Using Geographic Information Systems to Plan Pedestrian Safety Programs in a Large Metropolitan Area

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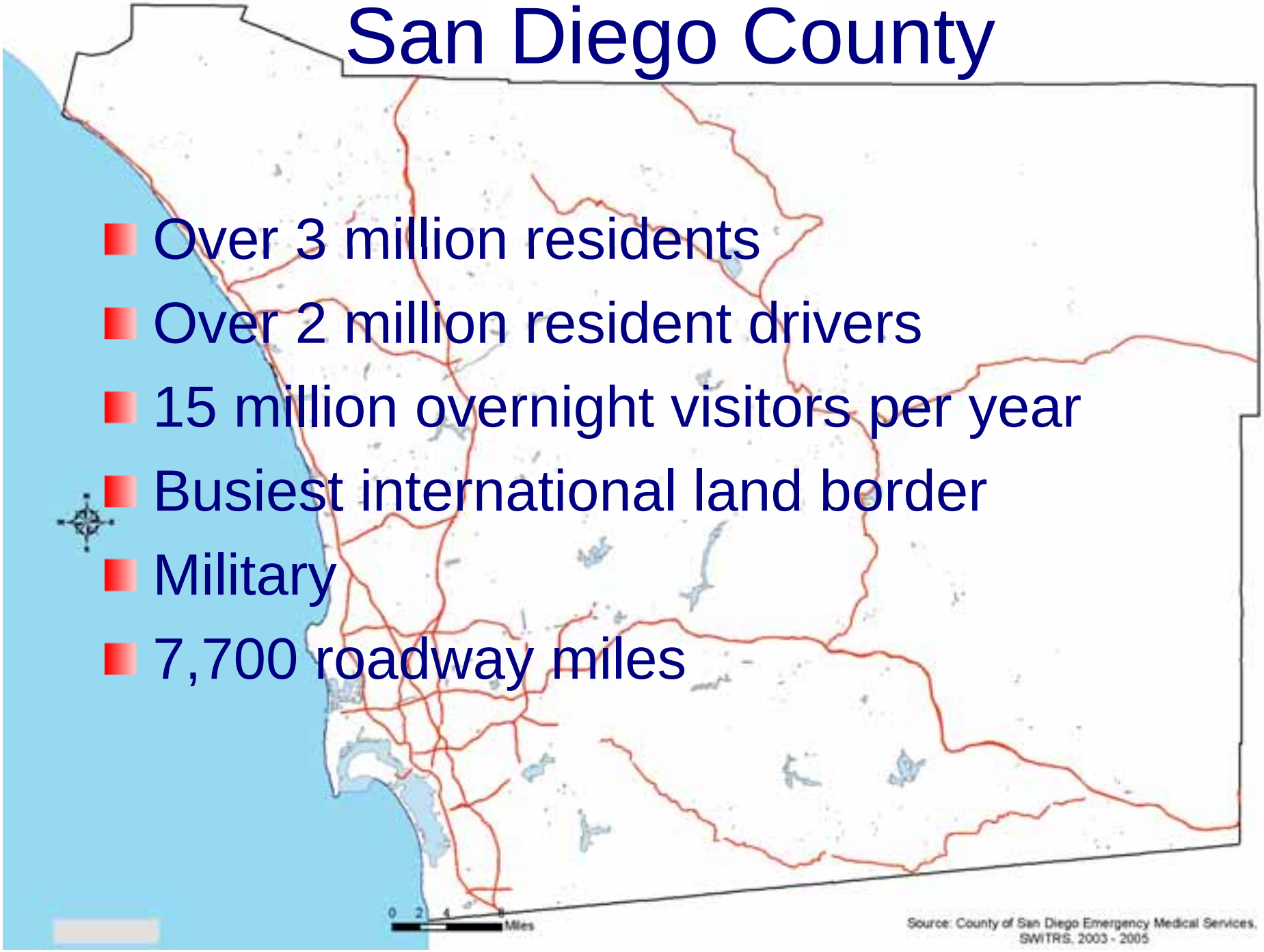
Presented to the ESRI GIS in Public Health Conference
October 9, 2007

San Diego County

- Over 3 million residents
- Over 2 million resident drivers
- 15 million overnight visitors per year
- Busiest international land border
- Military
- 7,700 roadway miles



Motor Vehicle Crashes, Injuries, and Deaths (2005)

- 16,136 crashes
  - 23,503 Injuries
  - 308 deaths from MV crashes (1.3%)
- 1025 Pedestrian crashes
  - 1,165 Injuries
  - 62 deaths (5.3%)

Pedestrians made up 20% of traffic-related deaths

Health Care Burden: Pedestrian Injuries: 2005

- 522 Ambulance transports
- 916 Emergency Dept. patients
- 359 Hospital Discharges
- 246 Major Trauma Patients

Pedestrian Crash Characteristics: San Diego County

- Drinking pedestrians: 13%
- Hit & run: 16%
- Pedestrian at fault: 38%
- 0 to 14 Years: 19%
- Noon – 6 P.M.: 38%

SWITRS

- StateWide Integrated Traffic Records System
- Police reports
- Maintained by California Highway Patrol
- All injury crashes in California
  - San Diego county crashes
- Incidents geocoded locally

SWITRS Geocoding

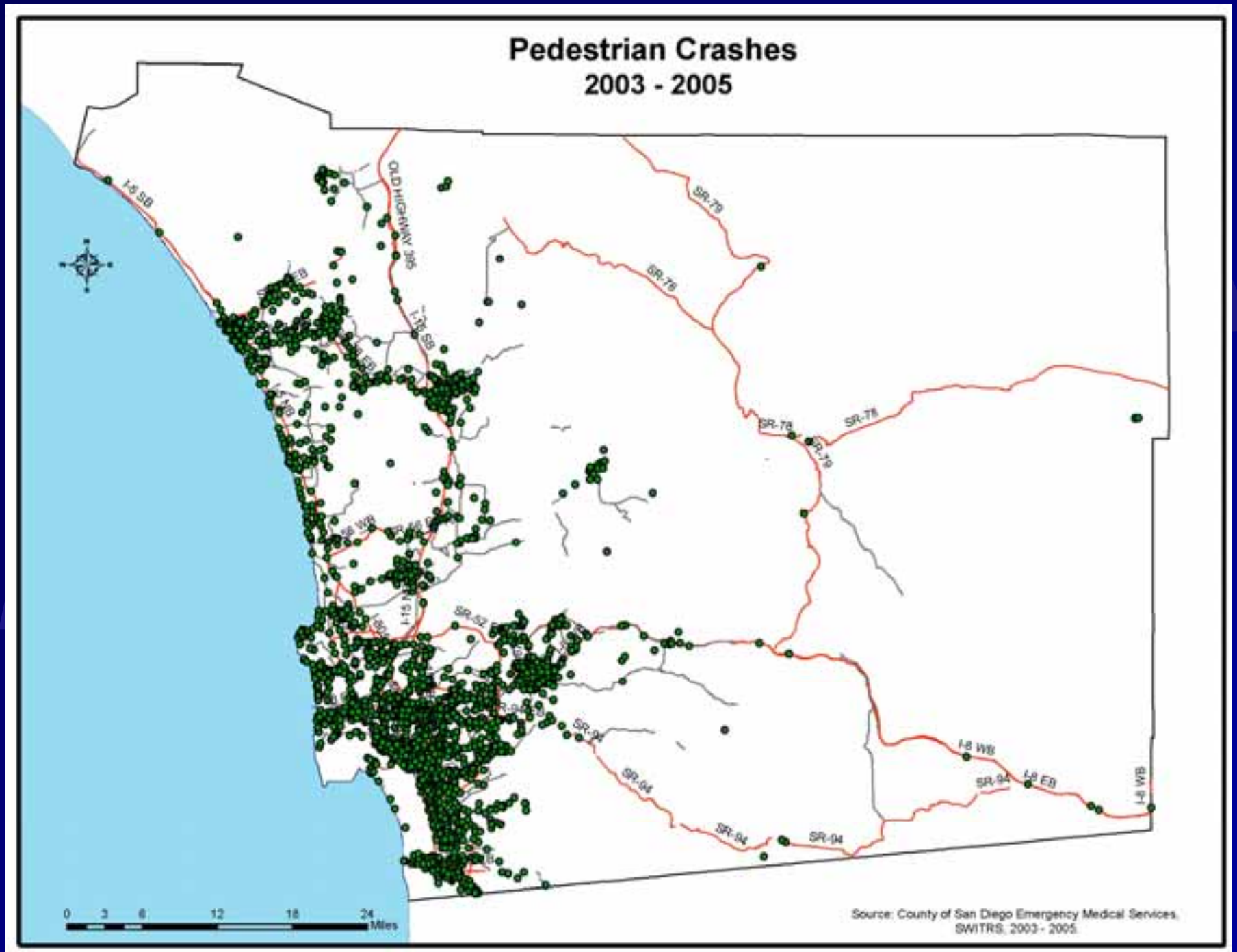
- Custom Program
  - Based on roads, distance & direction from intersection
- ~75% automatic
- 25% manual
  - Misspellings
  - Street aliases
  - Direction errors
  - Other

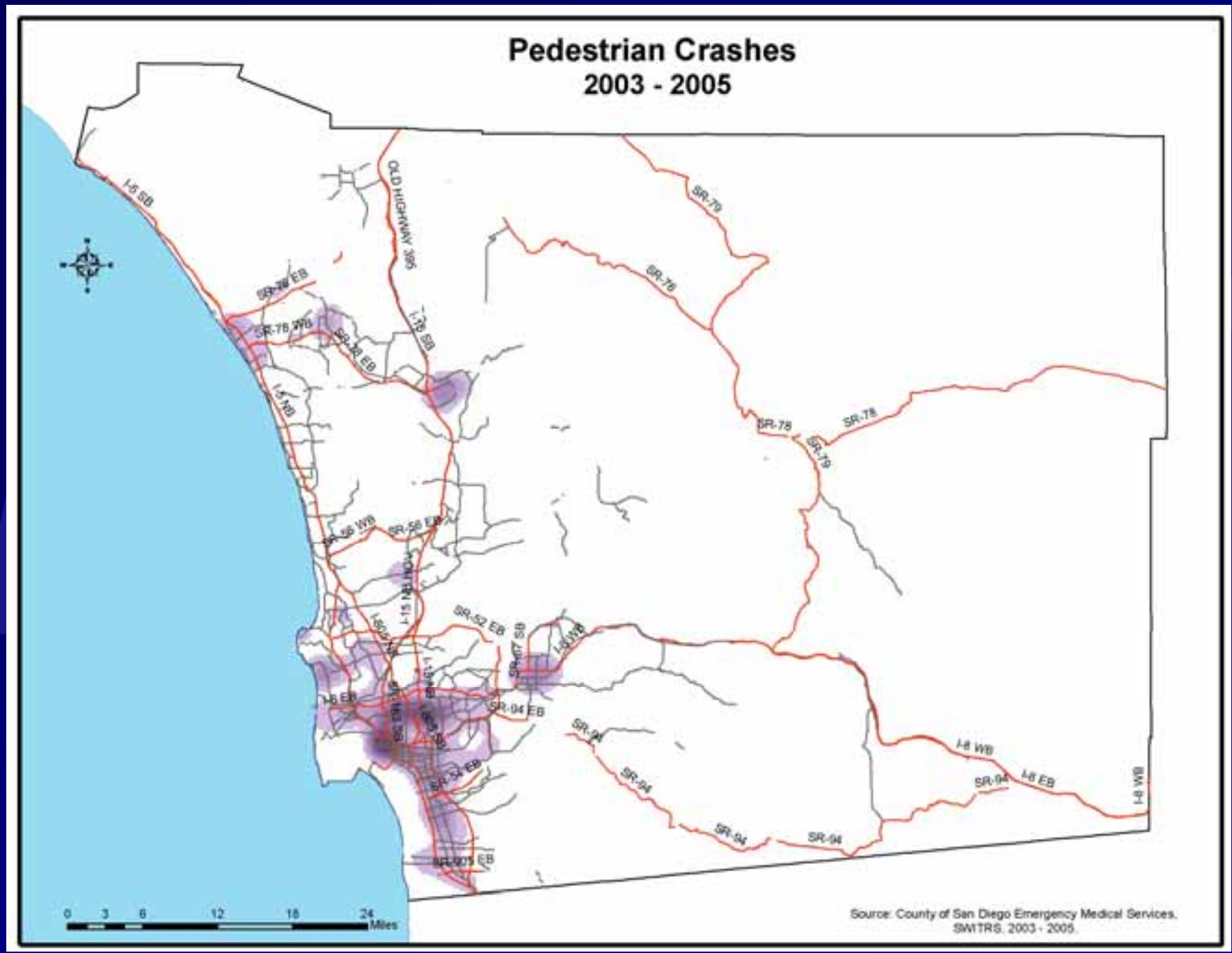
Objectives

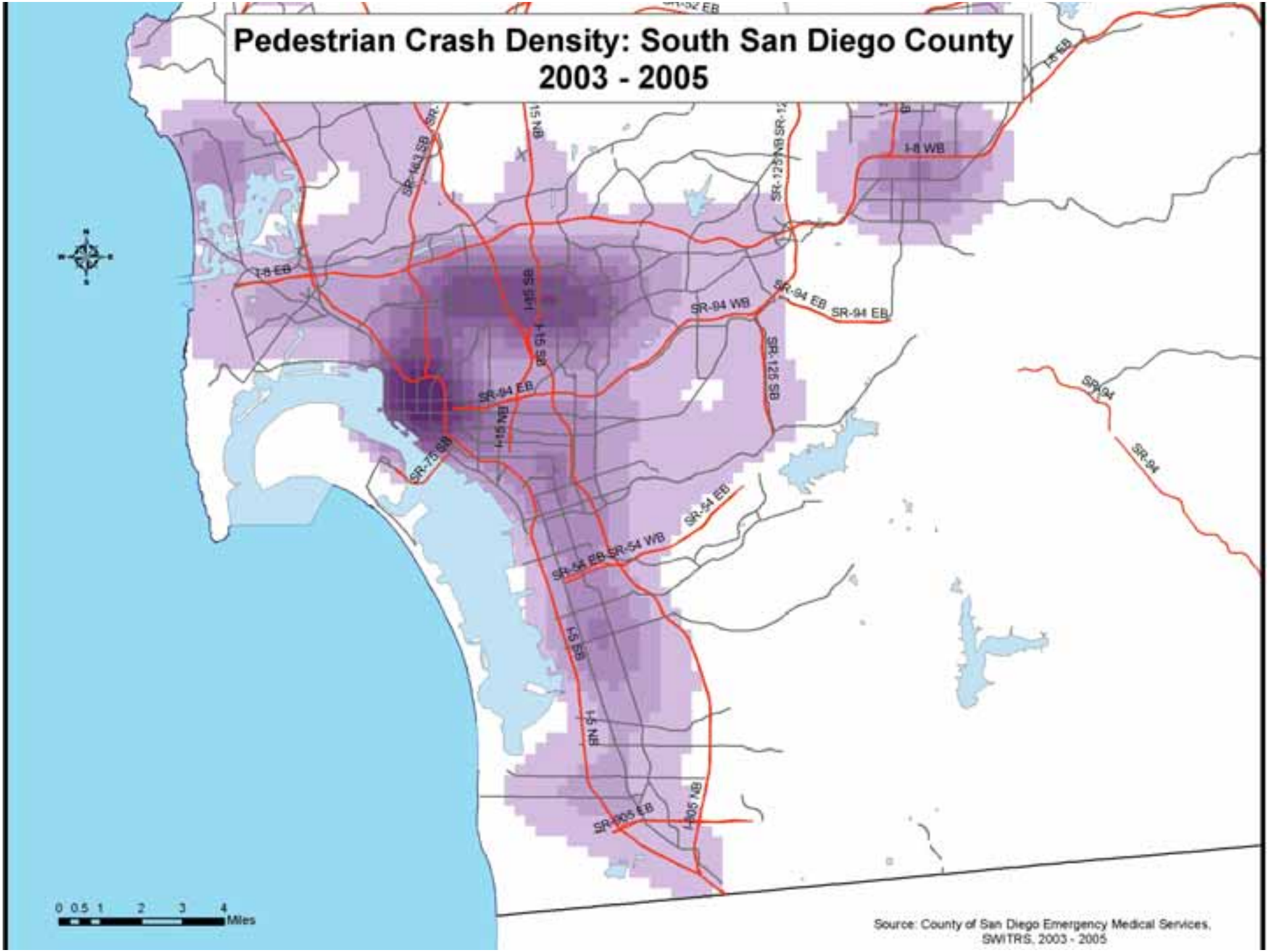
- Identify areas with high pedestrian crashes
- Determine risk factors for those areas

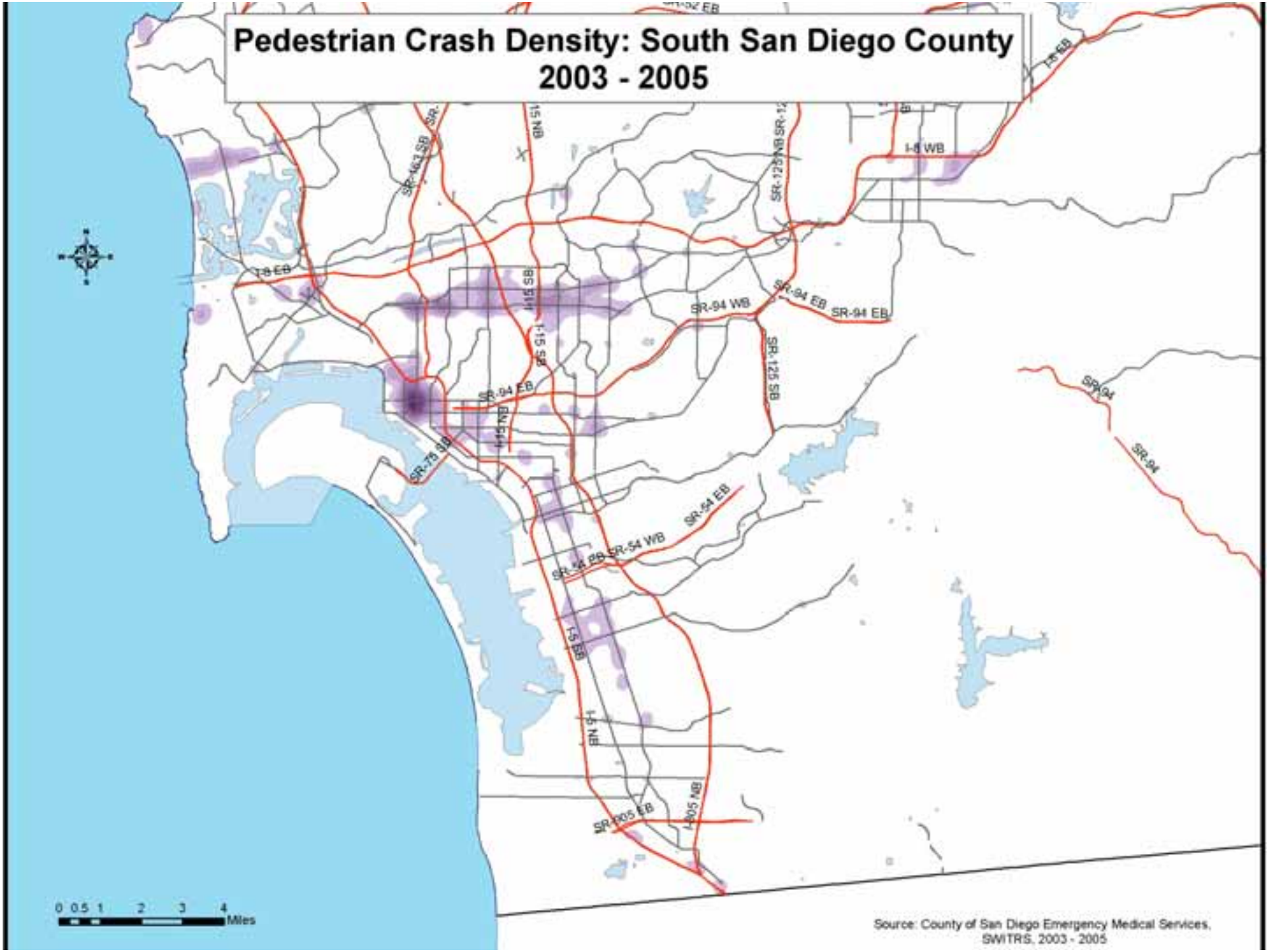
Methods

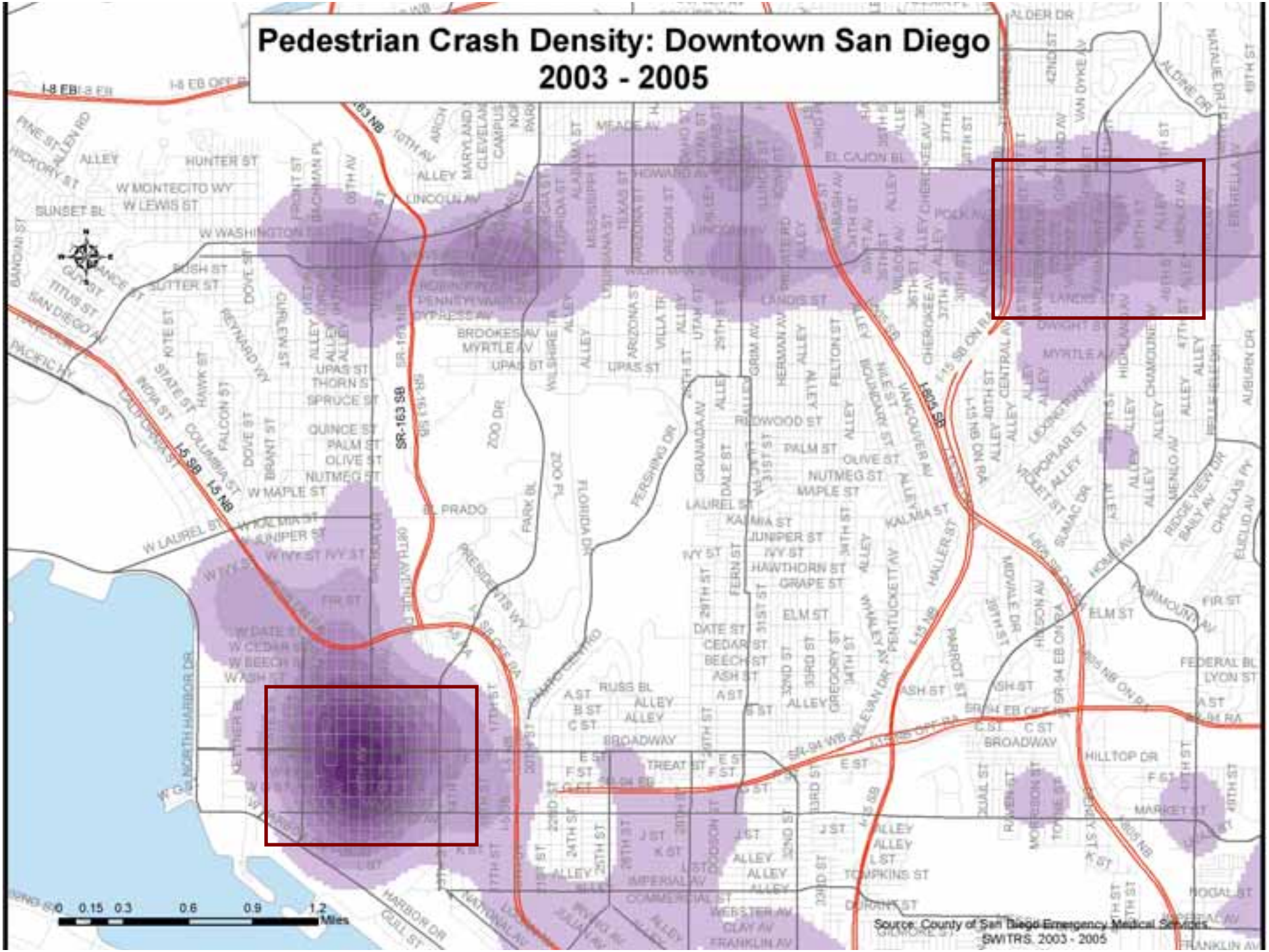
- Density function at county level
- Examine clusters by crash, victim, and environmental factors

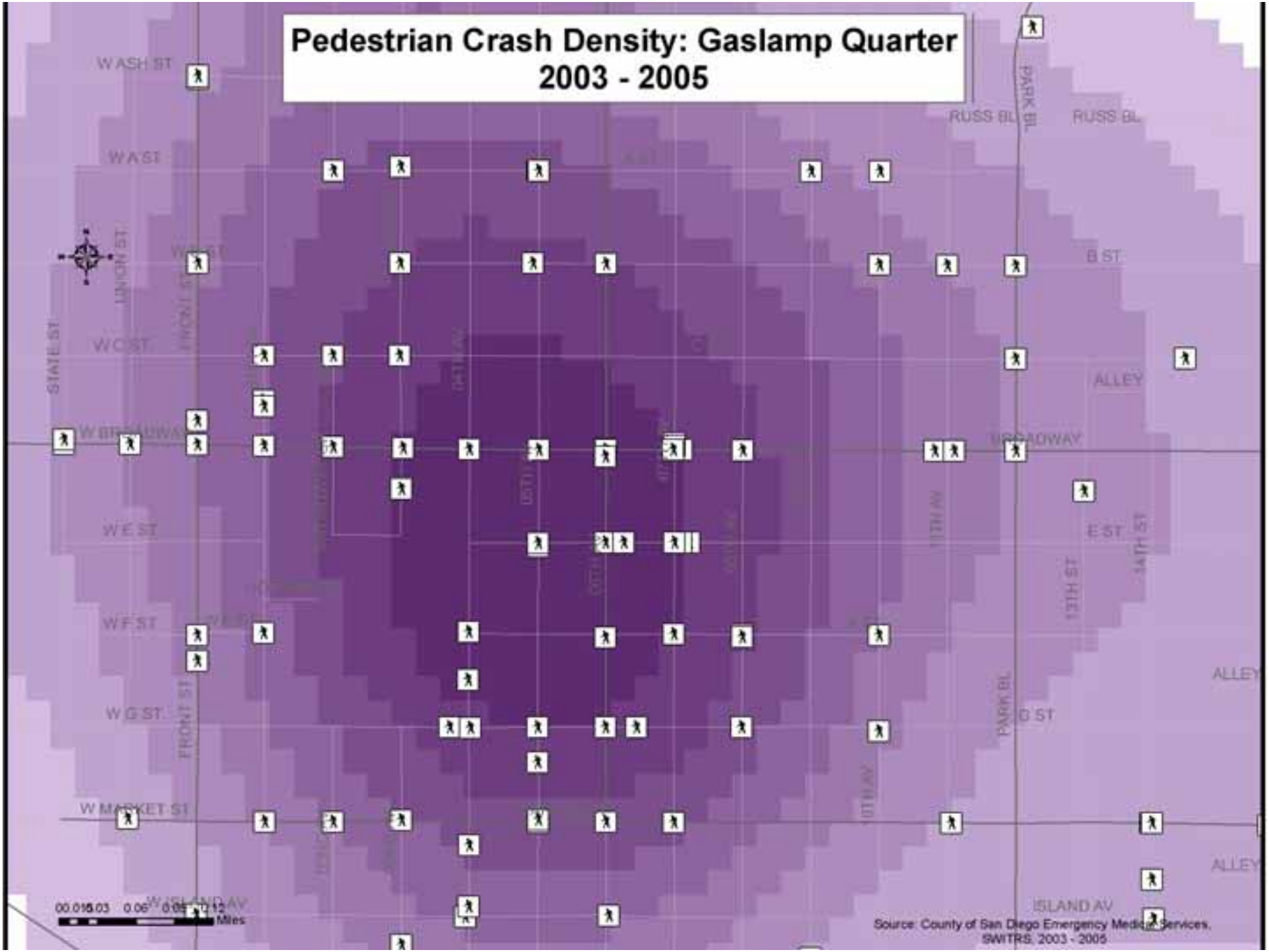

Pedestrian Crashes
2003 - 2005
I-5 SB
OLD HIGHWAY 395
I-15 SB
SR-79
SR-76
SR-76
SR-76
SR-79
I-15 NB
SR-52
SR-94
SR-94
SR-94
SR-94
I-8 WB
SR-94
I-8 EB
I-8 WB
0 3 6 12 18 24
Miles
Source: County of San Diego Emergency Medical Services,
SWITRS, 2003 - 2005.

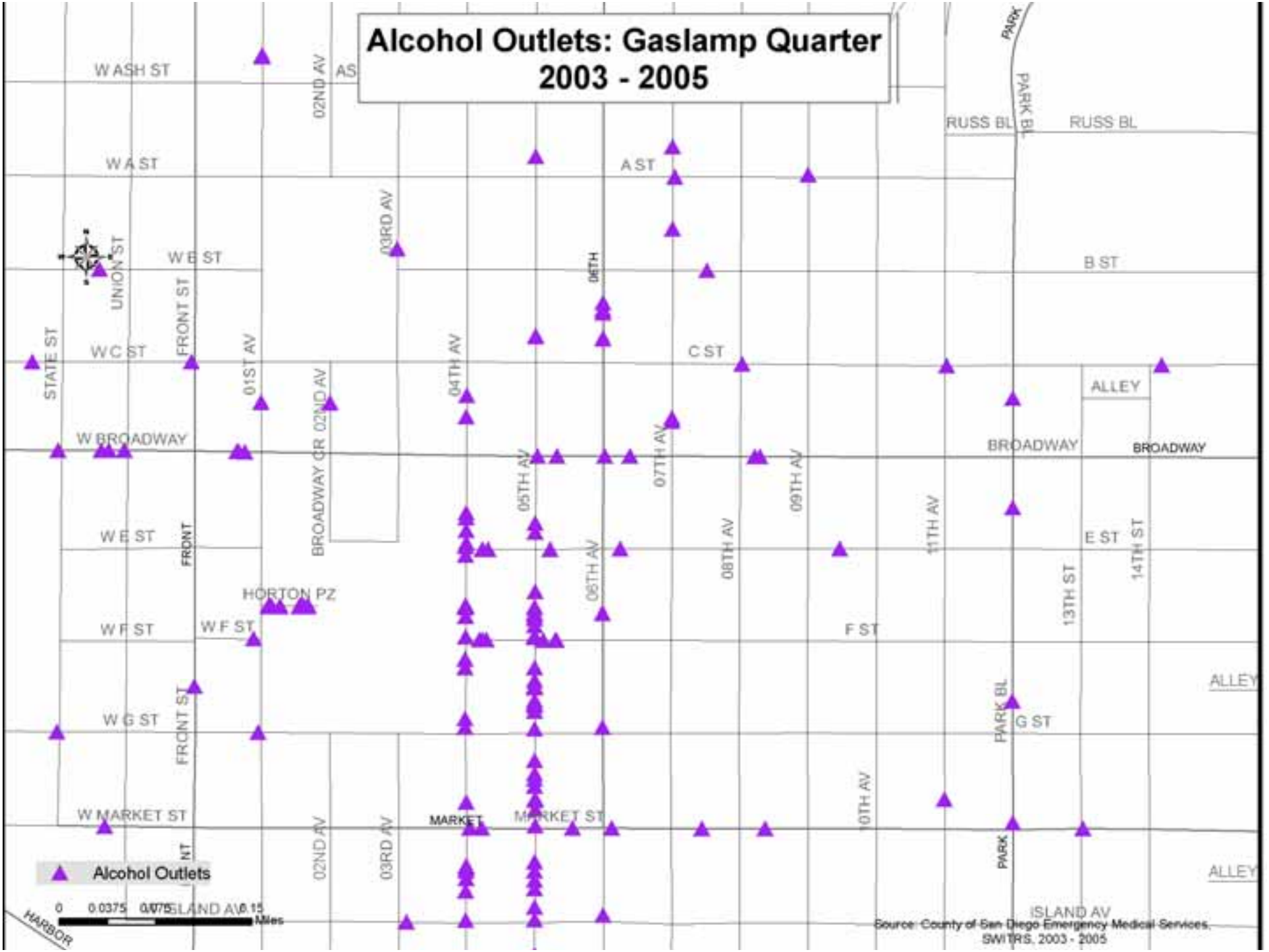

Pedestrian Crashes
2003 - 2005
I-5 SB
OLD HIGHWAY 395
I-15 SB
SR-78
SR-79
SR-78 EB
SR-78 WB
SR-56 EB
I-5 NB
SR-56 WB
I-15 NB HOV
SR-52 EB
SR-67 SB
I-8 WB
I-8 EB
SR-94 EB
SR-94
SR-54 EB
SR-905 EB
0 3 6 12 18 24 Miles
Source: County of San Diego Emergency Medical Services, SWITRS, 2003 - 2005.

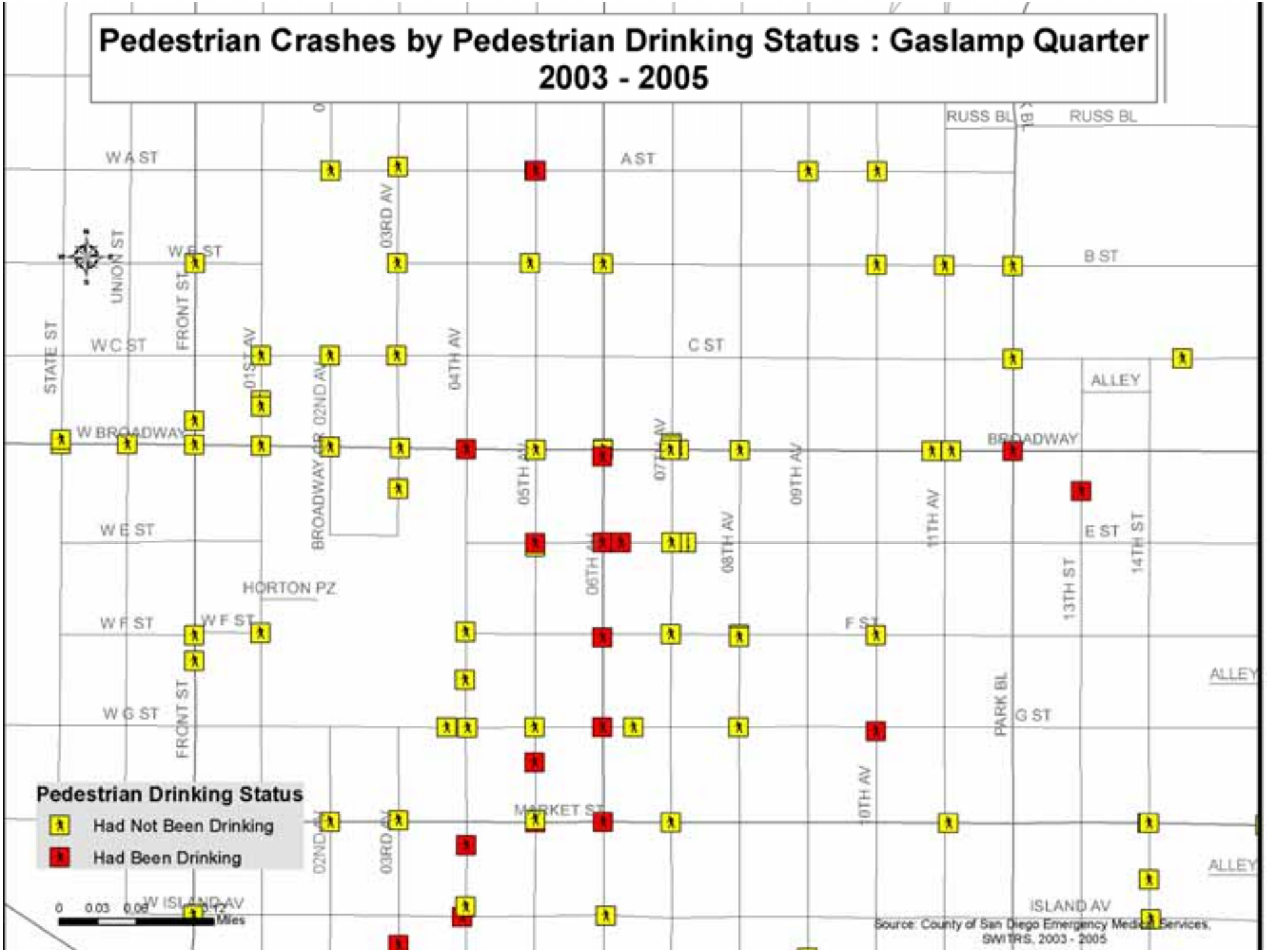

Pedestrian Crash Density: South San Diego County
2003 - 2005
I-8 EB
I-8 WB
SR-94 WB
SR-94 EB
SR-94 EB
SR-94 EB
SR-94
SR-94
SR-94
SR-54 EB
SR-54 EB
SR-54 WB
I-5 SB
I-5 NB
I-15 SB
I-15 NB
SR-75 SB
SR-125 SB
SR-125 NB
SR-163 SB
SR-905 EB
I-805 NB
0 0.5 1 2 3 4
Miles
Source: County of San Diego Emergency Medical Services,
SWITRS, 2003 - 2005


Pedestrian Crash Density: South San Diego County
2003 - 2005
I-8 EB
I-8 WB
SR-163 SB
I-15 NB
I-15 SB
SR-94 WB
SR-94 EB
SR-94 EB
SR-125 SB
SR-94
SR-94
SR-75 SB
SR-54 EB
SR-54 EB SR-54 WB
I-5 SB
I-5 NB
SR-905 EB
I-805 NB
0 0.5 1 2 3 4
Miles
Source: County of San Diego Emergency Medical Services,
SWITRS, 2003 - 2005

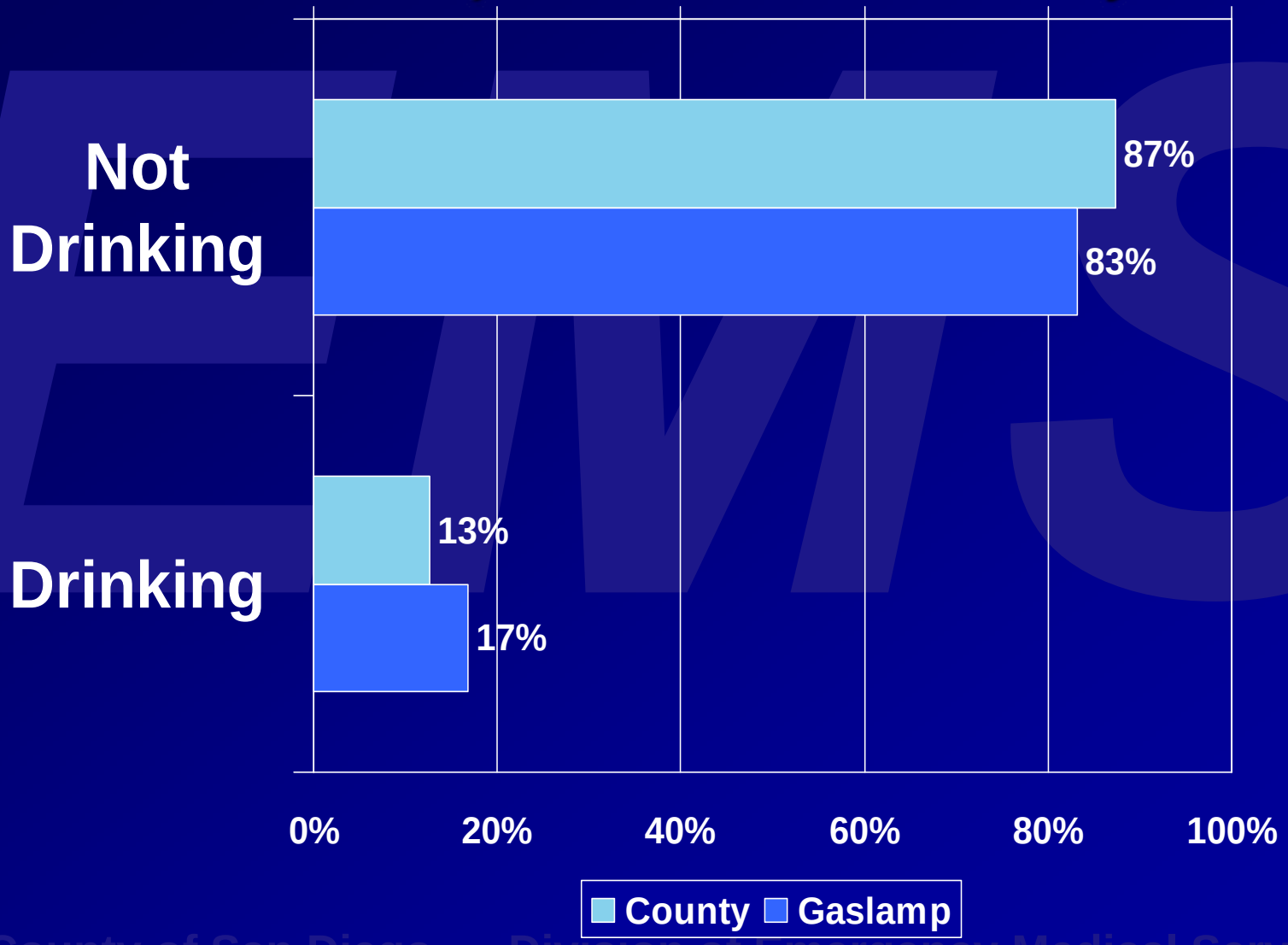

Pedestrian Crash Density: Downtown San Diego
2003 - 2005
0 0.15 0.3 0.6 0.9 1.2
Miles
Source: County of San Diego Emergency Medical Services
SWITRS, 2003 - 2005

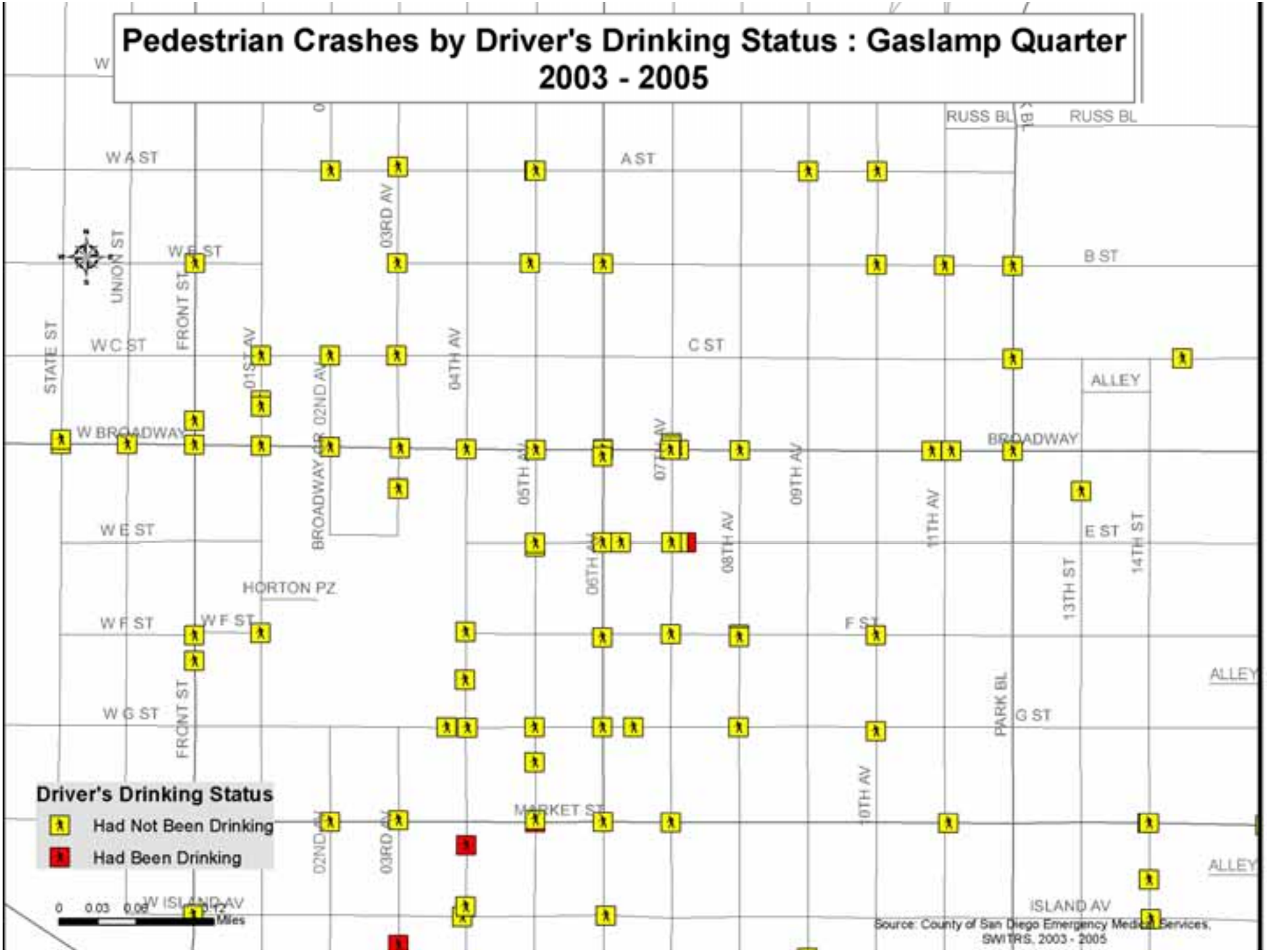

Pedestrian Crash Density: Gaslamp Quarter
2003 - 2005
WASH ST
W A ST
W COST
W E ST
W F ST
W G ST
W MARKET ST
W ISLAND AV
STATE ST
UNION ST
FRONT ST
PARK BL
RUSS BL
B ST
ALLEY
BROADWAY
E ST
ISLAND AV
Miles
Source: County of San Diego Emergency Medical Services,
SWITRS, 2003 - 2005


Alcohol Outlets: Gaslamp Quarter
2003 - 2005
W ASH ST
W A ST
W B ST
W C ST
W BROADWAY
W E ST
W F ST
W G ST
W MARKET ST
A ST
B ST
C ST
E ST
F ST
G ST
RUSS BL
RUSS BL
PARK BL
PARK BL
ALLEY
ALLEY
ALLEY
BROADWAY
BROADWAY
ISLAND AV
ISLAND AV
HORTON PZ
MARKET
MARKET ST
STATE ST
UNION ST
FRONT ST
FRONT ST
FRONT ST
FRONT
01ST AV
02ND AV
02ND AV
02ND AV
BROADWAY CR
03RD AV
03RD AV
03RD AV
04TH AV
05TH AV
06TH AV
06TH
07TH AV
08TH AV
09TH AV
10TH AV
11TH AV
13TH ST
14TH ST
Alcohol Outlets
0 0.0375 0.075 0.15
Miles
HARBOR
Source: County of San Diego Emergency Medical Services,
SWITRS, 2003 - 2005

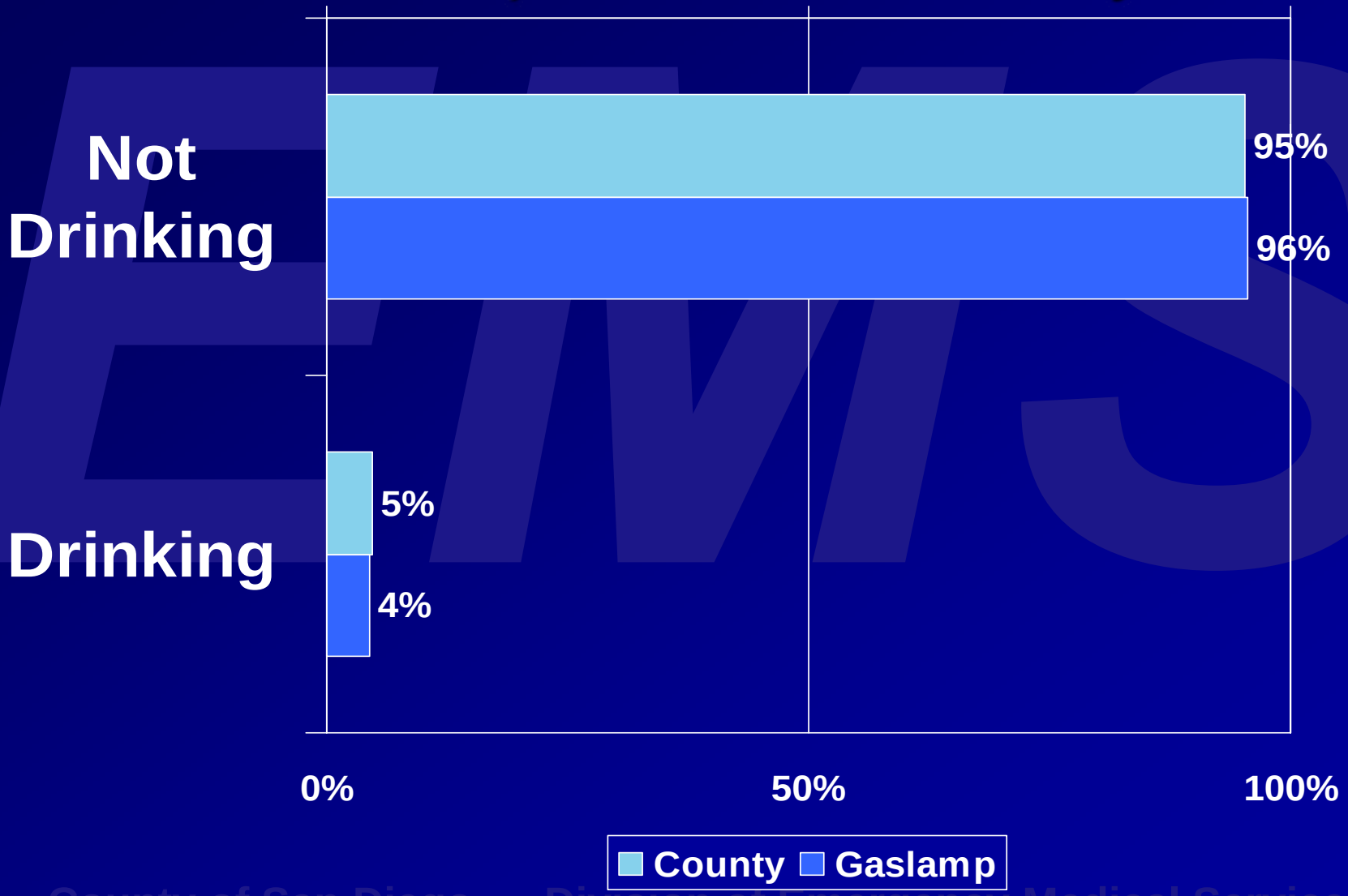

Pedestrian Crashes by Pedestrian Drinking Status : Gaslamp Quarter
2003 - 2005
W A ST
A ST
RUSS BL
RUSS BL
W B ST
B ST
W C ST
C ST
ALLEY
W BROADWAY
BROADWAY
W E ST
E ST
HORTON PZ
W F ST
F ST
W G ST
G ST
ALLEY
ALLEY
ISLAND AV
W ISLAND AV
MARKET ST
UNION ST
STATE ST
FRONT ST
01ST AV
02ND AV
03RD AV
04TH AV
05TH AV
06TH AV
07TH AV
08TH AV
09TH AV
10TH AV
11TH AV
13TH ST
14TH ST
PARK BL
BROADWAY CIR
Pedestrian Drinking Status
Had Not Been Drinking
Had Been Drinking
0 0.03 0.06 0.12 Miles
Source: County of San Diego Emergency Medical Services, SWITRS, 2003 - 2005

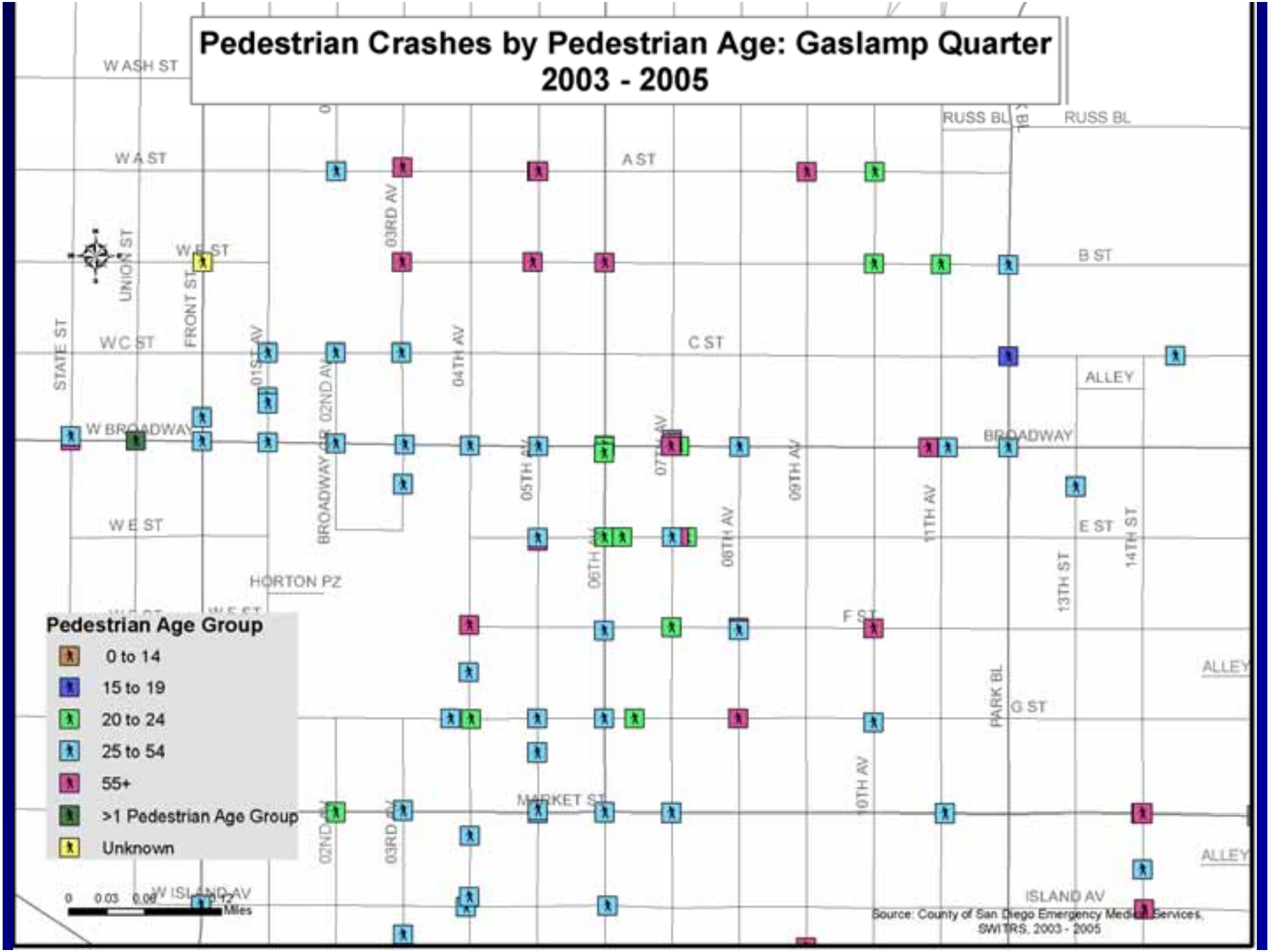
Pedestrian Drinking Status: Gaslamp Quarter vs. County



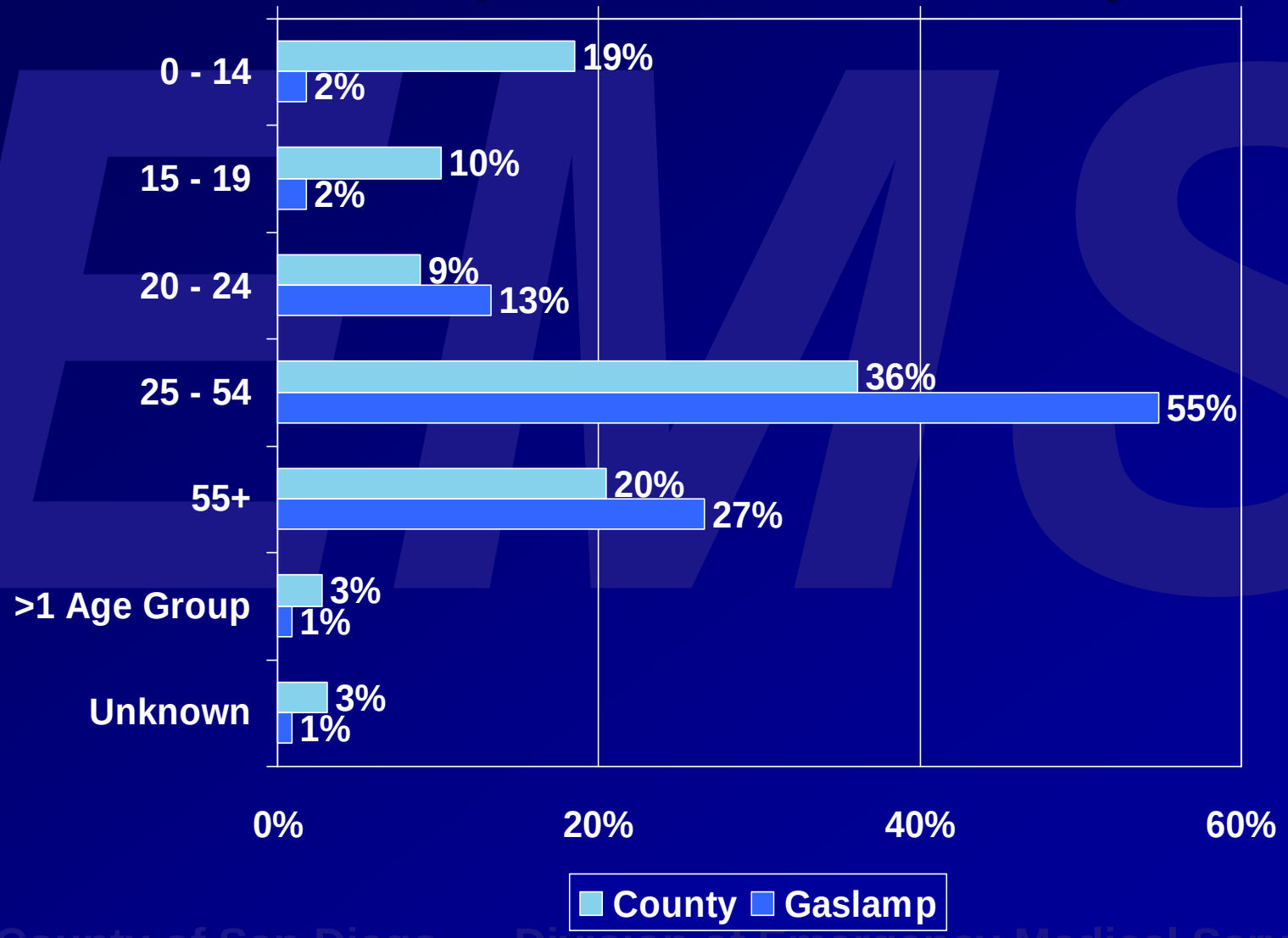

Pedestrian Crashes by Driver's Drinking Status : Gaslamp Quarter
2003 - 2005
W A ST
A ST
RUSS BL
W B ST
B ST
W C ST
C ST
ALLEY
W BROADWAY
BROADWAY
W E ST
E ST
HORTON PZ
W F ST
F ST
W G ST
G ST
MARKET ST
ISLAND AV
UNION ST
FRONT ST
STATE ST
01ST AV
02ND AV
03RD AV
04TH AV
05TH AV
06TH AV
07TH AV
08TH AV
09TH AV
10TH AV
11TH AV
13TH ST
14TH ST
PARK BL
BROADWAY CIR
Driver's Drinking Status
Had Not Been Drinking
Had Been Drinking
0 0.03 0.06 0.12 Miles
Source: County of San Diego Emergency Medical Services, SWITRS, 2003 - 2005

Driver's Drinking Status: Gaslamp Quarter vs. County

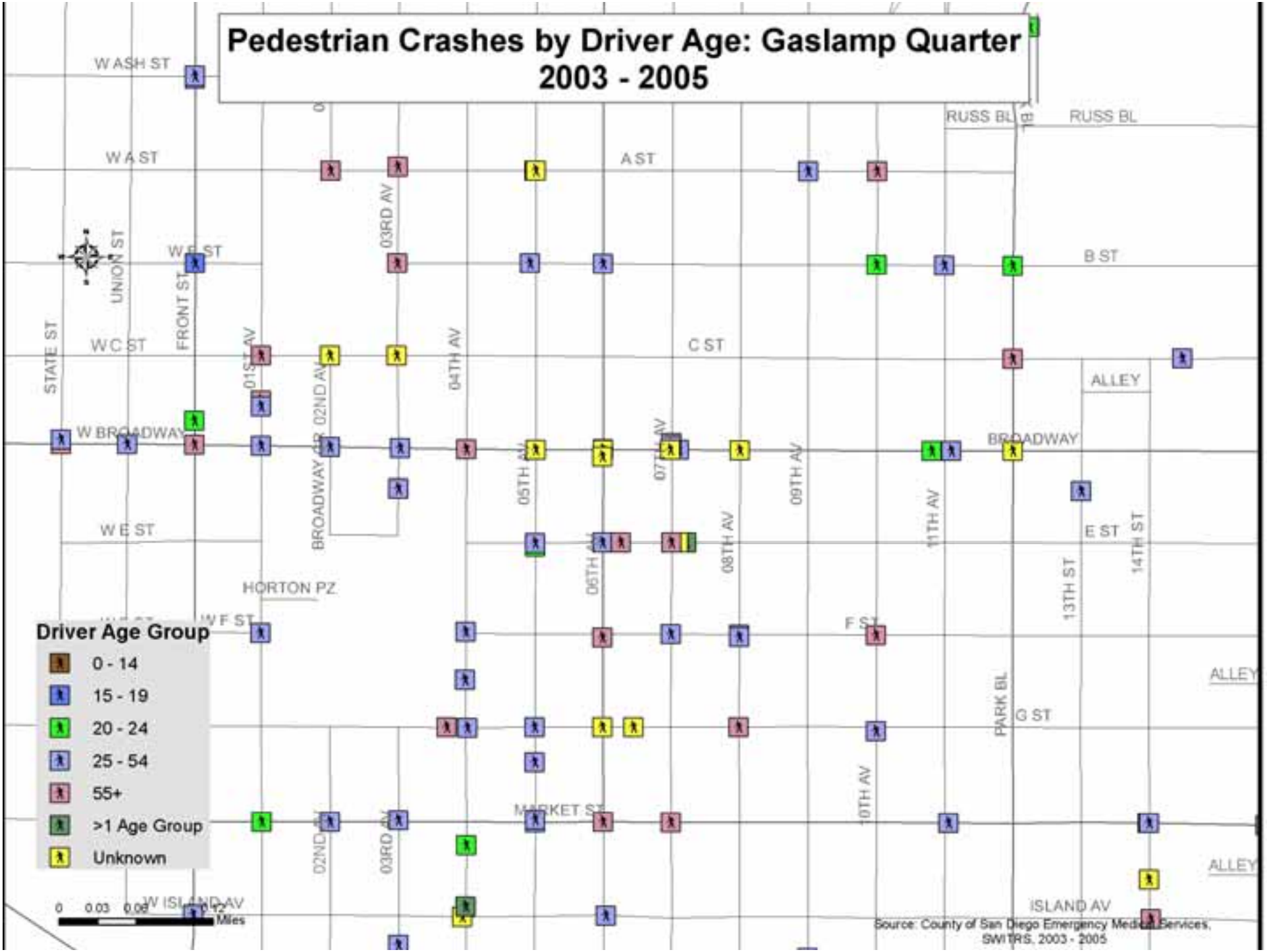



Pedestrian Crashes by Pedestrian Age: Gaslamp Quarter
2003 - 2005
W ASH ST
W A ST
A ST
RUSS BL
B ST
W B ST
W C ST
C ST
ALLEY
W BROADWAY
BROADWAY
W E ST
E ST
HORTON PZ
F ST
G ST
MARKET ST
W ISLAND AV
ISLAND AV
STATE ST
UNION ST
FRONT ST
01ST AV
02ND AV
03RD AV
04TH AV
05TH AV
06TH AV
07TH AV
09TH AV
10TH AV
11TH AV
13TH ST
14TH ST
PARK BL
Pedestrian Age Group
0 to 14
15 to 19
20 to 24
25 to 54
55+
>1 Pedestrian Age Group
Unknown
0 0.03 0.06 0.12
Miles
Source: County of San Diego Emergency Medical Services,
SWITRS, 2003 - 2005

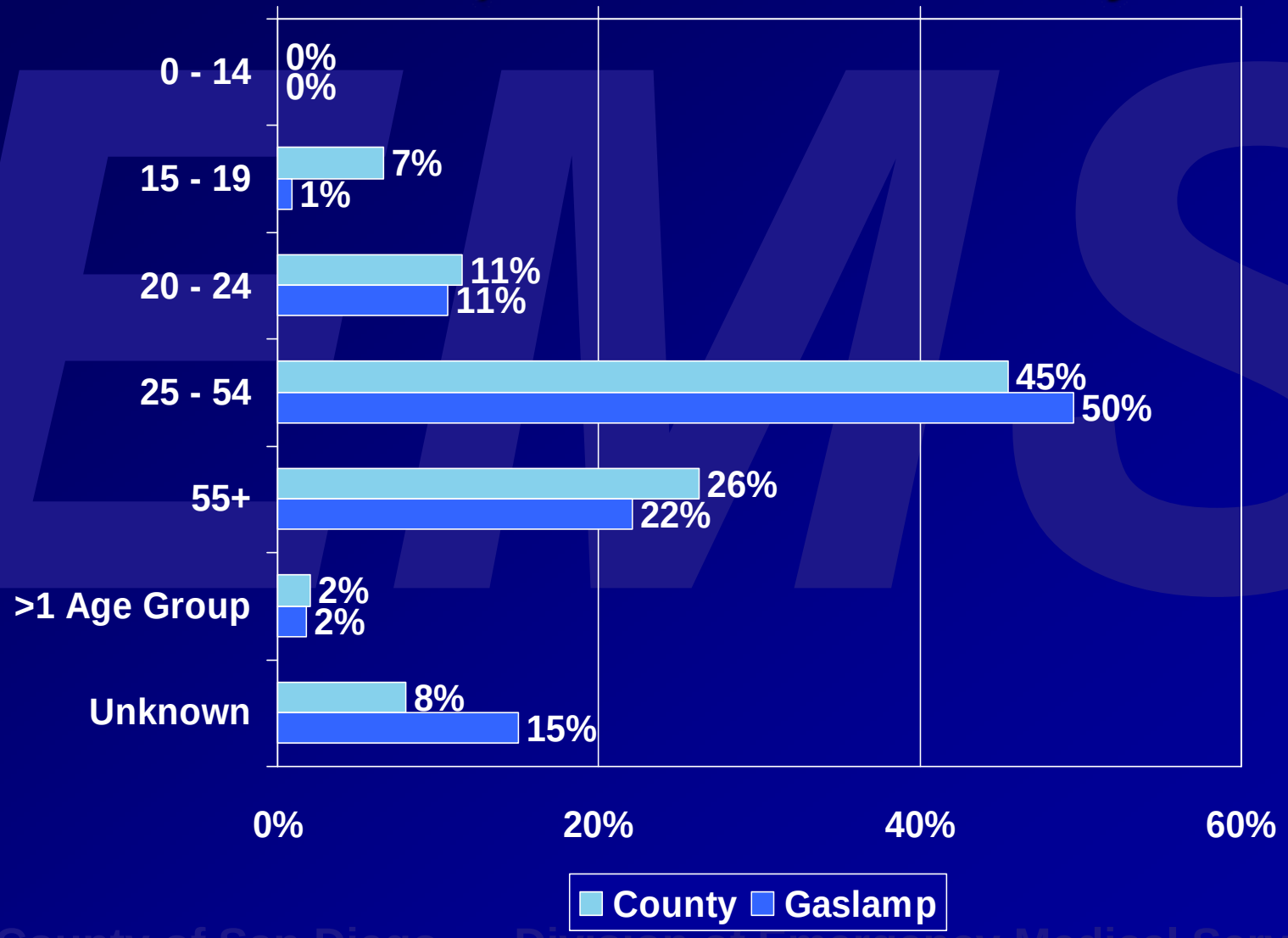
Pedestrian Age Groups: Gaslamp Quarter vs. County

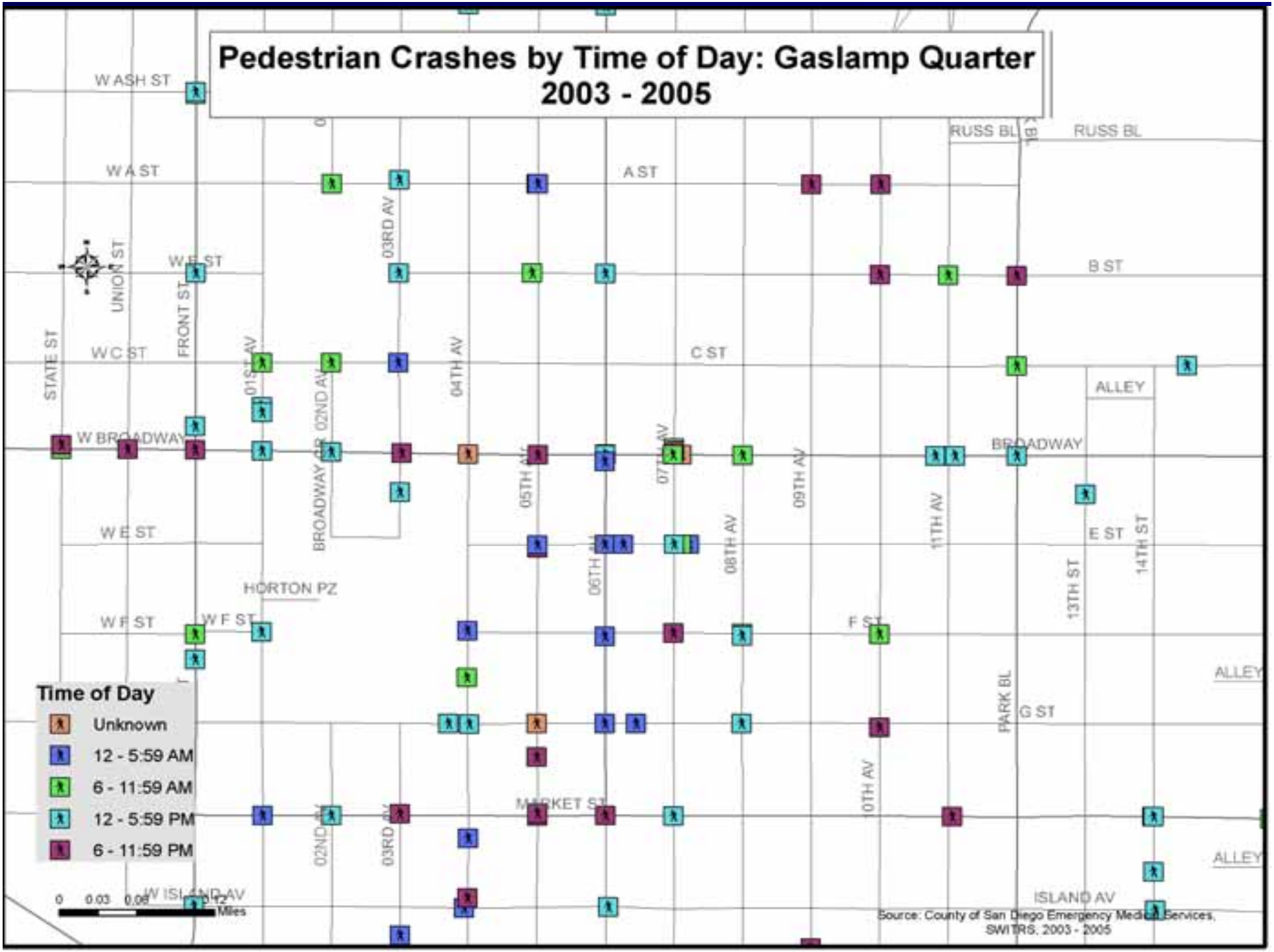


EMS

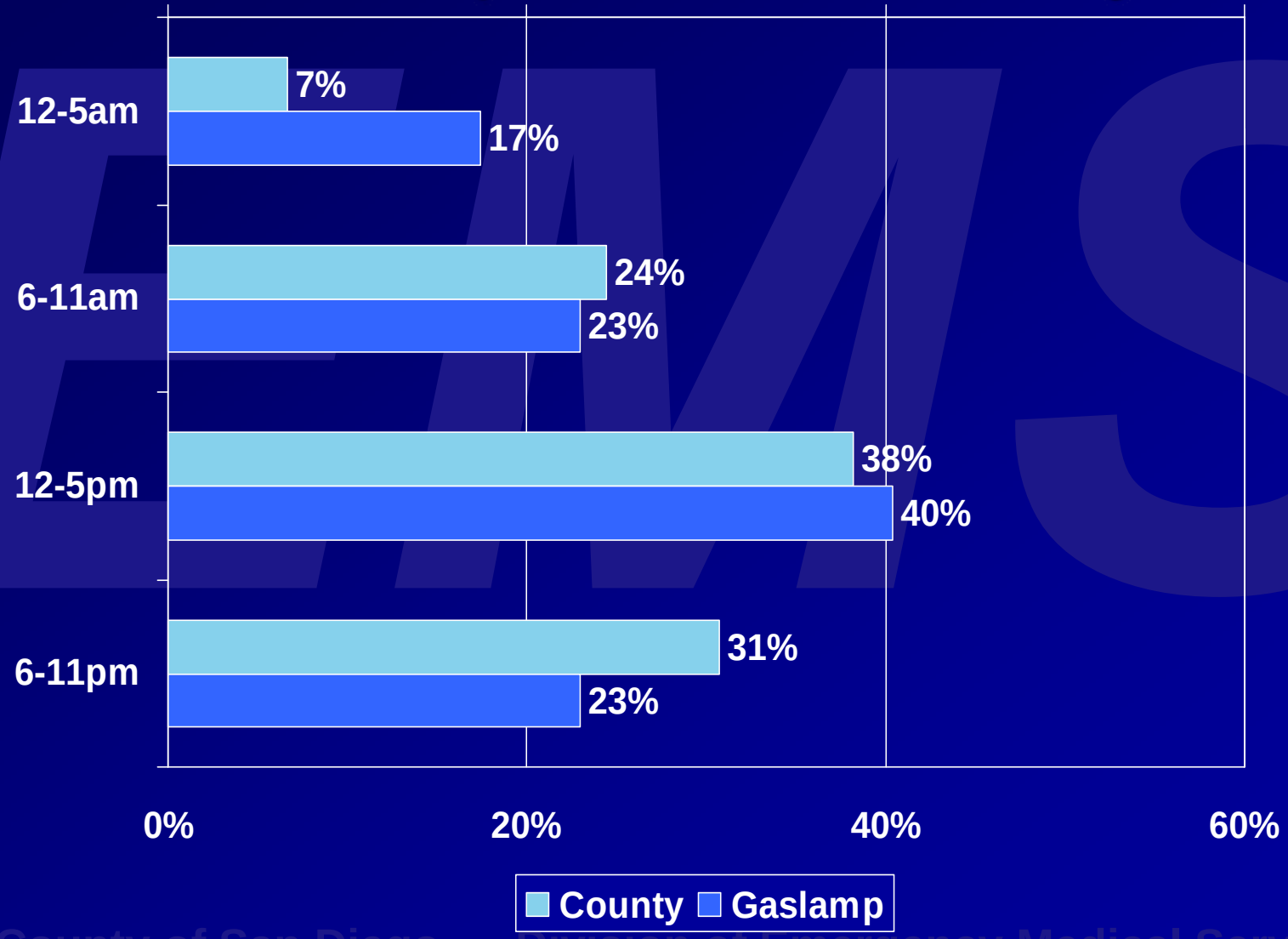

Pedestrian Crashes by Driver Age: Gaslamp Quarter
2003 - 2005
W ASH ST
W A ST
A ST
RUSS BL
RUSS BL
B ST
W C ST
C ST
ALLEY
W BROADWAY
BROADWAY
W E ST
E ST
HORTON PZ
W F ST
F ST
G ST
ALLEY
MARKET ST
ALLEY
ISLAND AV
W ISLAND AV
UNION ST
FRONT ST
STATE ST
01ST AV
02ND AV
03RD AV
04TH AV
05TH AV
06TH AV
07TH AV
08TH AV
09TH AV
10TH AV
11TH AV
13TH ST
14TH ST
PARK BL
BROADWAY
Driver Age Group
0 - 14
15 - 19
20 - 24
25 - 54
55+
>1 Age Group
Unknown
0 0.03 0.08 0.12 Miles
Source: County of San Diego Emergency Medical Services, SWITRS, 2003 - 2005

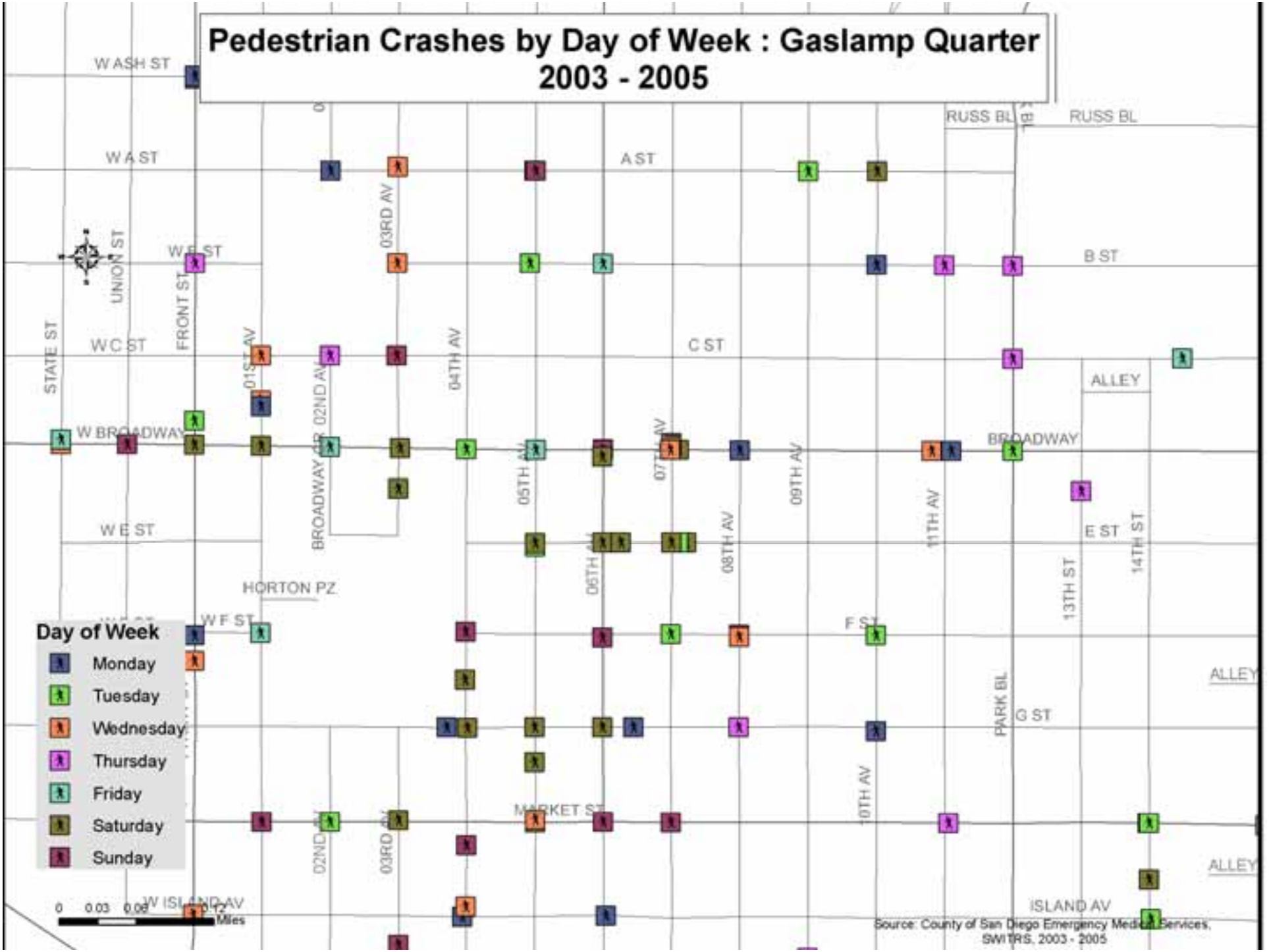
Driver Age Groups: Gaslamp Quarter vs. County



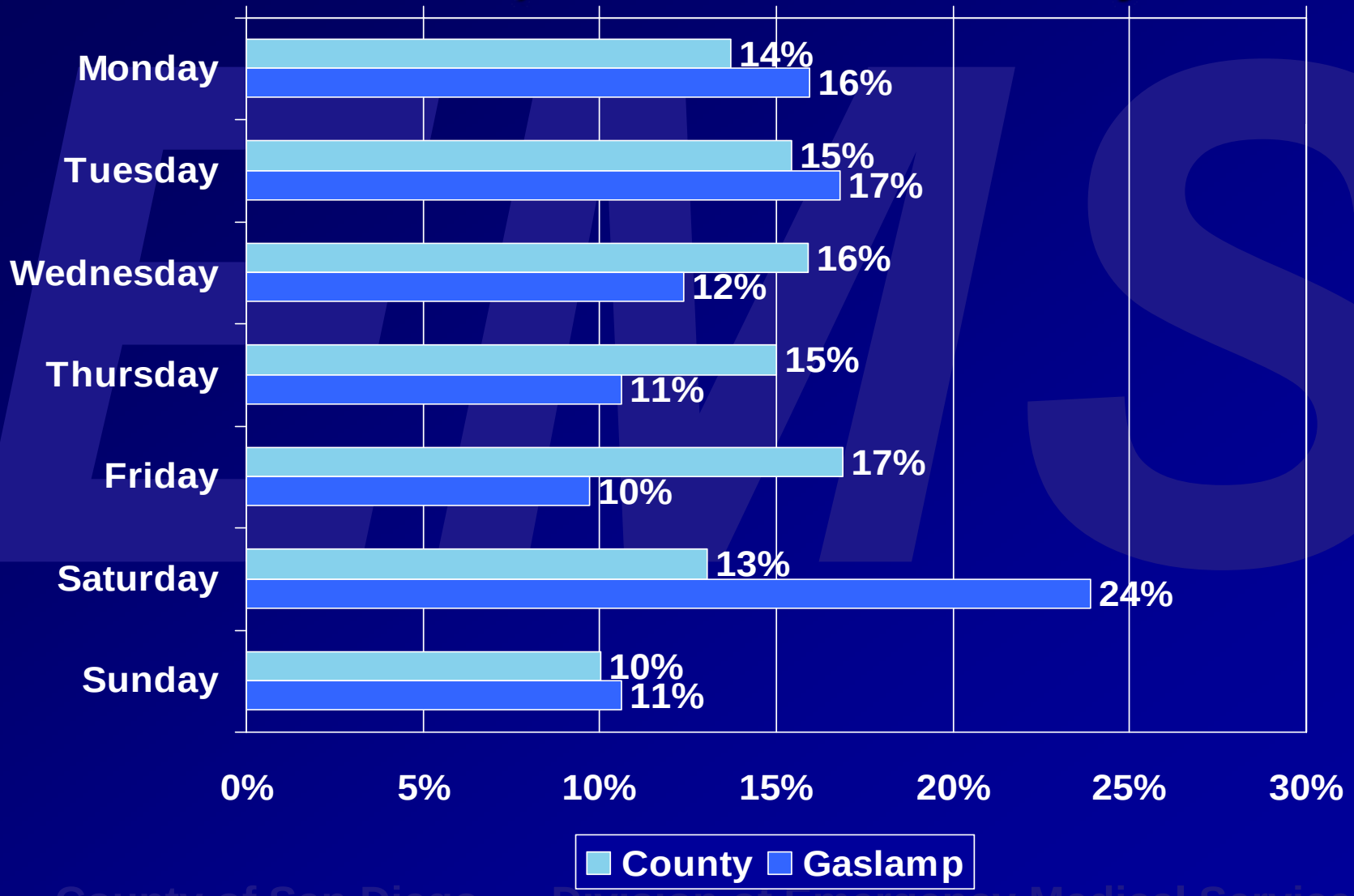

Pedestrian Crashes by Time of Day: Gaslamp Quarter
2003 - 2005
W ASH ST
W A ST
A ST
RUSS BL
RUSS BL
B ST
W B ST
UNION ST
FRONT ST
STATE ST
W C ST
C ST
ALLEY
W BROADWAY
BROADWAY
W E ST
E ST
HORTON PZ
W F ST
F ST
G ST
ALLEY
ALLEY
ISLAND AV
01ST AV
02ND AV
03RD AV
04TH AV
05TH AV
06TH AV
07TH AV
08TH AV
09TH AV
10TH AV
11TH AV
13TH ST
14TH ST
PARK BL
MARKET ST
BROADWAY CIR
Time of Day
Unknown
12 - 5:59 AM
6 - 11:59 AM
12 - 5:59 PM
6 - 11:59 PM
0 0.03 0.06 0.12
Miles
Source: County of San Diego Emergency Medical Services, SWITRS, 2003 - 2005

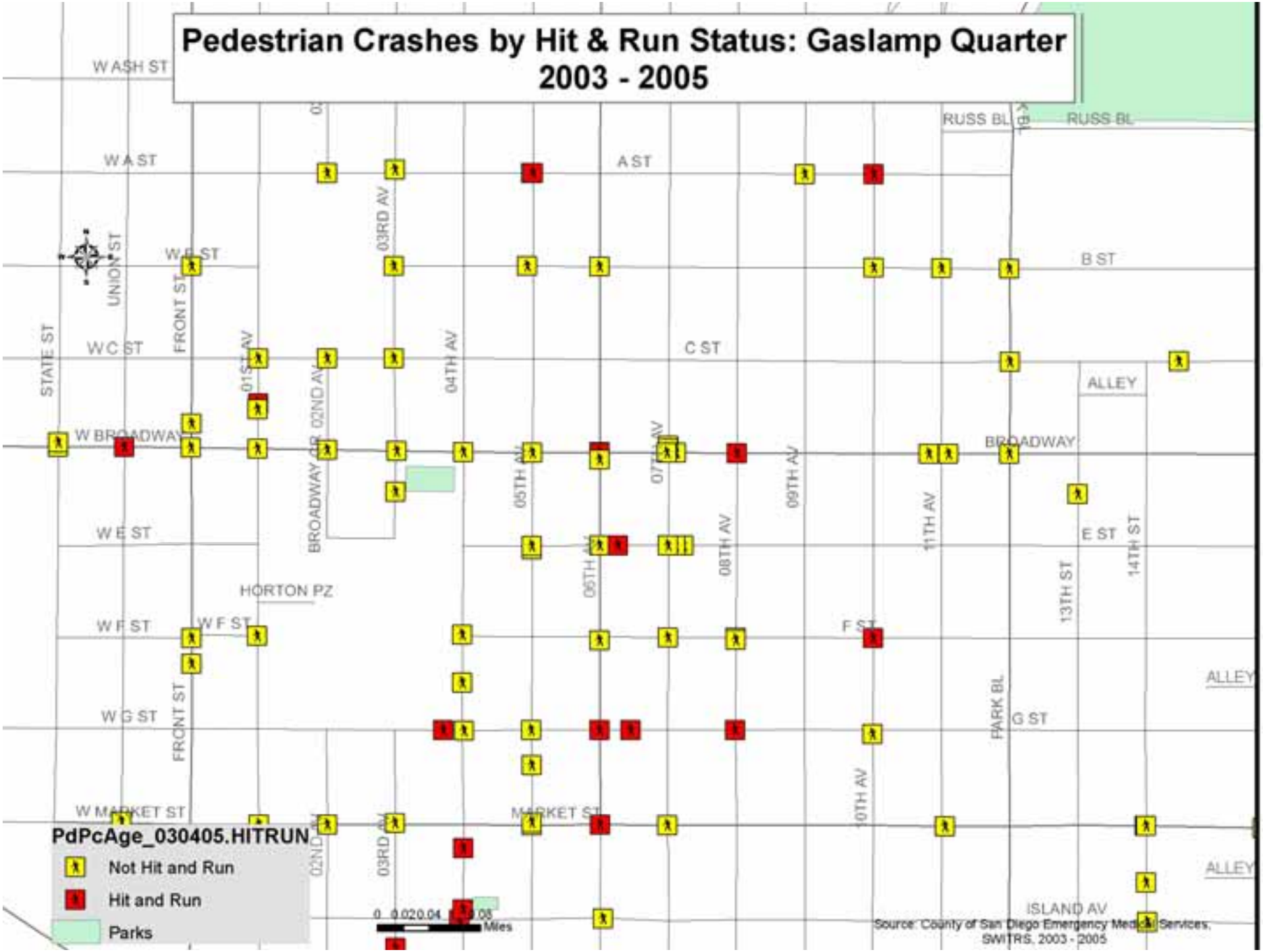
Time of Day of Crash: Gaslamp Quarter vs. County



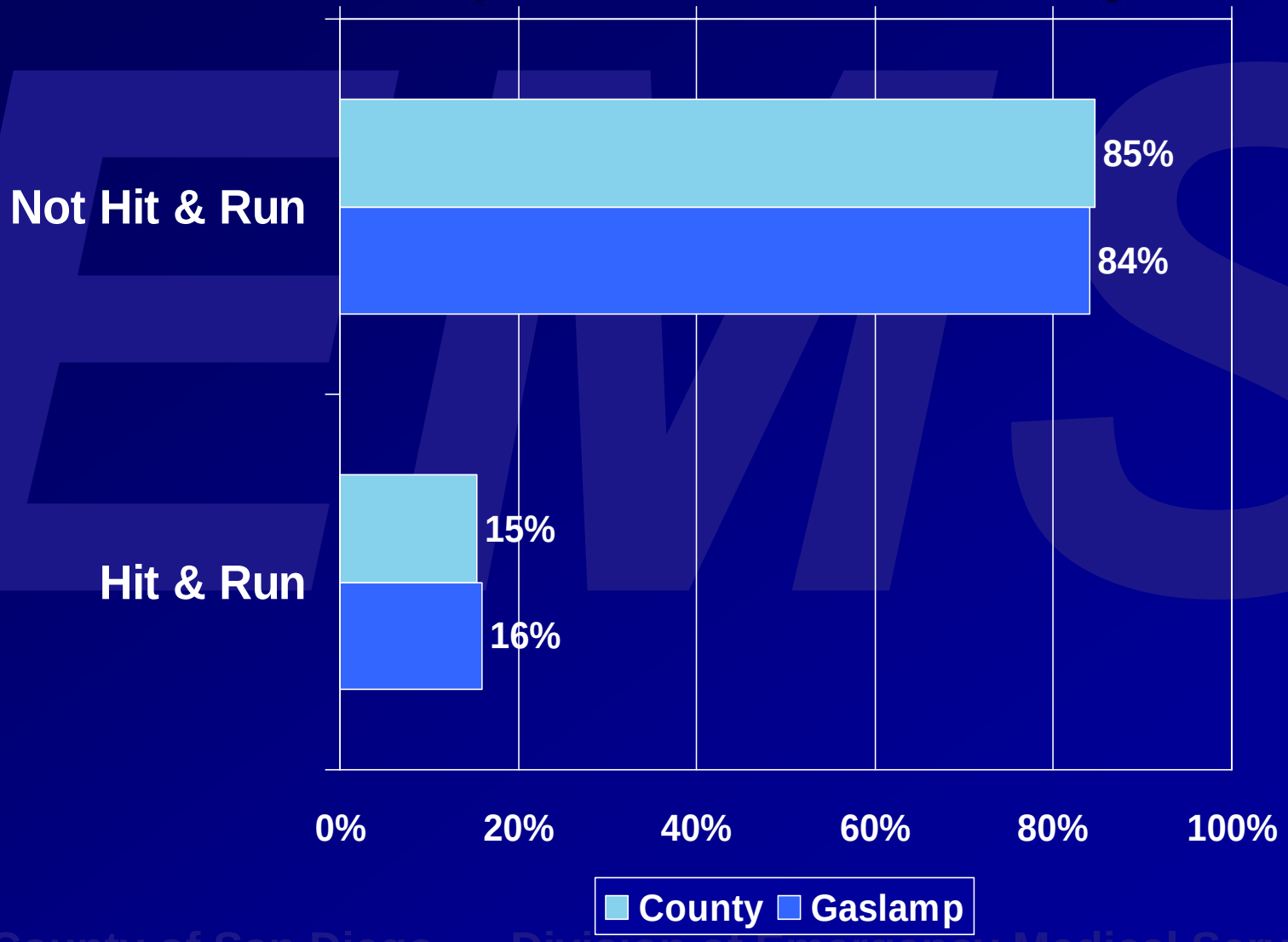

Pedestrian Crashes by Day of Week : Gaslamp Quarter
2003 - 2005
W ASH ST
W A ST
A ST
RUSS BL
RUSS BL
B ST
W B ST
W C ST
C ST
ALLEY
W BROADWAY
BROADWAY
W E ST
E ST
W F ST
F ST
G ST
ALLEY
ALLEY
MARKET ST
ISLAND AV
ISLAND AV
HORTON PZ
STATE ST
UNION ST
FRONT ST
01ST AV
02ND AV
03RD AV
04TH AV
05TH AV
06TH AV
07TH AV
08TH AV
09TH AV
10TH AV
11TH AV
13TH ST
14TH ST
PARK BL
BROADWAY CIR
Day of Week
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday
0 0.03 0.06 0.12
Miles
Source: County of San Diego Emergency Medical Services,
SWITRS, 2003 - 2005

Crash Day of Week: Gaslamp Quarter vs. County

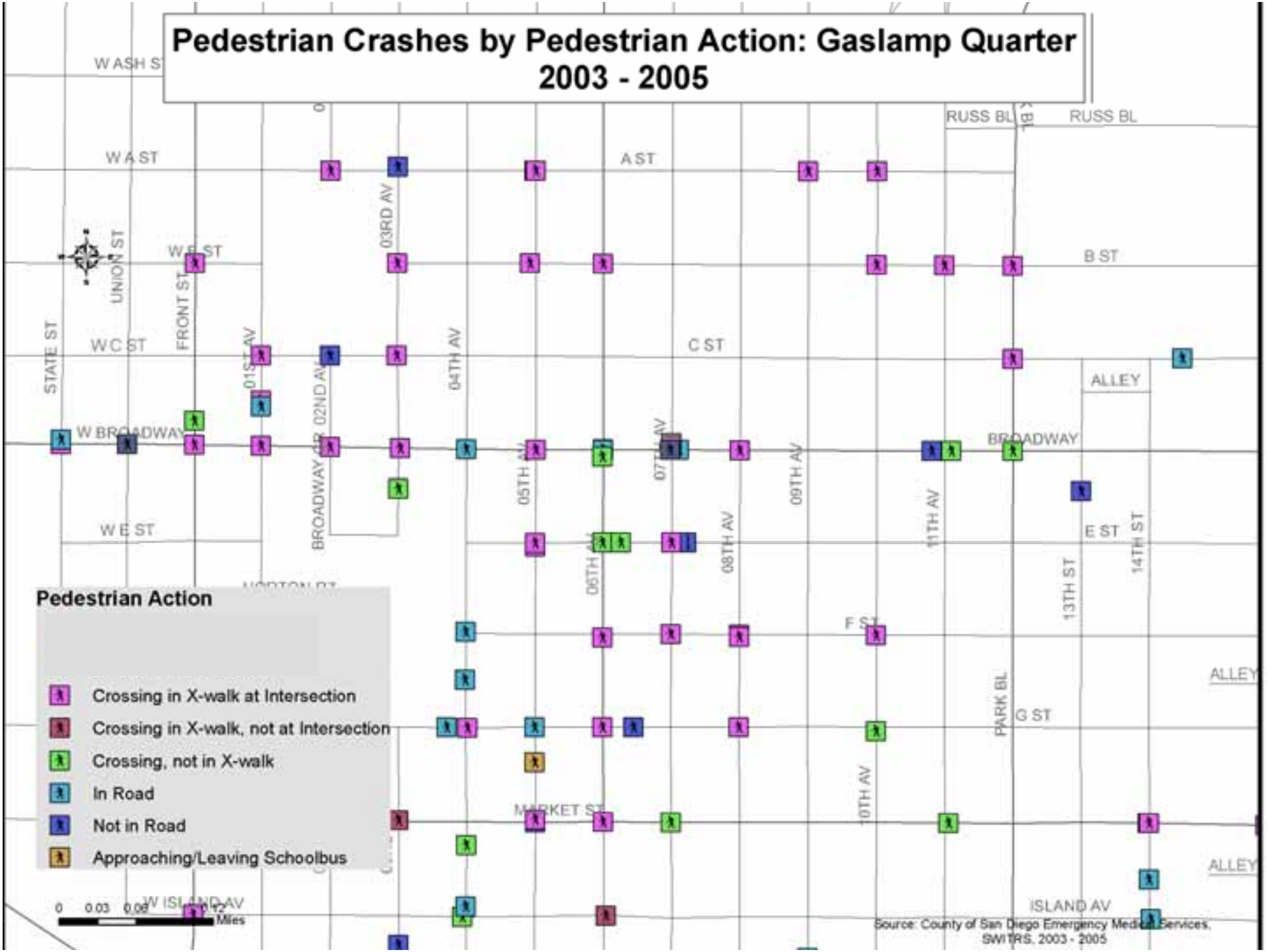



Pedestrian Crashes by Hit & Run Status: Gaslamp Quarter
2003 - 2005
W ASH ST
W A ST
A ST
RUSS BL
RUSS BL
B ST
W C ST
C ST
ALLEY
W BROADWAY
BROADWAY
W E ST
E ST
HORTON PZ
W F ST
F ST
ALLEY
W G ST
G ST
W MARKET ST
MARKET ST
ALLEY
ISLAND AV
UNION ST
FRONT ST
STATE ST
01ST AV
02ND AV
03RD AV
04TH AV
05TH AV
06TH AV
07TH AV
08TH AV
09TH AV
10TH AV
11TH AV
13TH ST
14TH ST
PARK BL
BROADWAY DR
PdPcAge_030405.HITRUN
Not Hit and Run
Hit and Run
Parks
0 0.02 0.04 0.08 Miles
Source: County of San Diego Emergency Medical Services; SWITRS, 2003 - 2005

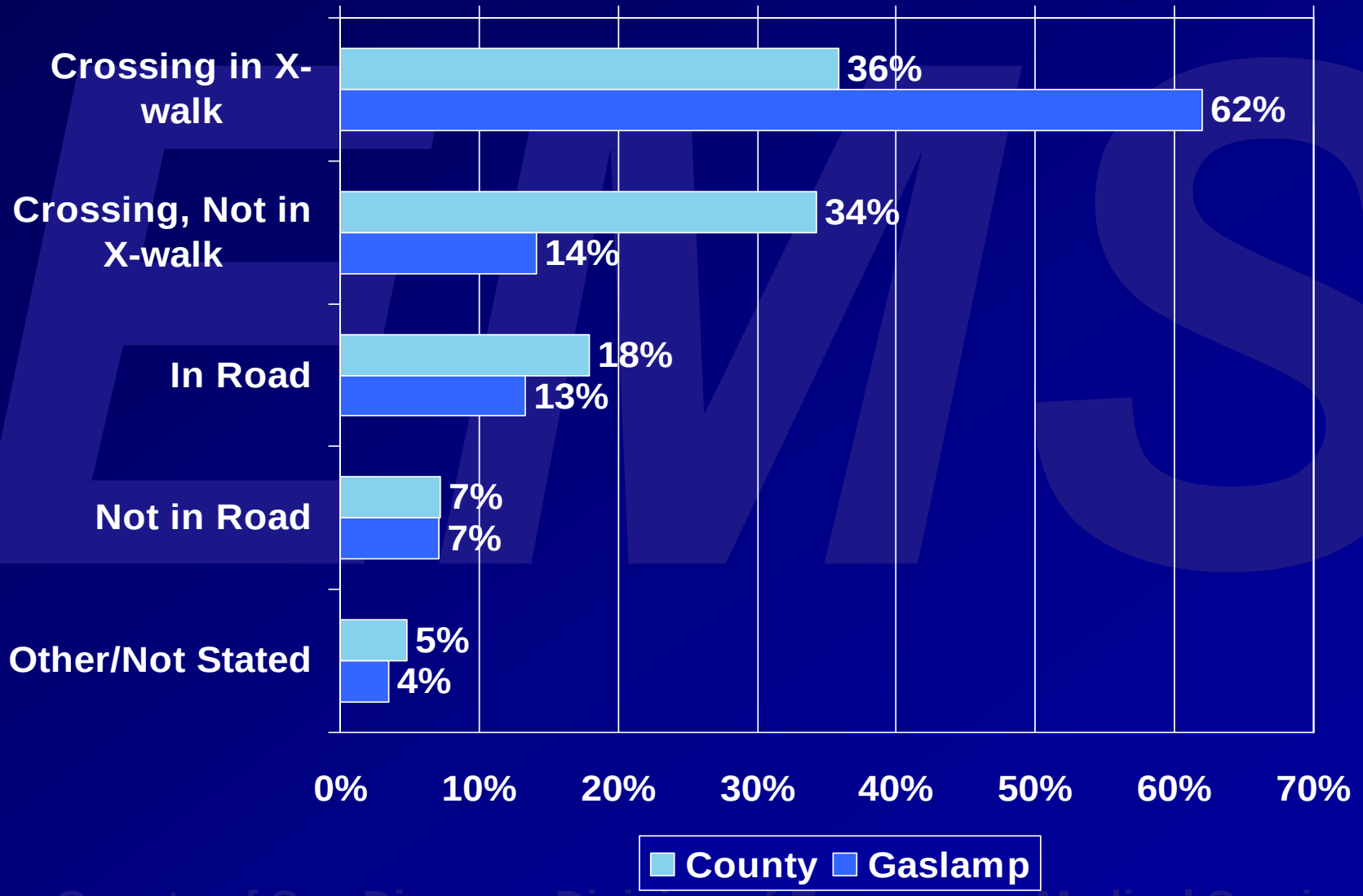
Pedestrian Hit & Run Status: Gaslamp Quarter vs. County

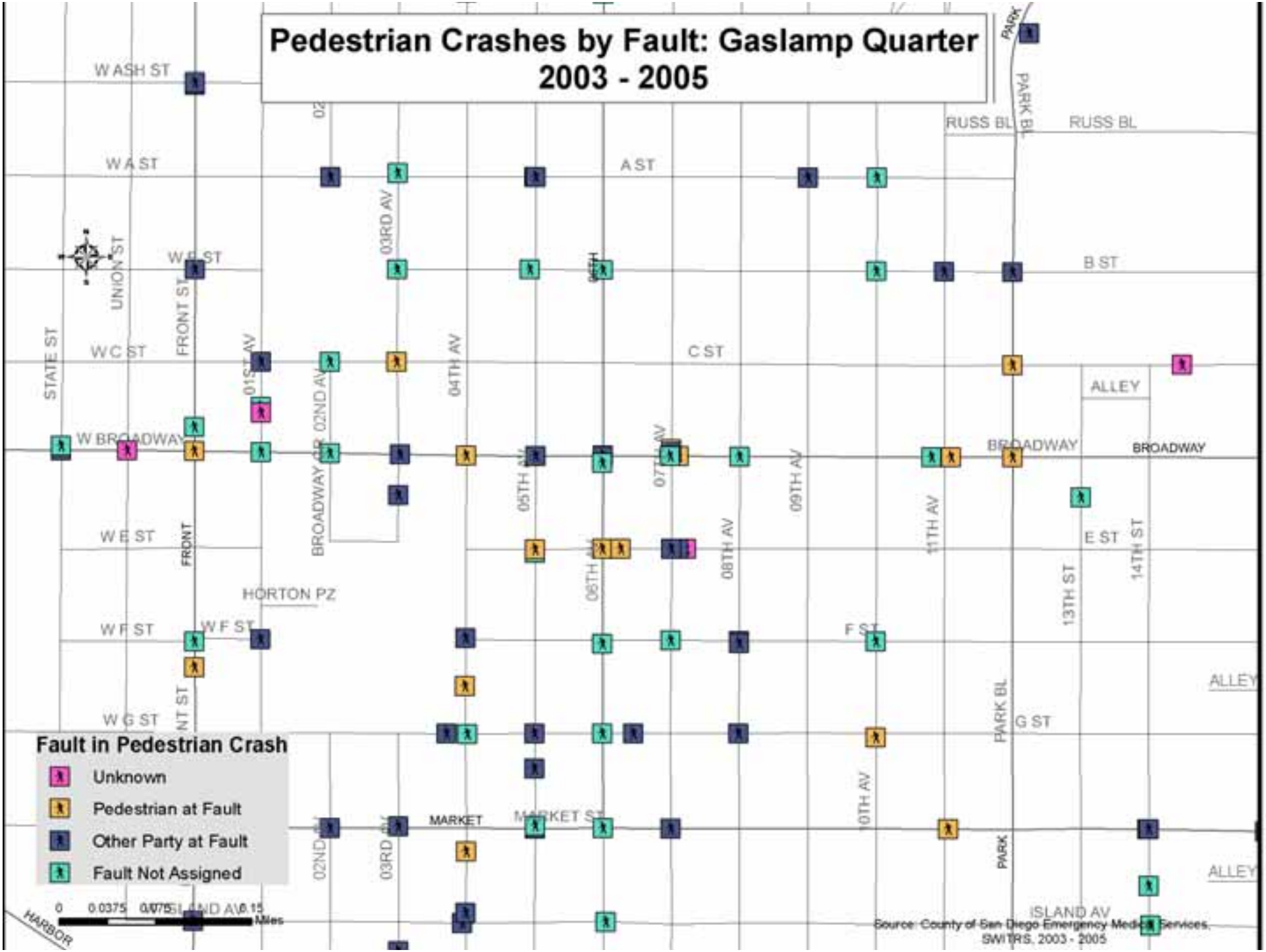


County of San Diego Division of Emergency Medical Services

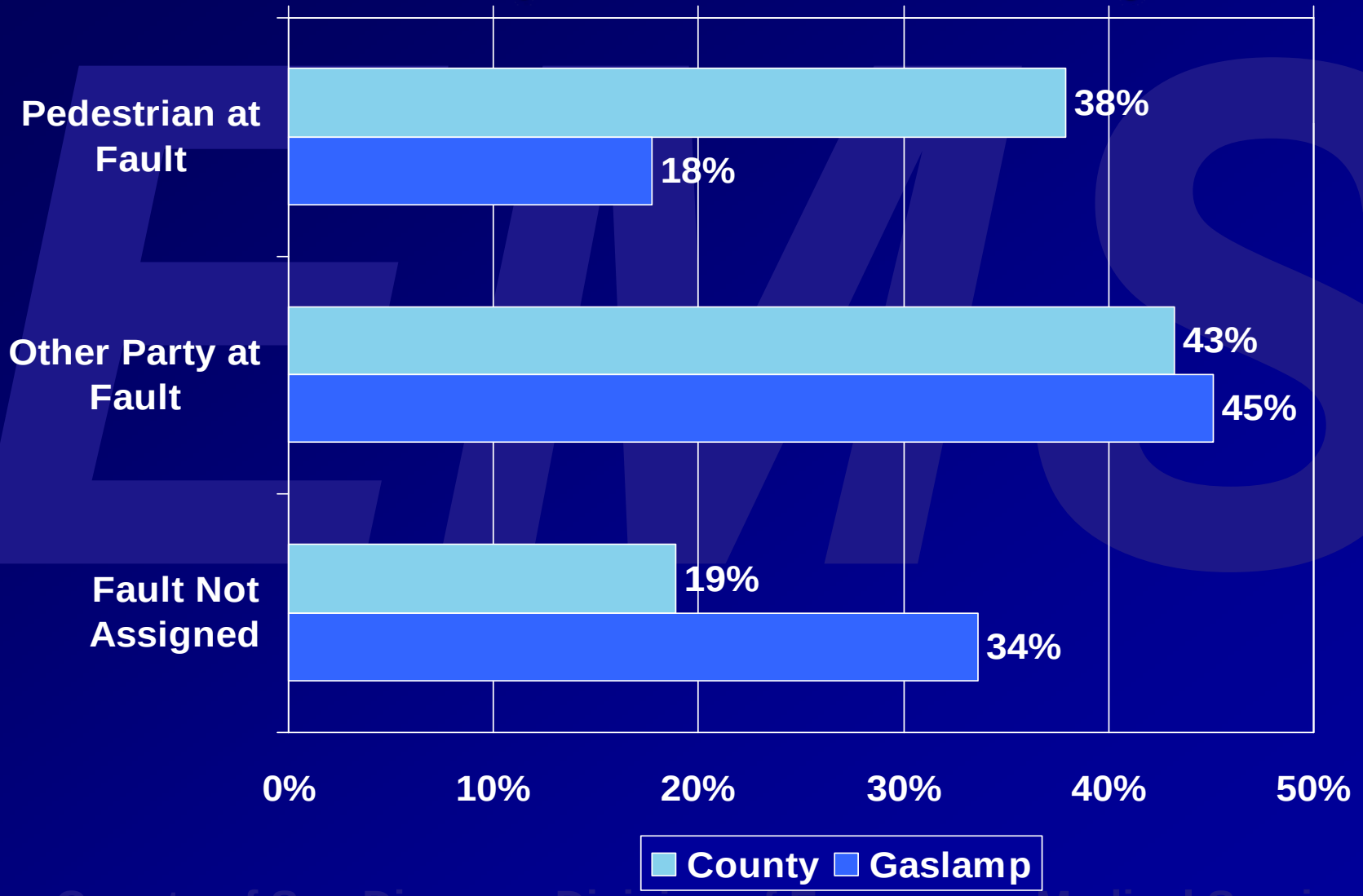

Pedestrian Crashes by Pedestrian Action: Gaslamp Quarter
2003 - 2005
W ASH ST
RUSS BL
W A ST
A ST
B ST
W B ST
W C ST
C ST
W E ST
E ST
F ST
G ST
ALLEY
UNION ST
FRONT ST
STATE ST
03RD AV
04TH AV
05TH AV
06TH AV
07TH AV
08TH AV
09TH AV
10TH AV
11TH AV
13TH ST
14TH ST
PARK BL
BROADWAY
W BROADWAY
MARKET ST
ISLAND AV
Pedestrian Action
Crossing in X-walk at Intersection
Crossing in X-walk, not at Intersection
Crossing, not in X-walk
In Road
Not in Road
Approaching/Leaving Schoolbus
0 0.03 0.06 0.12 Miles
Source: County of San Diego Emergency Medical Services, SWITRS, 2003 - 2005

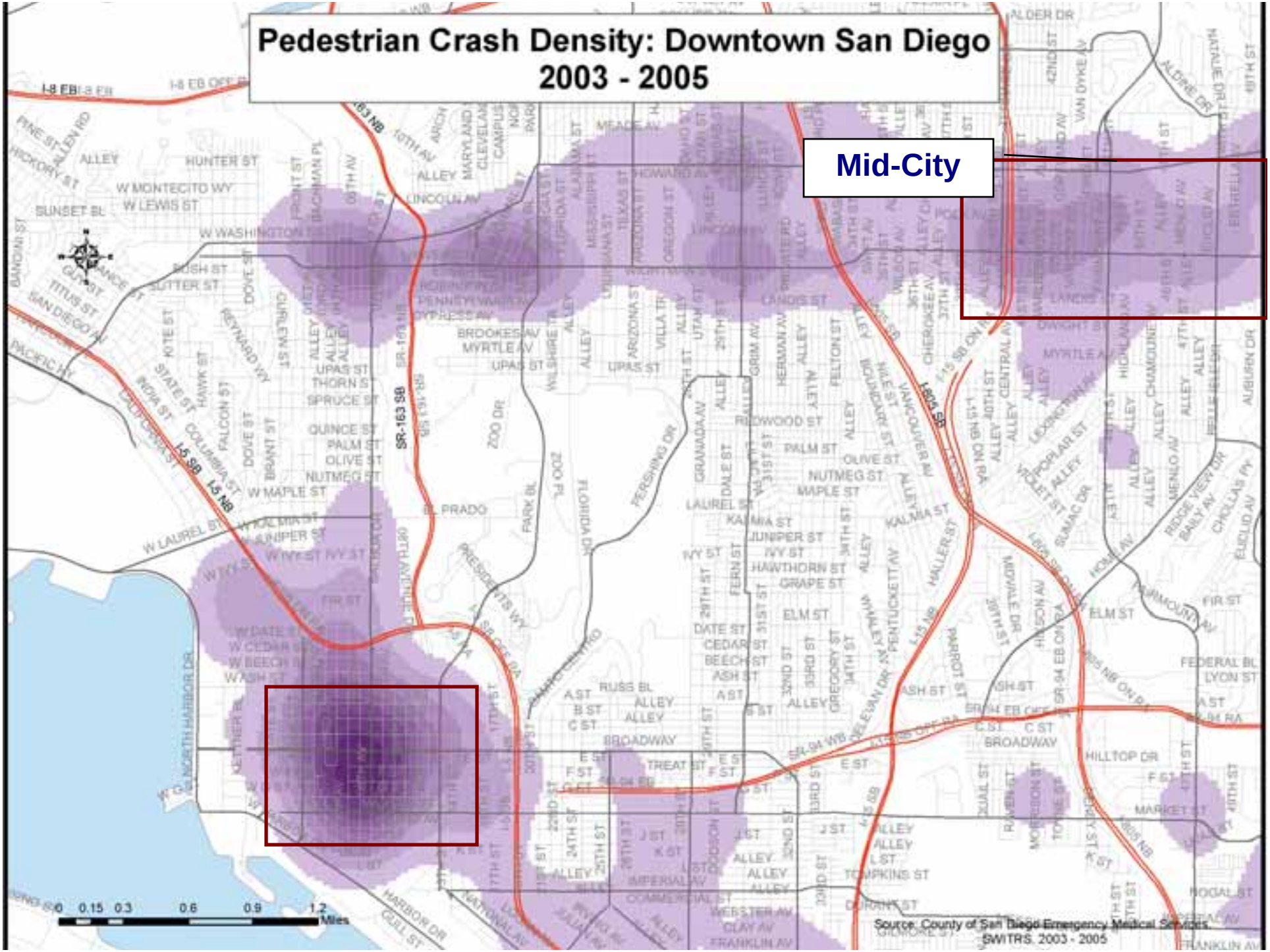
Pedestrian Action: Gaslamp Quarter vs. County

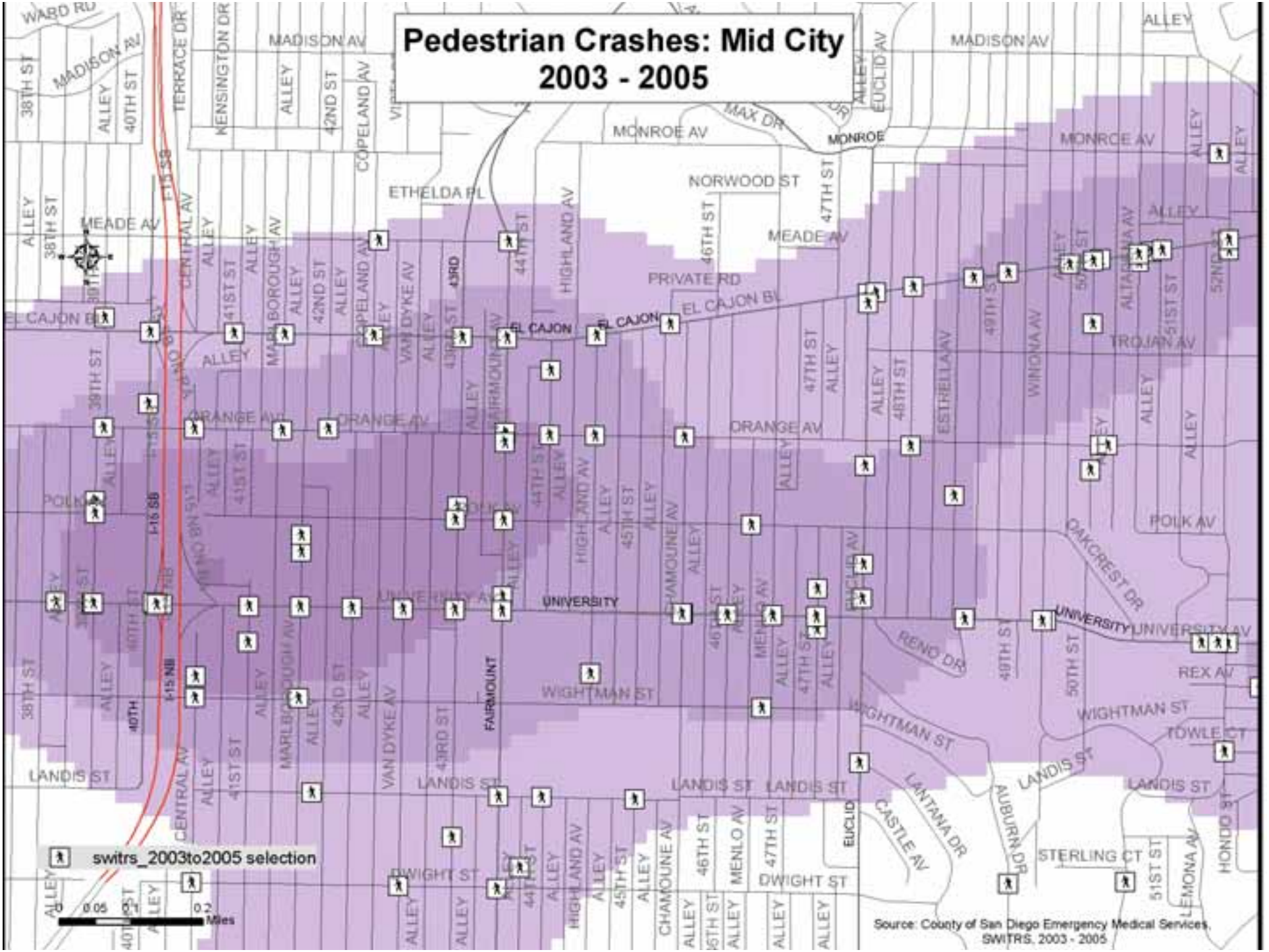


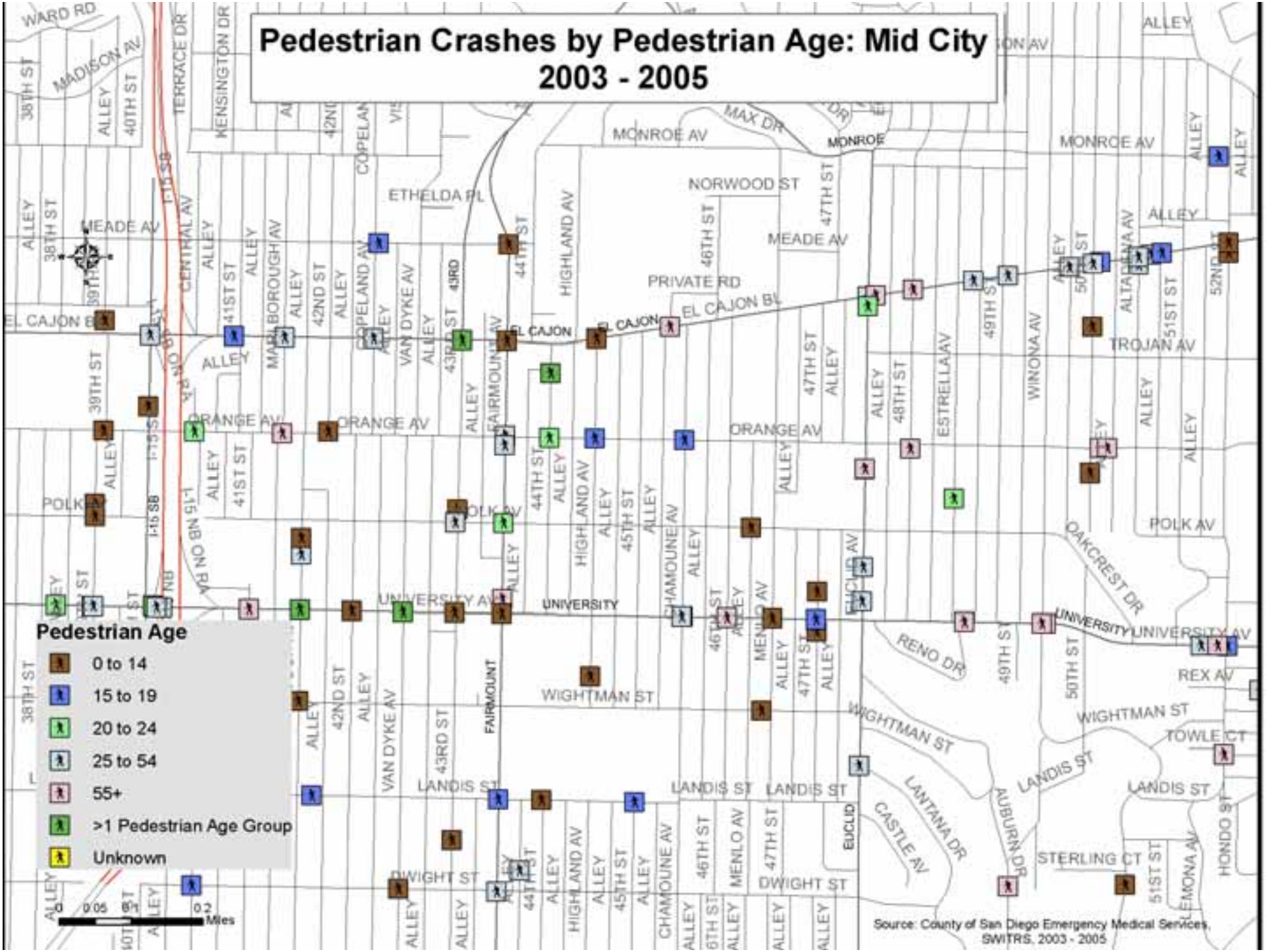

Pedestrian Crashes by Fault: Gaslamp Quarter
2003 - 2005
W ASH ST
W A ST
A ST
RUSS BL
RUSS BL
PARK BL
B ST
W C ST
C ST
ALLEY
W BROADWAY
BROADWAY
BROADWAY
W E ST
E ST
HORTON PZ
W F ST
F ST
W G ST
G ST
ALLEY
ALLEY
MARKET
MARKET ST
ISLAND AV
HARBOR
STATE ST
UNION ST
FRONT ST
01ST AV
02ND AV
03RD AV
04TH AV
05TH AV
06TH AV
07TH AV
08TH AV
09TH AV
10TH AV
11TH AV
13TH ST
14TH ST
Fault in Pedestrian Crash
Unknown
Pedestrian at Fault
Other Party at Fault
Fault Not Assigned
0 0.0375 0.075 0.15
Miles
Source: County of San Diego Emergency Medical Services,
SWITRS, 2003 - 2005

Fault in Pedestrian Crashes: Gaslamp Quarter vs. County

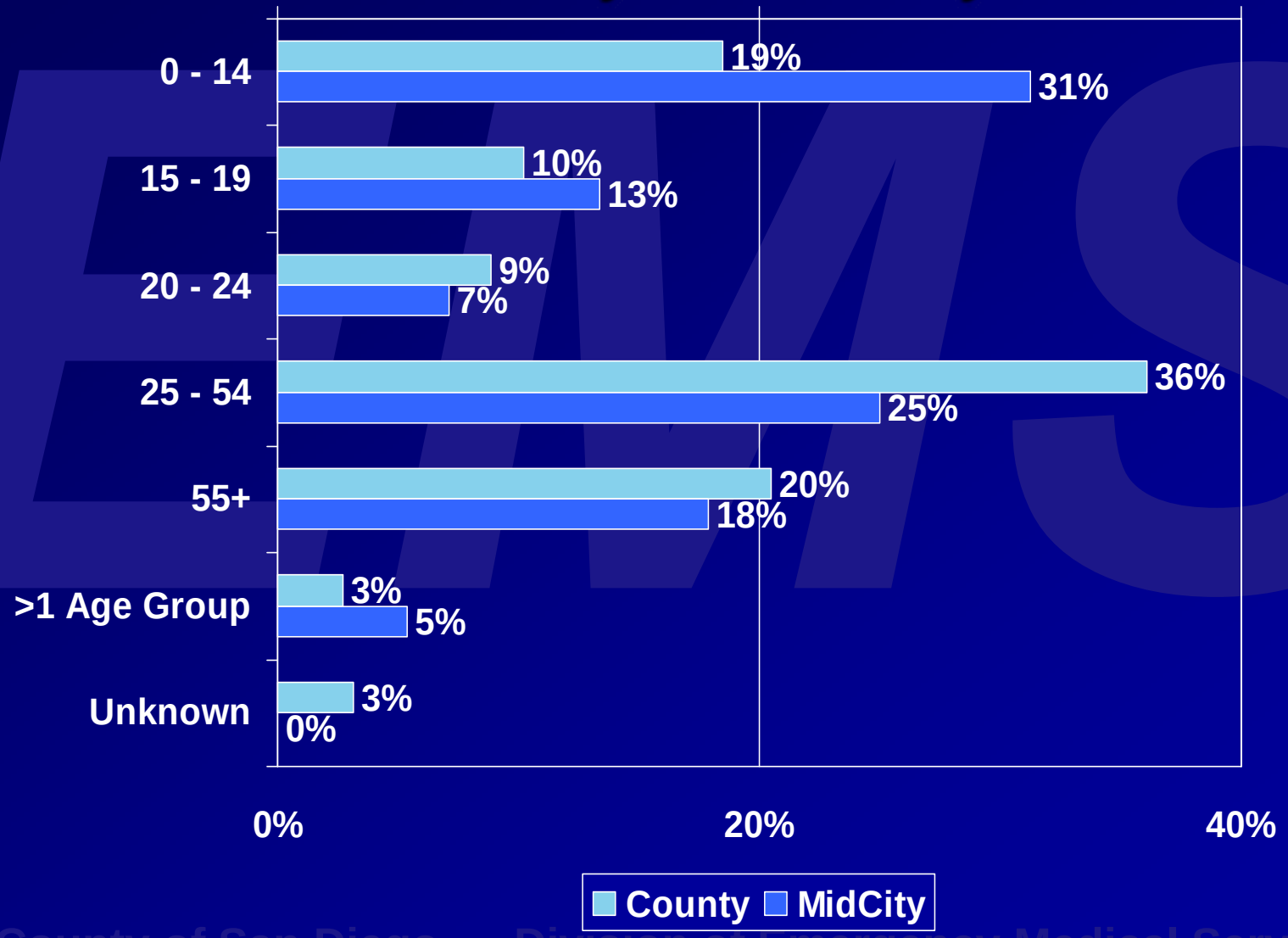


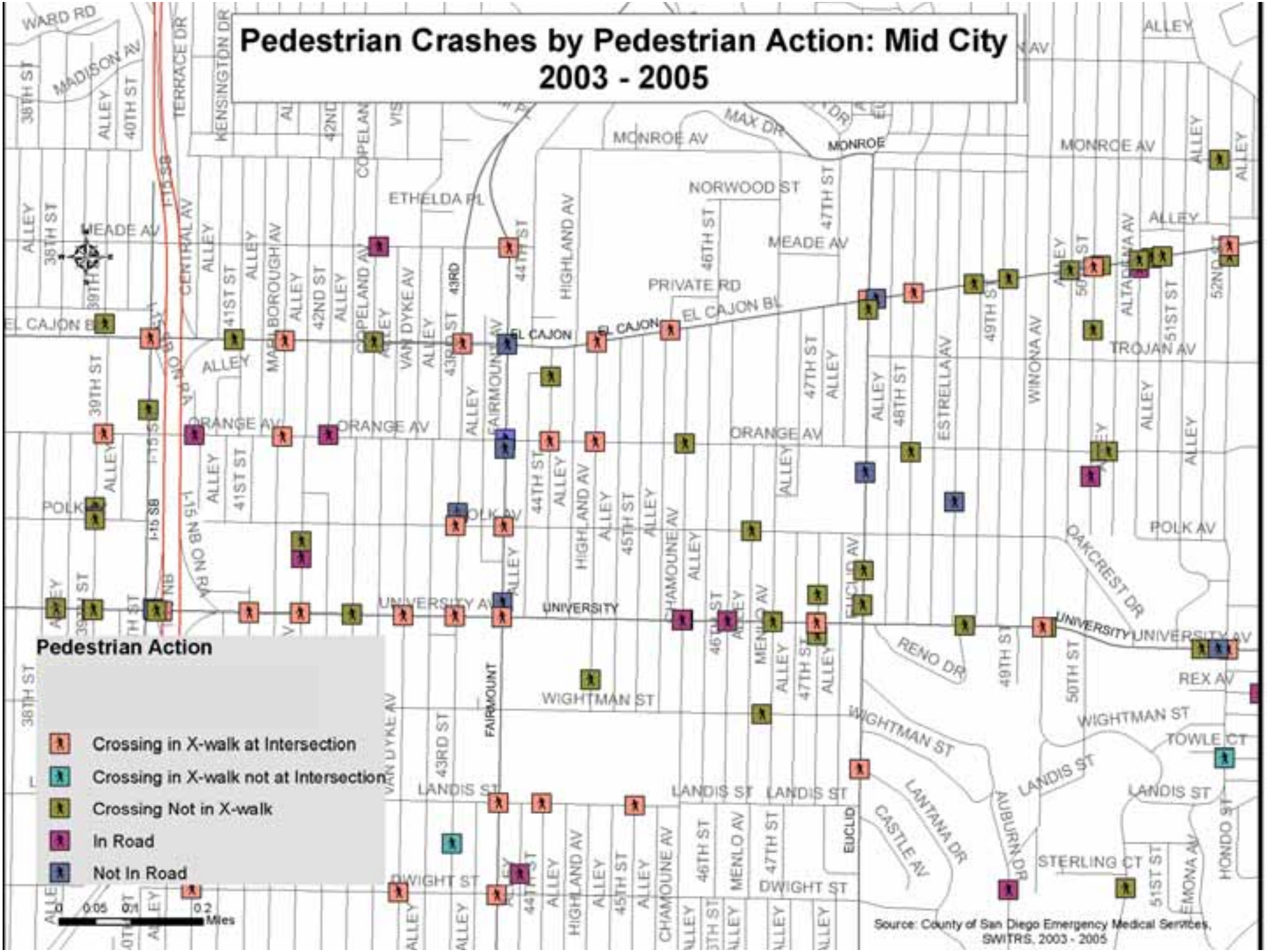

Pedestrian Crash Density: Downtown San Diego
2003 - 2005
Mid-City
0 0.15 0.3 0.6 0.9 1.2
Miles
Source: County of San Diego Emergency Medical Services
SWITRS 2003 - 2005

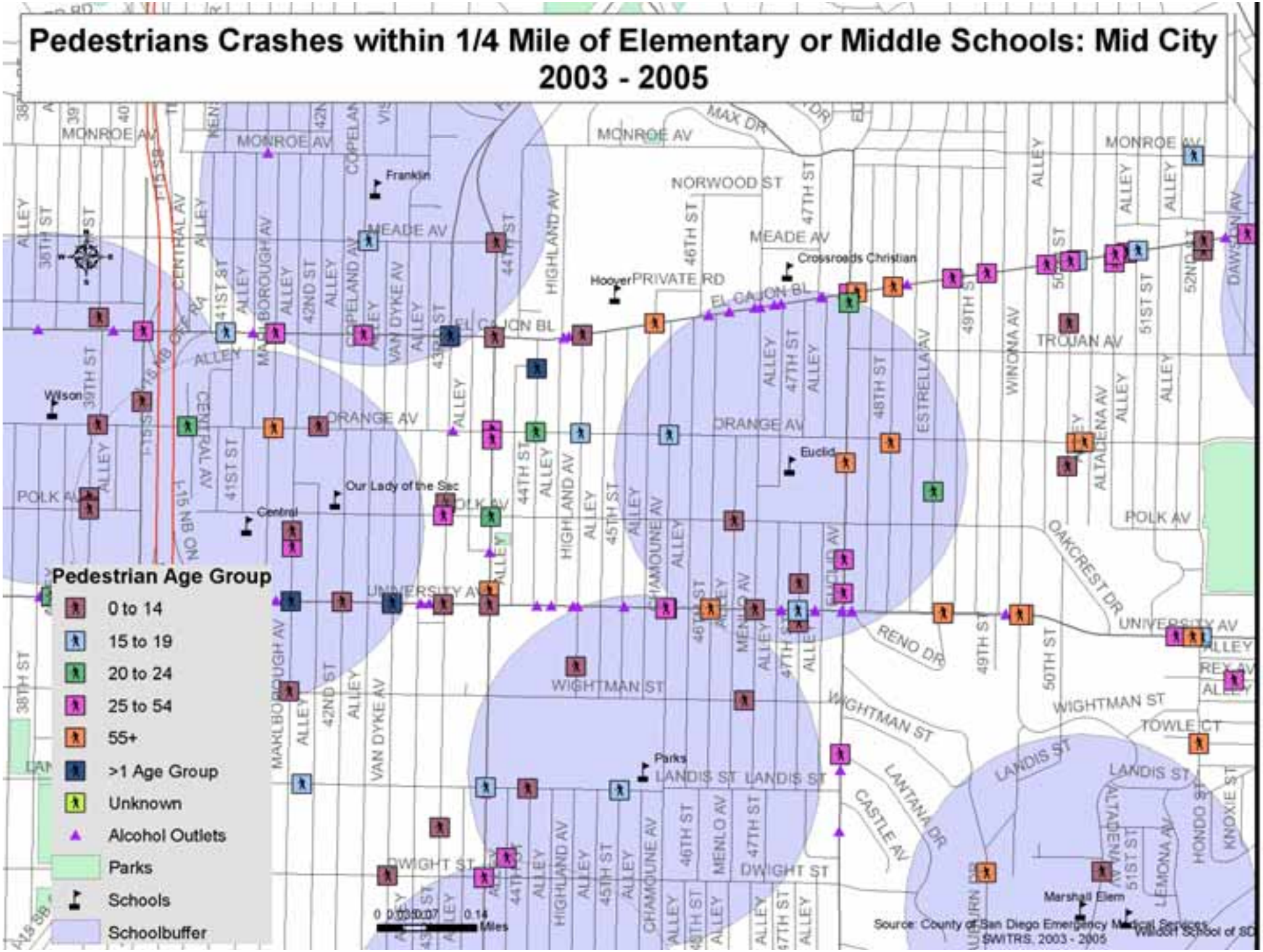

Pedestrian Crashes: Mid City
2003 - 2005
MADISON AV
MONROE AV
NORWOOD ST
ETHELDA PL
MEADE AV
PRIVATE RD
EL CAJON BL
ORANGE AV
UNIVERSITY
WIGHTMAN ST
LANDIS ST
DWIGHT ST
TROJAN AV
POLK AV
REX AV
TOWLE CT
STERLING CT
OAKCREST DR
RENO DR
LANTANA DR
CASTLE AV
AUBURN DR
HONDO ST
LEMONA AV
I-15 SB
I-15 NB
switrs_2003to2005 selection
0 0.05 0.1 0.2
Miles
Source: County of San Diego Emergency Medical Services, SWITRS, 2003 - 2005


Pedestrian Crashes by Pedestrian Age: Mid City
2003 - 2005
Pedestrian Age
0 to 14
15 to 19
20 to 24
25 to 54
55+
>1 Pedestrian Age Group
Unknown
0 0.05 0.1 0.2 Miles
Source: County of San Diego Emergency Medical Services, SWITRS, 2003 - 2005
MONROE AV
MEADE AV
EL CAJON BL
ORANGE AV
POLK AV
UNIVERSITY AV
WIGHTMAN ST
LANDIS ST
DWIGHT ST
ETHELDA PL
NORWOOD ST
PRIVATE RD
TROJAN AV
REX AV
TOWLE CT
STERLING CT
OAKCREST DR
RENO DR
WARD RD
MADISON AV
TERRACE DR
KENSINGTON DR
CENTRAL AV
MARLBOROUGH AV
COPELAND AV
VAN DYKE AV
FAIRMOUNT
HIGHLAND AV
CHAMOUNE AV
MENLO AV
EUCLID
CASTLE AV
LANTANA DR
AUBURN DR
WINONA AV
ESTRELLA AV
ALTADENA AV
LEMONA AV
HONDO ST
I-15 SB
I-15 NB ON RA
38TH ST
39TH ST
40TH ST
41ST ST
42ND ST
43RD ST
44TH ST
45TH ST
46TH ST
47TH ST
48TH ST
49TH ST
50TH ST
51ST ST
52ND ST
ALLEY

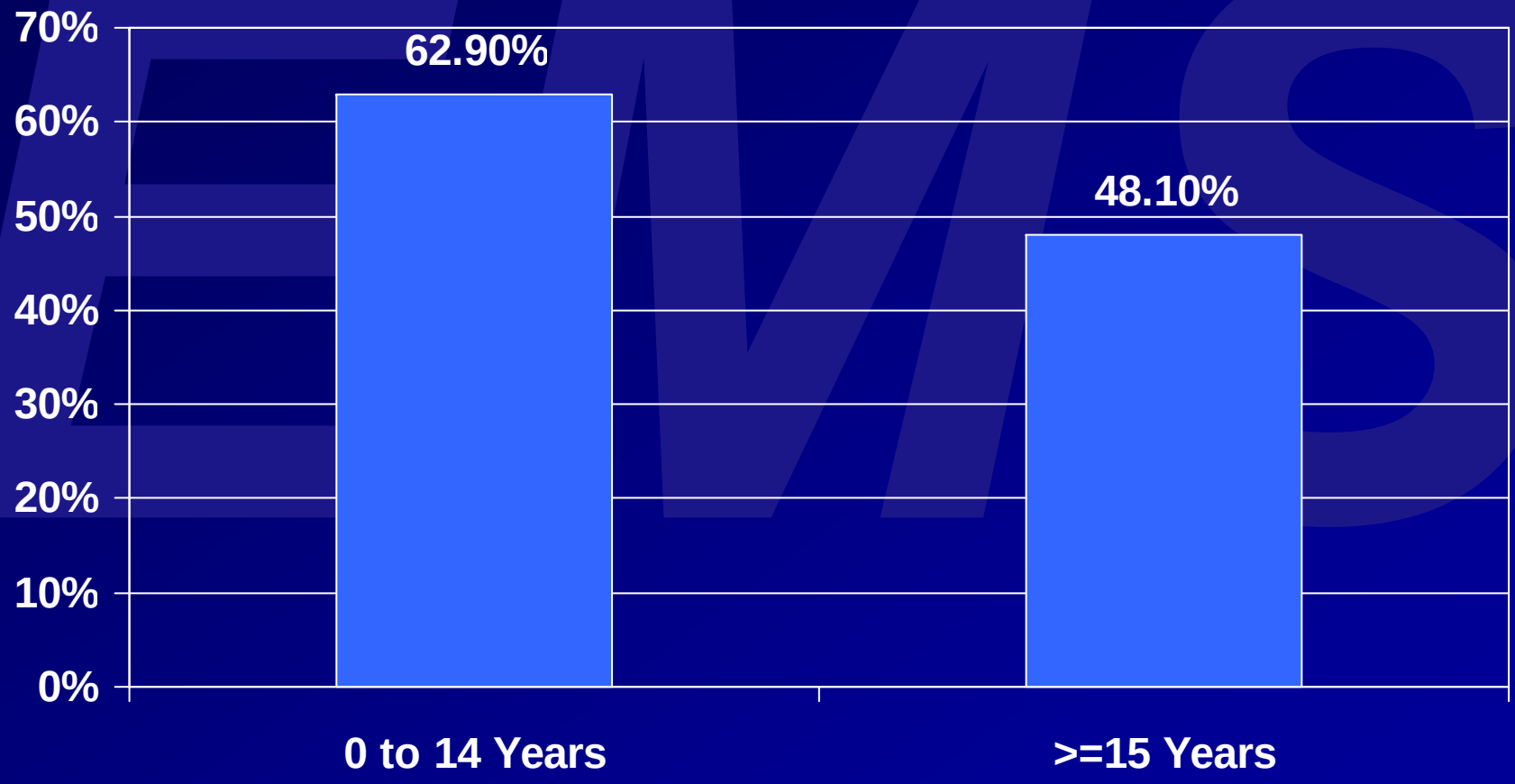
Pedestrian Age Groups: Mid-City vs. County




Pedestrian Crashes by Pedestrian Action: Mid City
2003 - 2005
Pedestrian Action
Crossing in X-walk at Intersection
Crossing in X-walk not at Intersection
Crossing Not in X-walk
In Road
Not In Road
0 0.05 0.1 0.2 Miles
Source: County of San Diego Emergency Medical Services, SWITRS, 2003 - 2005
MONROE AV
MEADE AV
EL CAJON BL
ORANGE AV
POLK AV
UNIVERSITY AV
WIGHTMAN ST
LANDIS ST
DWIGHT ST
TROJAN AV
REX AV
TOWLE CT
STERLING CT
ETHELDA PL
NORWOOD ST
PRIVATE RD
HIGHLAND AV
FAIRMOUNT AV
CHAMOUNE AV
MENLO AV
EUCLID AV
ESTRELLA AV
WINONA AV
OAKCREST DR
RENO DR
LANTANA DR
CASTLE AV
AUBURN DR
HONDO ST
I-15 SB
I-15 NB ON RA
CENTRAL AV
MARLBOROUGH AV
COPELAND AV
VAN DYKE AV
ALTADENA AV
MAX DR
TERRACE DR
KENSINGTON DR
WARD RD
MADISON AV
ALLEY
38TH ST
39TH ST
40TH ST
41ST ST
42ND ST
43RD ST
44TH ST
45TH ST
46TH ST
47TH ST
48TH ST
49TH ST
50TH ST
51ST ST
52ND ST


Pedestrians Crashes within 1/4 Mile of Elementary or Middle Schools: Mid City
2003 - 2005
Pedestrian Age Group
0 to 14
15 to 19
20 to 24
25 to 54
55+
>1 Age Group
Unknown
Alcohol Outlets
Parks
Schools
Schoolbuffer
MONROE AV
NORWOOD ST
MEADE AV
ORANGE AV
UNIVERSITY AV
POLK AV
WIGHTMAN ST
LANDIS ST
DWIGHT ST
TROJAN AV
RENO DR
OAKCREST DR
TOWLE CT
Franklin
Hoover
Crossroads Christian
Wilson
Euclid
Our Lady of the Sac
Central
Parks
Marshall Elem
Source: County of San Diego Emergency Medical Services
SWITRS, 2003 - 2005

Percent within ¼ Mile of an Elementary or Middle School, by Age: Mid-City



Conclusions

- Unique risk factors down to the neighborhood level
- Grid street layout
- Alcohol
- Age patterns
- Look for environmental issues where risk factors cluster
  - E.g., crossing outside of crosswalk: more crosswalks needed?

Recommendations

- Education
  - Remind drivers to look out for drunk walkers
  - Don’t drink and walk! Messages
  - Message distribution sites
    - Schools
    - Bars
- Engineering
  - Targeted street closures
  - Pedestrian bridges
- Enforcement
  - Police presence at key hours
  - Drinking & walking legislation

Acknowledgements

The authors wish to thank

- California Highway Patrol
- San Diego County law enforcement agencies

For More Information

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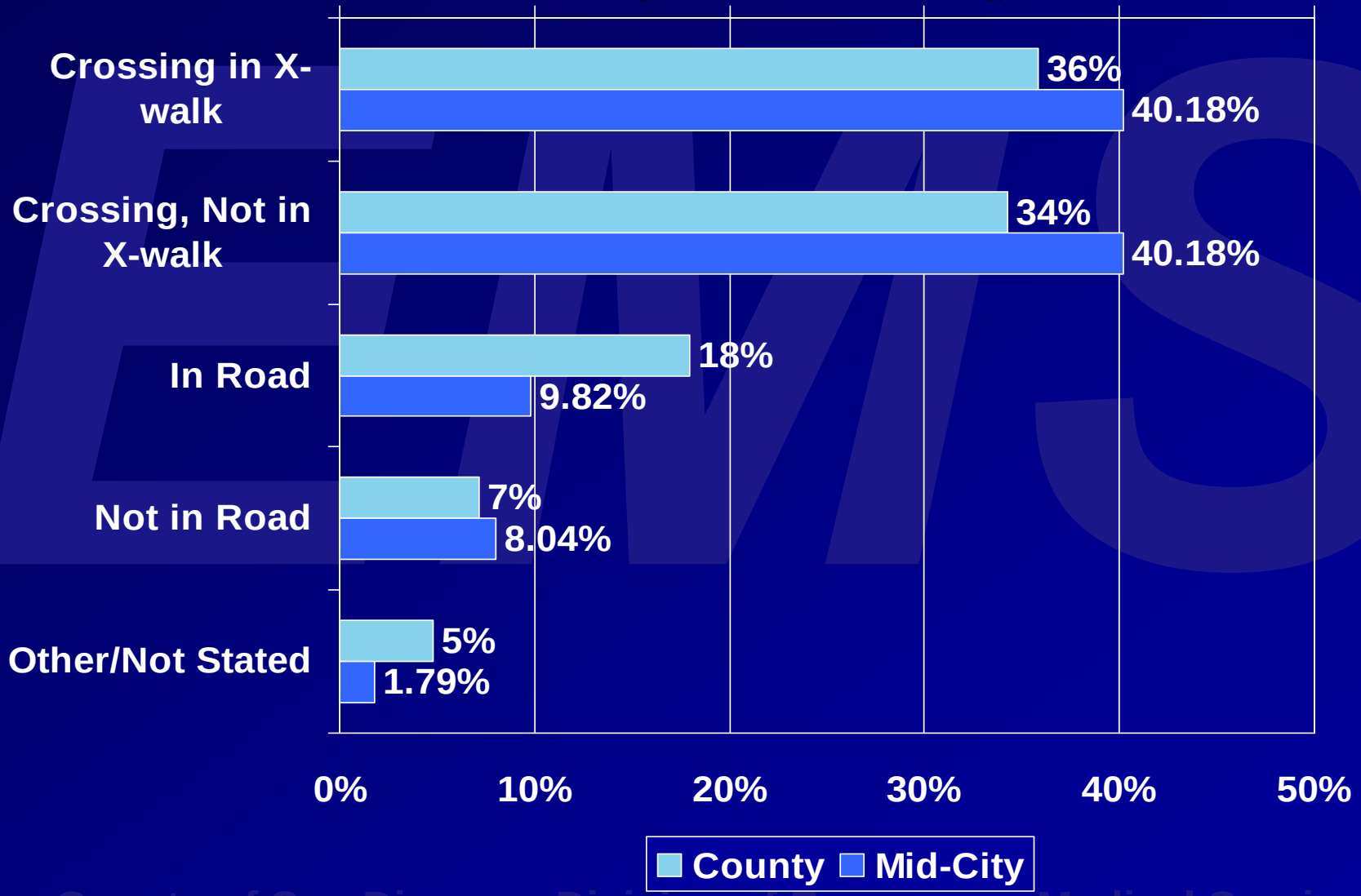
Pedestrian Action: Mid-City vs. County