies that were reviewed are documented in **Exhibit 1**.

Exhibit 1 – Literature Review of Pedestrian Demand Estimation Methodologies

Document Title	Key Characteristics of Methodology Introduced
Sketch-Plan Method for Estimating Pedestrian Traffic for Central Business Districts and Suburban Growth Corridors.	*Sketch plan methodology is introduced to estimate peak-hour pedestrian trips for crossings at intersections and mid-block locations. The method applies peak vehicle-per-hour turning movement counts, transit vehicle or passenger counts, and walk and bike counts.*
Georgia Guidebook for Pedestrian Planning	*Guidebook addresses identification of pedestrian needs for a region based on an assessment of:* ▪ *Accessibility – measure of the proximity of a location to a pedestrian attractor (school, park, commercial center)* ▪ *Connectivity – the degree to which the pedestrian network is connected to the street system and various destinations.* ▪ *Continuity – measures whether or not there is continuous sidewalk, refers to gaps in sidewalk.* ▪ *System coverage – extent of pedestrian facilities available, assessing the percent of sidewalks provided along arterials, major collectors, and neighborhood routes.* ▪ *Demographic analysis – the demographics of residents of particular cities and regions provides input for determining the types of pedestrian facilities that could enhance existing quality of life.* ▪ *Air quality – regions with poor air quality may be suitable candidates for improved pedestrian activity.*
Development of a Methodology to Estimate Bicycle and Pedestrian Travel Demand	*Report summarizes research activities to develop a bicycle and pedestrian demand forecasting methodology. Methodology is based upon they type and intensity of land uses adjacent to a study corridor. Bicycle and trip generation rates were developed.*
Targeting Pedestrian Infrastructure Improvements: A methodology to assist providers in identifying suburban locations with potential increases in pedestrian travel.	*Introduces methodology tailored to suburban clusters and corridors where past research has shown that the potential exists for substantial volumes of pedestrian travel. (1) Pedestrian Location Identification Tool help differentiate between suburban areas that do and do not have the potential for pedestrian travel. (2) The Pedestrian Infrastructure Prioritization Decision System supports decision-making processes to allocate investments in infrastructure improvement to areas that do have potential for pedestrian travel.*
Pedestrian Travel Potential in Northern New Jersey. A Metropolitan Planning Organization's Approach to Identifying Investment Priorities.	*NJPTA has adopted an approach using regional analysis and priority setting to guide planning activity for a very local scale. Pedestrian Potential Index was developed that utilizes four key indicators: population densities, employment densities, land use mix, and street network density all analyzed at the census tract level. Thresholds were set to begin to find priority areas in which investment strategies would be more likely to generate a high return in terms of walking trips generated.*

Proposed Methodology

The proposed ADOT Pedestrian Demand Index (PDI) utilizes four indicators to determine the propensity for pedestrian facilities to be utilized if they were provided. The indicators are developed on a census tract

basis and are: (1) Activity balance, (2) Pedestrian Facilities Index, and (3) Road Density Index. (4) Pedestrian Potential Index

The proposed Arizona Pedestrian Demand Index (PDI) utilizes four indicators. A summary of the indicators is described below:

1. Activity Balance Index (ABI) – This is a measure of the relationship between population and employment and is computed by dividing employment by population (employment/census tract population). The results are subsequently divided into five quintiles. Scores of 1 are assigned to results in the outer quintiles (showing the most imbalance between employment and population). A score of 2 is assigned to zones in the second and fourth quintiles. A score of 3 is assigned to zones in the 3rd, or middle quintile. The GIS data required to compute this index is: (1) population data by census tract, and (2) employment data by census tract.

2. Pedestrian Facilities Index (PFI) – This is a measure of the urbanization and population density. This measure is computed by calculating the population divided by land area for each census tract. The results are divided into quintiles and assigned a score of 1 to 5 where:

   1 = lowest results, or least relative index value; and
   5 = highest relative index value (most urban or densest population).

   A summary of GIS data required to compute this index is: (1) population data by census tract, and (2) land area of census tract.

3. Road Density Index (RDI) – This is also a measure of urbanization and is computed as the total number of miles of non-limited access highway roads and streets in a census tract to the total land area of that tract. The results are divided into quintiles and assigned a score of 1 to 5, where :

   1 = lowest results, or least relative index value; and
   5 = highest relative index value.

   A summary of GIS data required to compute this index is (1) total number of miles of non-limited access highway facilities, per census tract (available through HPMS database)., and land area of census tract.

4. Journey to Work (JTW) – This measure, based on the U.S. Census Journey to Work data, is a measure of means of transportation. The measure is computed as the percentage of total workers (16 years and over) who travel to work by walking at the census tract level. The results are divided into quintiles and assigned a score of 1 to 5, where :

   1 = lowest results, or least index value; and
   5 = highest relative index value (highest percentage of workers travel to work by walking)

   A summary of GIS data required to compute this index is (1) total number of workers 16 years and over and total number of workers who travel to work by walking.

Following the calculation of each of the above indexes, the individual index scores were summed to calculate a total Pedestrian Demand Index score for each highway segment. The overall PDI scores were normalized from 0 to 100. Subsequently, roadway segments within urbanized area boundaries were given an additional 10 points to their score, and the overall score was renormalized from 0 to 100.

State highway segments that pass through census tracts with PDI scores between 52 and 100 were categorized as those with the highest pedestrian demand potential (Highest and High PDI in attached graphics). Tracts with scores between 31 and 65 are considered to have moderate pedestrian demand (Moderate and Low PDI). Scores less than 30 have low (Lowest PDI) pedestrian demand.

Crash Rate Index

A secondary analysis was conducted utilizing pedestrian-crash data provided by ADOT. The five-year history of all pedestrian-related crashes was obtained for all state highways. The number of crashes on each highway segment was calculated and summed. The number of crashes for each highway segment was subsequently normalized by segment length to develop a Crash Rate Index.

Analysis Results

The results of the analysis are depicted in the pages at the end of this document. The results of the methodology can serve as an 'initial' screening device that identifies areas of potential pedestrian demand. The areas that are depicted as "Moderate PDI" or above can be further analyzed for their pedestrian potential. Additional analysis tools may include field reviews, aerial photography, land use mapping, identification of specific pedestrian generators such as parks and schools.

The analysis results may be updated with information gleaned from the initial screening analysis.

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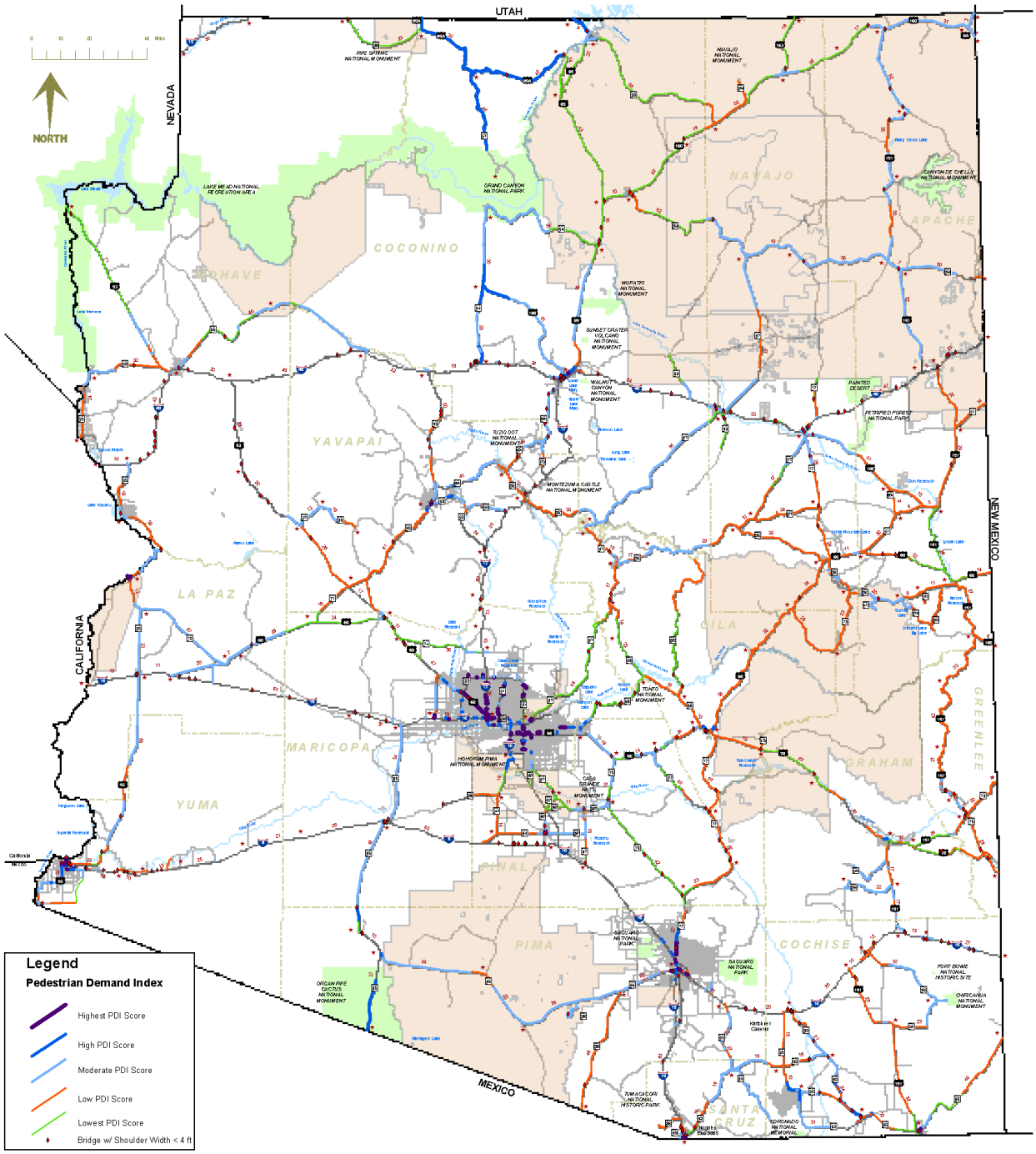
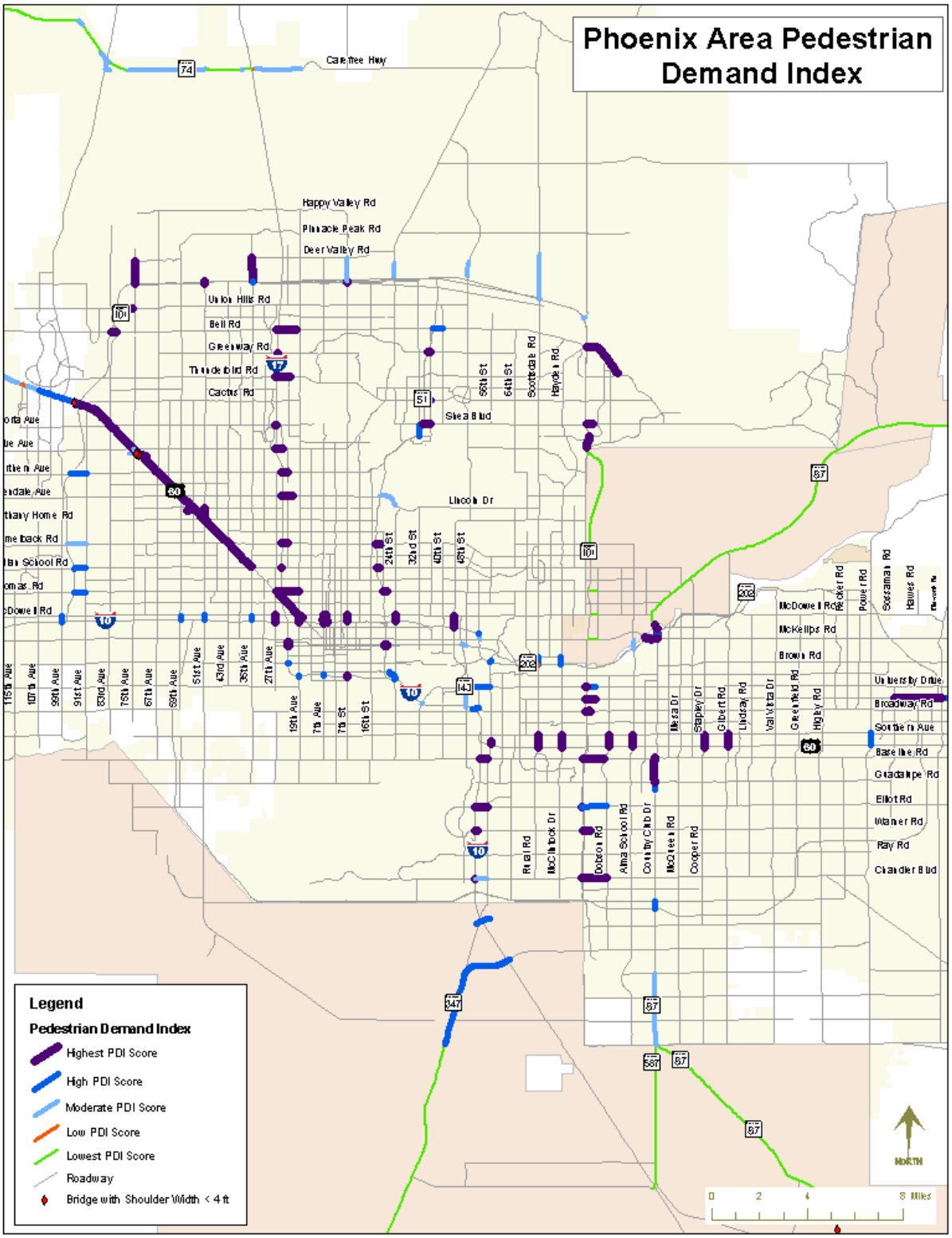
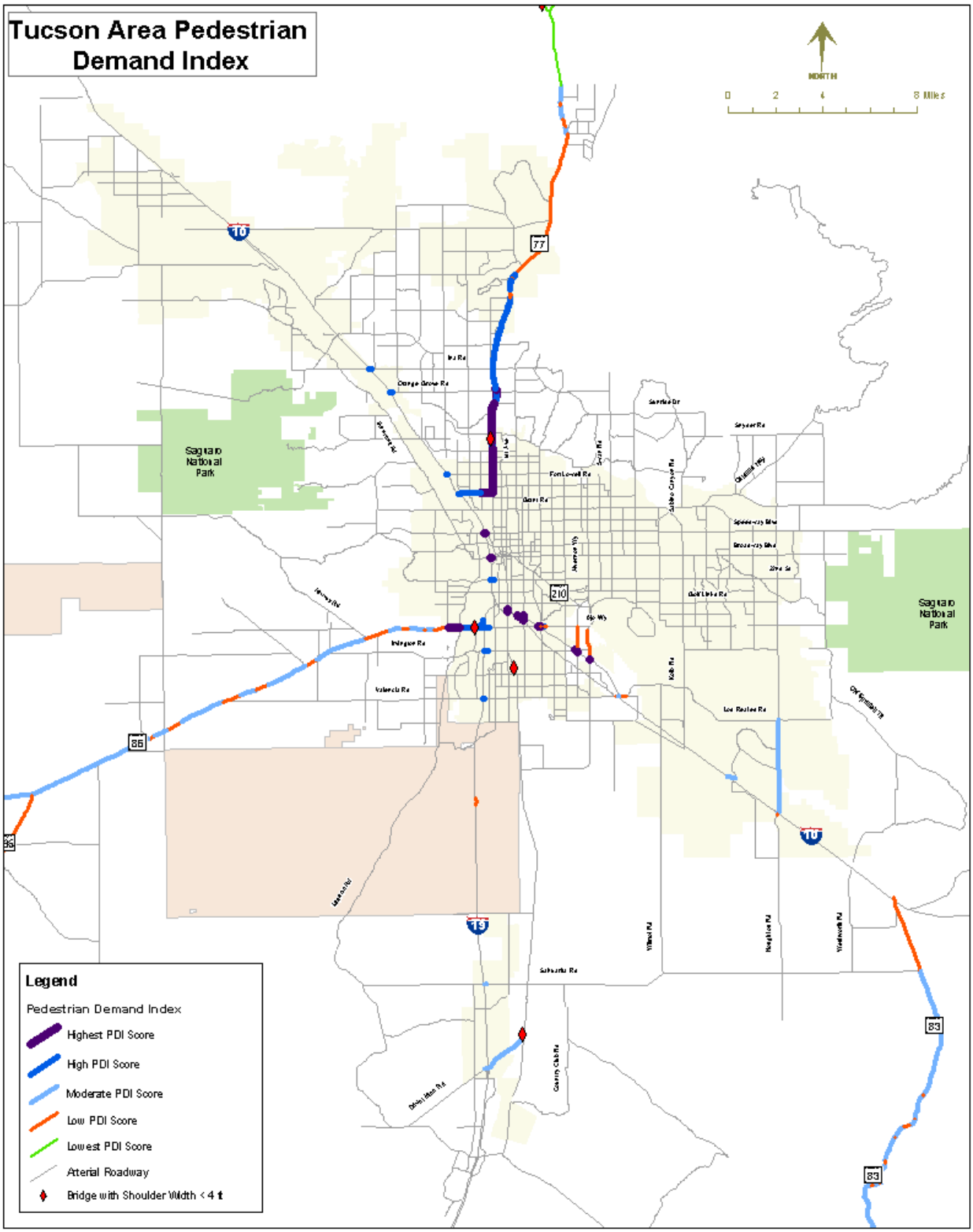
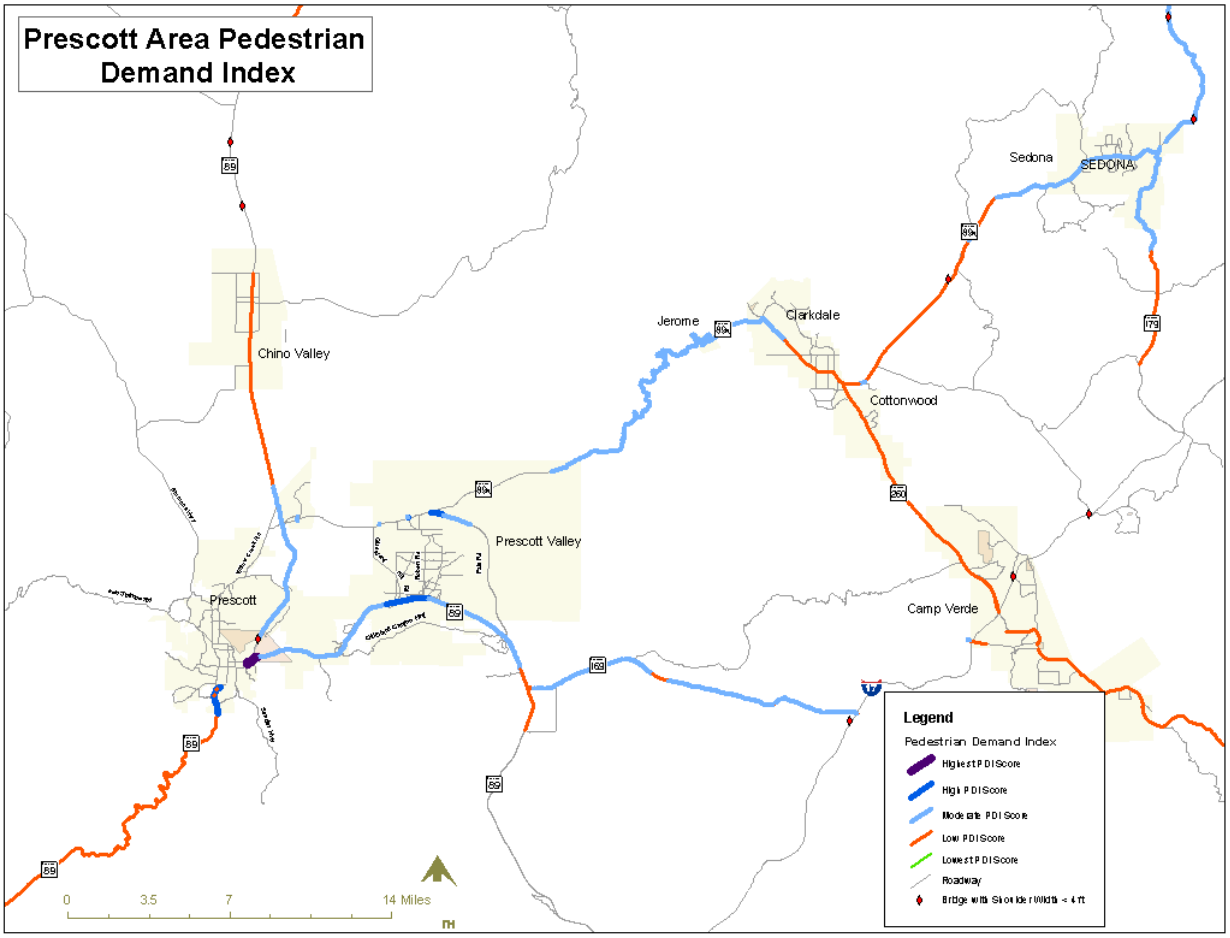
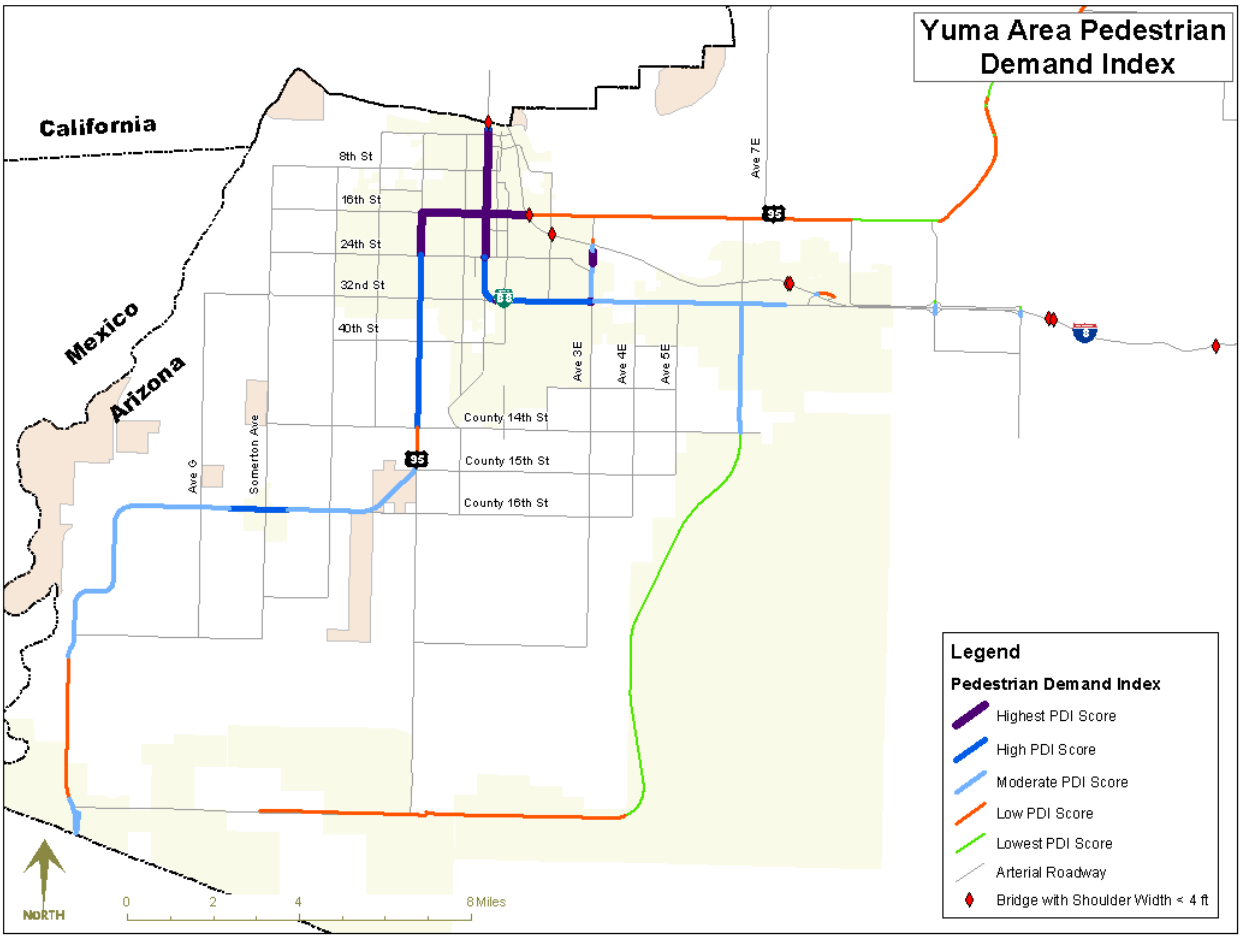
PEDESTRIAN DEMAND INDEX MAPS

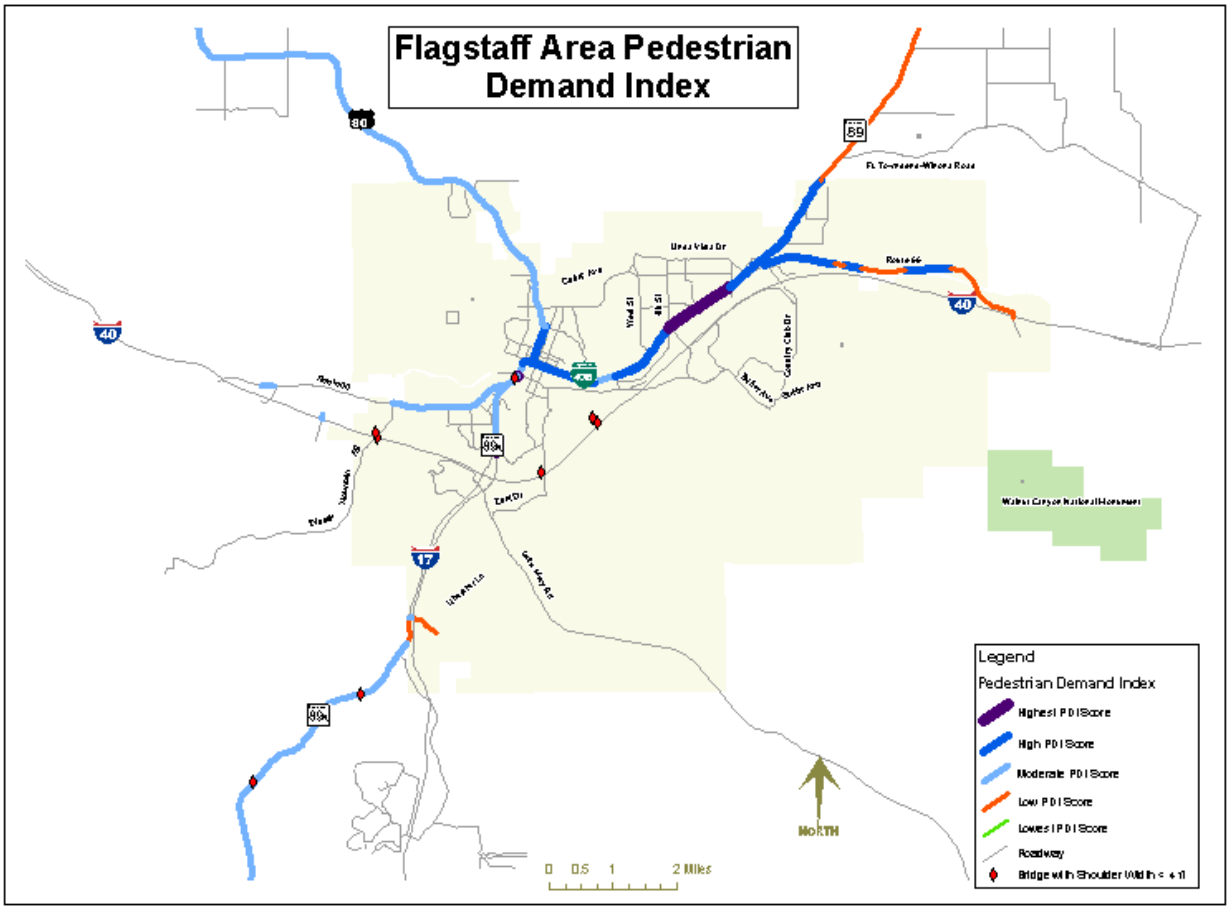

UTAH
NEVADA
NEW MEXICO
CALIFORNIA
MEXICO
NORTH
COCONINO
MOHAVE
NAVAJO
APACHE
YAVAPAI
LA PAZ
MARICOPA
YUMA
GILA
GRAHAM
GREENLEE
PINAL
PIMA
COCHISE
SANTA CRUZ
Legend
Pedestrian Demand Index
Highest PDI Score
High PDI Score
Moderate PDI Score
Low PDI Score
Lowest PDI Score
Bridge w/ Shoulder Width < 4 ft


Phoenix Area Pedestrian Demand Index
Legend
Pedestrian Demand Index
Highest PDI Score
High PDI Score
Moderate PDI Score
Low PDI Score
Lowest PDI Score
Roadway
Bridge with Shoulder Width < 4 ft
Cave Creek Rd
Happy Valley Rd
Pinnacle Peak Rd
Deer Valley Rd
Union Hills Rd
Bell Rd
Greenway Rd
Thunderbird Rd
Cactus Rd
Shea Blvd
Lincoln Dr
McDowell Rd
McKellips Rd
Broadway Rd
Southern Ave
Baseline Rd
Guadalupe Rd
Elliot Rd
Warner Rd
Ray Rd
Chandler Blvd
University Drive
NORTH
0 2 4 8 Miles


Tucson Area Pedestrian Demand Index
NORTH
0 2 4 8 Miles
Saguaro National Park
Saguaro National Park
Legend
Pedestrian Demand Index
Highest PDI Score
High PDI Score
Moderate PDI Score
Low PDI Score
Lowest PDI Score
Arterial Roadway
Bridge with Shoulder Width < 4 ft


Prescott Area Pedestrian Demand Index
Sedona
SEDONA
Jerome
Clarkdale
Chino Valley
Cottonwood
Prescott Valley
Prescott
Camp Verde
0
3.5
7
14 Miles
Legend
Pedestrian Demand Index
Highest PDI Score
High PDI Score
Moderate PDI Score
Low PDI Score
Lowest PDI Score
Roadway
Bridge with Shoulder Width < 4 ft


Yuma Area Pedestrian Demand Index
California
Mexico
Arizona
8th St
16th St
24th St
32nd St
40th St
Ave 7E
Ave 3E
Ave 4E
Ave 5E
County 14th St
County 15th St
County 16th St
Ave G
Somerton Ave
95
8
NORTH
0
2
4
8 Miles
Legend
Pedestrian Demand Index
Highest PDI Score
High PDI Score
Moderate PDI Score
Low PDI Score
Lowest PDI Score
Arterial Roadway
Bridge with Shoulder Width < 4 ft


Flagstaff Area Pedestrian Demand Index
Legend
Pedestrian Demand Index
Highest PDI Score
High PDI Score
Moderate PDI Score
Low PDI Score
Lowest PDI Score
Roadway
Bridge with Shoulder Width < 4 ft
NORTH
0 0.5 1 2 Miles

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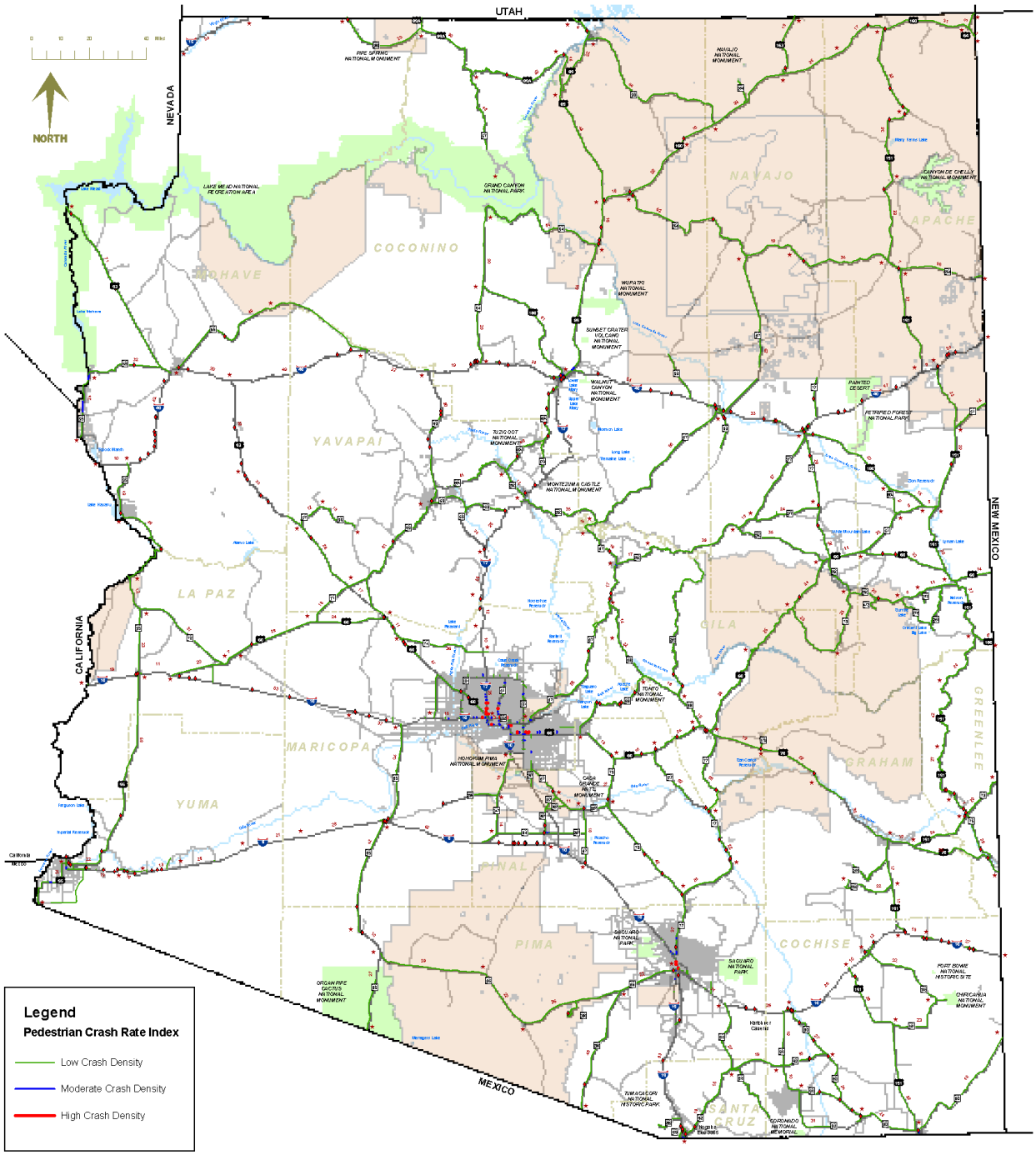
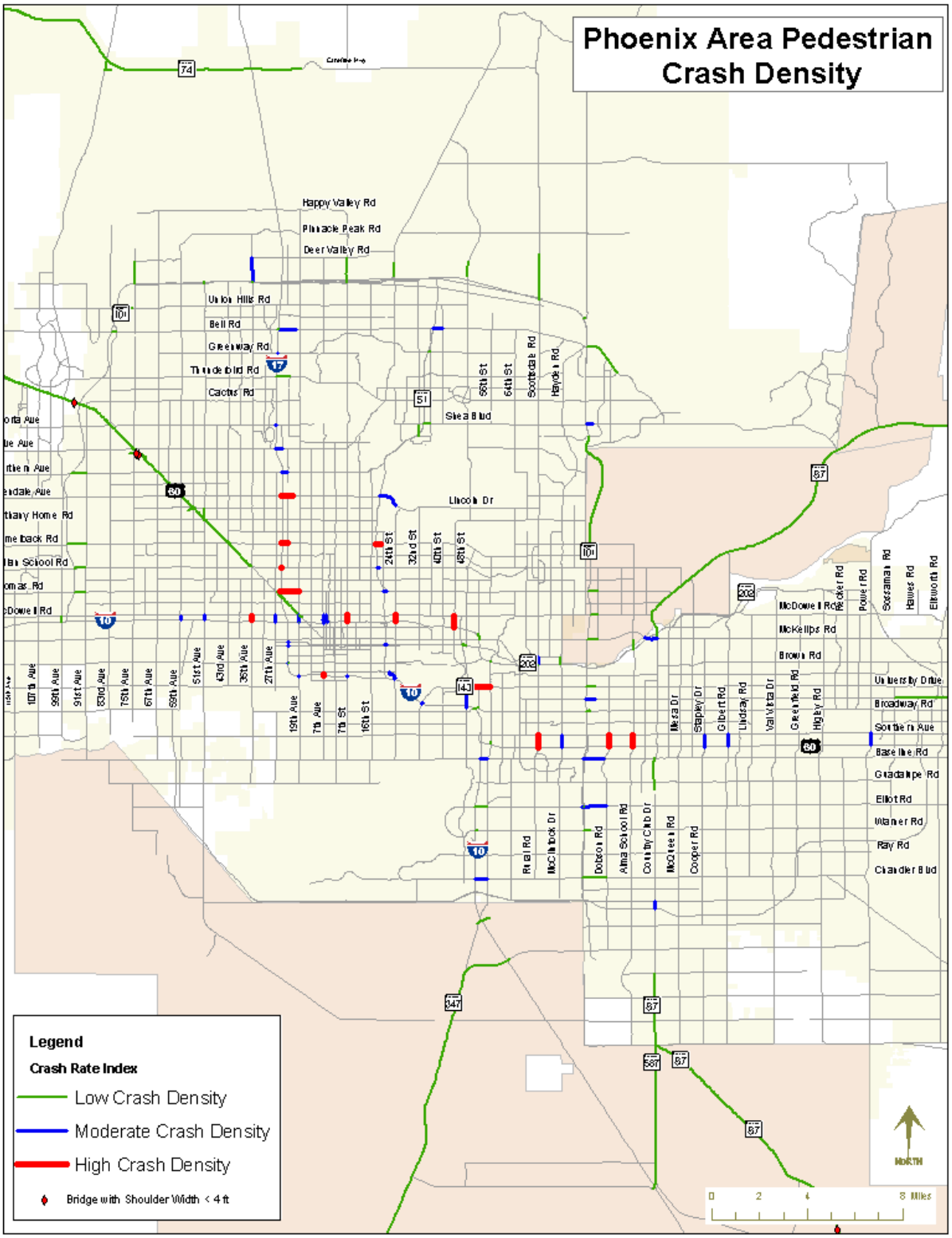
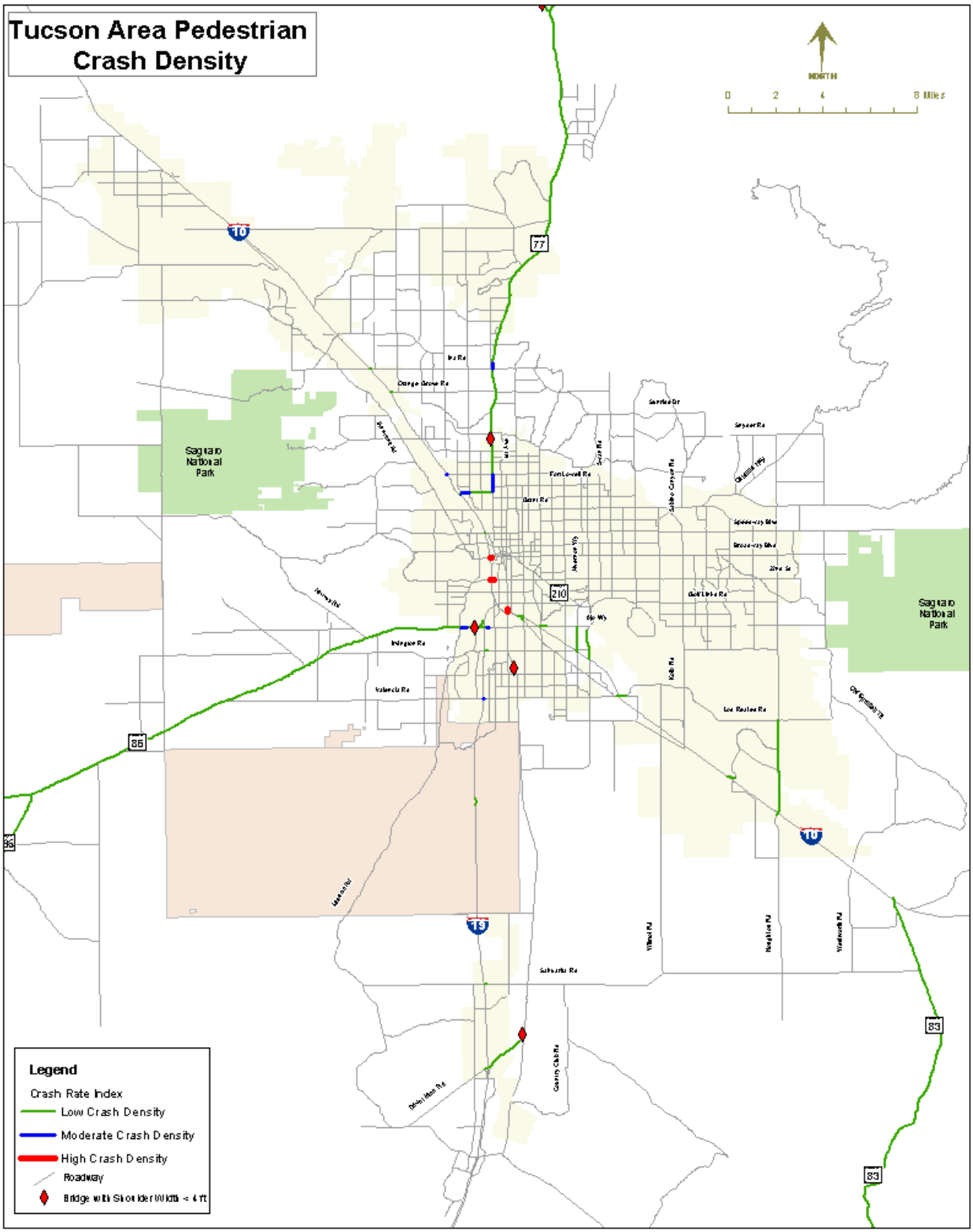
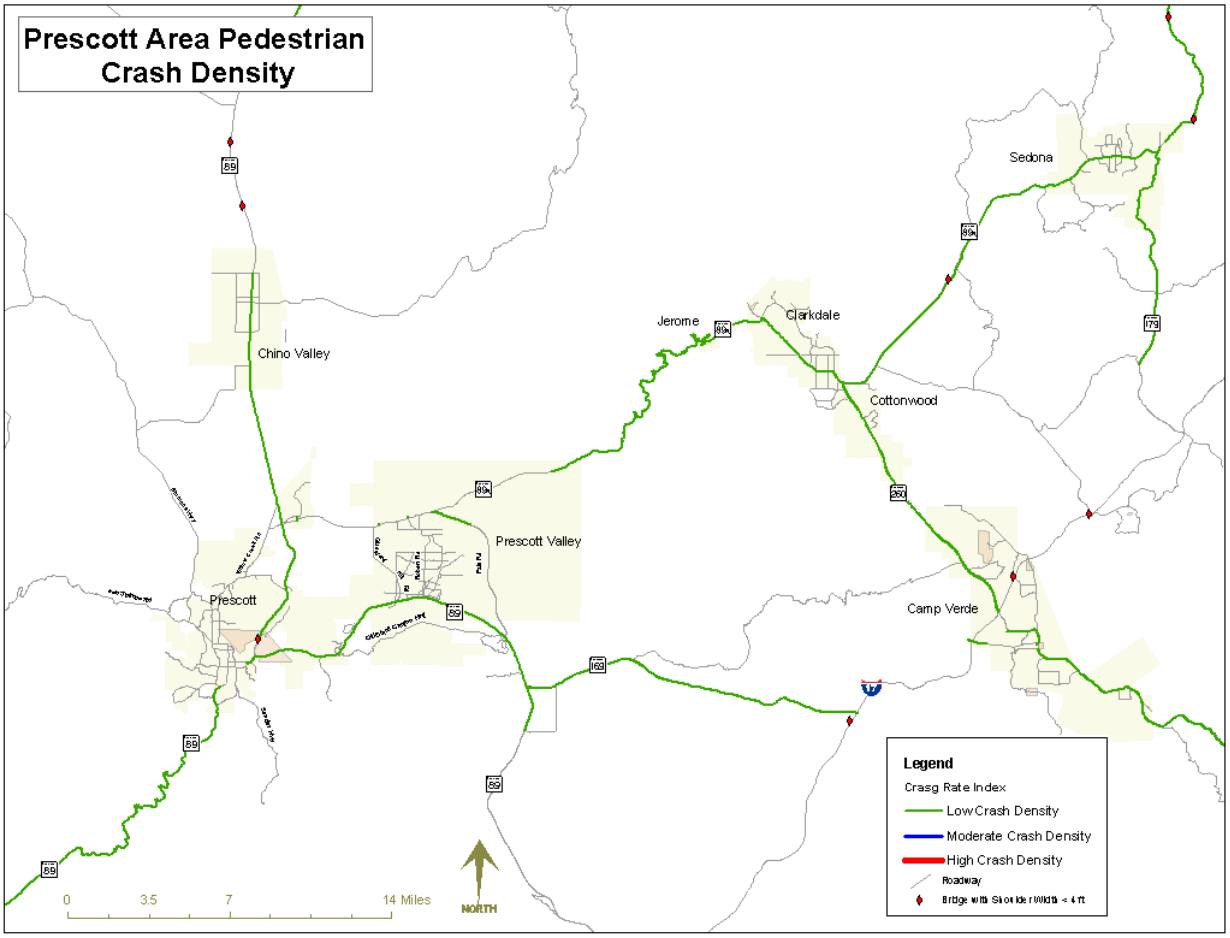
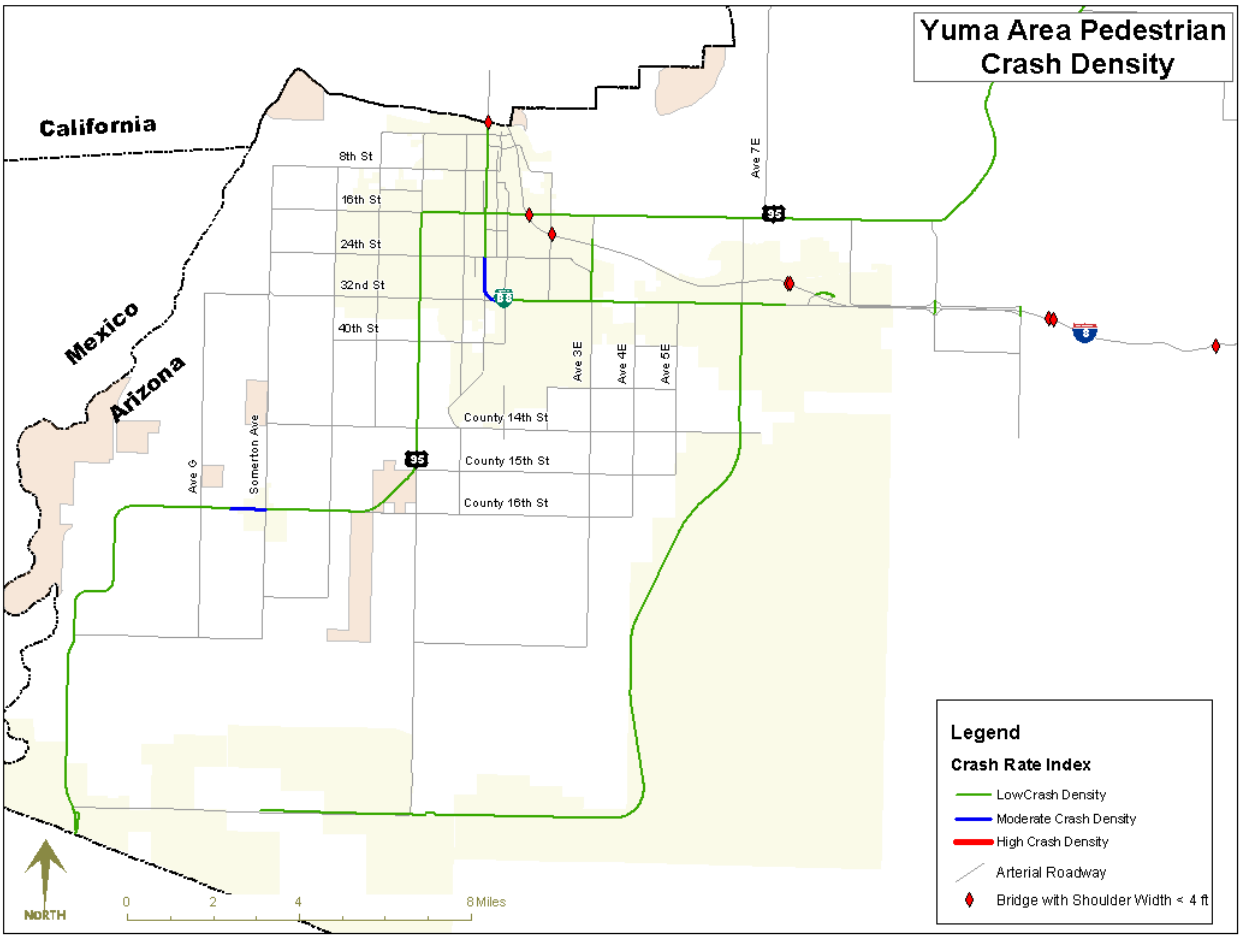
PEDESTRIAN CRASH RATE INDEX MAPS


UTAH
NEVADA
NEW MEXICO
CALIFORNIA
MEXICO
NORTH
COCONINO
MOHAVE
NAVAJO
APACHE
YAVAPAI
LA PAZ
MARICOPA
YUMA
GILA
GRAHAM
GREENLEE
PINAL
PIMA
COCHISE
SANTA CRUZ
Legend
Pedestrian Crash Rate Index
Low Crash Density
Moderate Crash Density
High Crash Density


Phoenix Area Pedestrian
Crash Density
Happy Valley Rd
Pinnacle Peak Rd
Deer Valley Rd
Union Hills Rd
Bell Rd
Greenway Rd
Thunderbird Rd
Cactus Rd
Shea Blvd
Lincoln Dr
McDowell Rd
McKellips Rd
Brown Rd
University Drive
Broadway Rd
Southern Ave
Baseline Rd
Guadalupe Rd
Elliot Rd
Warner Rd
Ray Rd
Chandler Blvd
Legend
Crash Rate Index
Low Crash Density
Moderate Crash Density
High Crash Density
Bridge with Shoulder Width < 4 ft
NORTH
0 2 4 8 Miles


Tucson Area Pedestrian
Crash Density
NORTH
0
2
4
8 Miles
Saguaro National Park
Saguaro National Park
10
77
210
86
19
83
Legend
Crash Rate Index
Low Crash Density
Moderate Crash Density
High Crash Density
Roadway
Bridge with Shoulder Width < 4 ft


Prescott Area Pedestrian Crash Density
Sedona
Jerome
Clarkdale
Chino Valley
Cottonwood
Prescott Valley
Prescott
Camp Verde
Legend
Crasg Rate Index
Low Crash Density
Moderate Crash Density
High Crash Density
Roadway
0
3.5
7
14 Miles
NORTH


Yuma Area Pedestrian
Crash Density
California
Mexico
Arizona
8th St
16th St
24th St
32nd St
40th St
Ave 3E
Ave 4E
Ave 5E
Ave 7E
Ave G
Somerton Ave
County 14th St
County 15th St
County 16th St
95
8
NORTH
0
2
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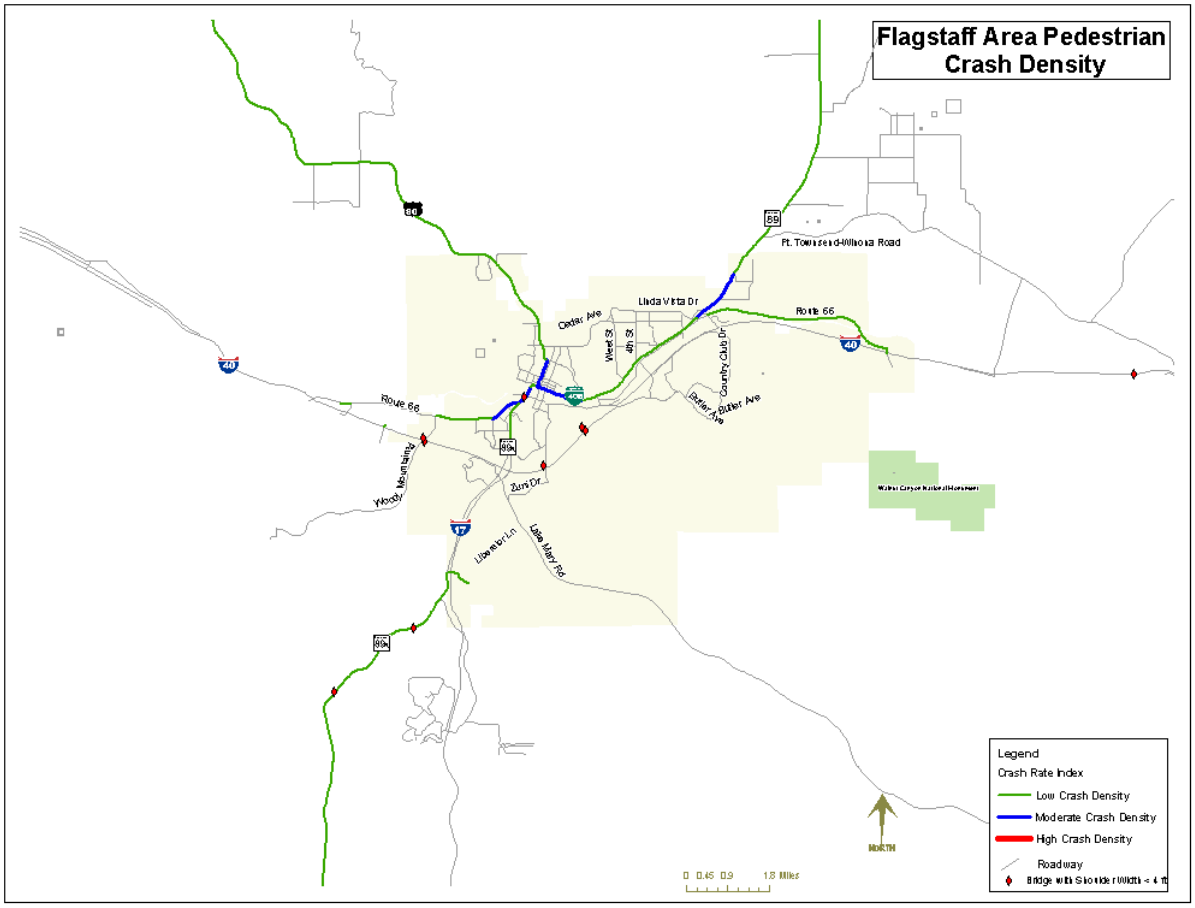
8 Miles
Legend
Crash Rate Index
LowCrash Density
Moderate Crash Density
High Crash Density
Arterial Roadway
Bridge with Shoulder Width < 4 ft


Flagstaff Area Pedestrian Crash Density
Ft. Townsend-Wilkinson Road
Linda Vista Dr
Route 66
Cedar Ave
West St
4th St
Country Club Dr
Butler Ave
Route 66
Woody Mountain
Zuni Dr
Lake Mary Rd
Legend
Crash Rate Index
Low Crash Density
Moderate Crash Density
High Crash Density
Roadway
NORTH
0 0.45 0.9 1.8 Miles