

CRASH ANALYSIS of the UMD/CSS Study Area
Conducted by the Duluth-Superior Metropolitan Interstate Council, May 2008

Explanation of Methodology

In April and May of 2008, the Duluth-Superior Metropolitan Interstate Council (MIC) conducted an analysis of available crash data for roadways connecting to the campuses of the University of Minnesota and College of St. Scholastica. All crashes in the area that were reported to the State of Minnesota in the years 2004, 2005 and 2006 were used in the analysis. Three years of data were used, because MnDOT uses three years of data in their annual crash analyses. The MIC decided to adopt the methodology used by MnDOT's for its crash analyses so that the findings of this analysis could be compared to regional and statewide average crash and severity rates for intersections and roadways of similar types (see tables 1-3). Data from the years 2004 – 2006 were used for the analysis since they were the three most recent years of data available at the time.

Intersections:

For analyzing crash histories at area intersections, a buffer of 50ft was applied. All crashes that occurred within 50ft of an intersection were assumed to be associated with that intersection. Once all relevant crashes were identified, a series of calculations were applied to the intersection to determine a crash rate, severity rate and crash cost value for that intersection. All rate values are measured in terms of *million vehicles entering the intersection* (MEV). Crash costs are determined by crash severity and are written as *cost per year*. The formulae for these calculations are as follows:

$$\text{Crash Rate} = \frac{(\text{total crashes}) \times (1,000,000 \text{ vehicles})}{(3 \text{ years}) \times (365 \text{ days}) \times (\text{annual avg. daily traffic})}$$

$$\text{Crash Severity:} = \frac{(1,000,000 \text{ vehicles}) \times (\text{weighted avg. of all crash's severity})}{(3 \text{ years}) \times (365 \text{ days}) \times (\text{annual avg. daily traffic})}$$

| Severity type | Severity Weight | Crash cost |
|-------------------------------|-----------------|--------------|
| Fatality (K) | 5 | \$3,600,000* |
| Incapacitating injury (A) | 4 | \$280,000 |
| Non-incapacitating injury (B) | 3 | \$61,000 |
| Possible injury (C) | 2 | \$30,000 |
| Property damage only (D) | 1 | \$ 4,400 |

* Crash costs for the first and second fatality crashes experienced at an intersection are adjusted to equal \$560,000

Road segment:

For analyzing the crash histories of road segments, no buffer was applied. Instead, only the crashes occurring along the segment were counted. Once all relevant crashes were identified, a series of calculations were applied to the intersection to determine a crash rate, severity rate and crash cost value for that intersection. All rate values are measured in terms of *million vehicle miles traveled* (MVM). Crash costs are determined by crash severity and are written as *cost per year*. The formulae for these calculations are as follows:

$$\text{Crash Rate} = \frac{(\text{total crashes}) \times (1,000,000 \text{ vehicles})}{(3 \text{ years}) \times (365 \text{ days}) \times (\text{annual avg. daily traffic}) \times (\text{miles})}$$

$$\text{Crash Severity:} = \frac{(1,000,000 \text{ vehicles}) \times (\text{weighted avg. of all crashes' severity})}{(3 \text{ years}) \times (365 \text{ days}) \times (\text{annual avg. daily traffic})}$$

Locations of concern:

For the purpose of the UMD/CSS study those locations (intersections or road segments) that exceeded more than one regional average were identified as locations of concern. Figure 1 and Figure 2 show the locations identified as such and how they compare to the regional average crash rates and severity rates for locations of similar type.

State & Regional Crash Values used for Comparison in the UMD/CSS Transportation Study— May, 2008

| Table 1: Average values for signalized intersections (MnDOT 2004-2005) | | | | |
|--|------------------|------------|---------------|-----------------------|
| SIGNALIZED INTERSECTIONS | REGION | CRASH RATE | SEVERITY RATE | AVG. CRASHES PER YEAR |
| High volume (>15,000 ADT) & high speed (>45 mph) | MnDOT District 1 | 0.60 | 0.90 | 4.20 |
| | Statewide | 0.80 | 1.20 | 9.90 |
| High volume (>15,000 ADT) & low speed (<45 mph) | MnDOT District 1 | 0.40 | 0.70 | 3.40 |
| | Statewide | 0.70 | 1.00 | 6.50 |
| Low volume (<15,000 ADT) & high speed (>45 mph) | MnDOT District 1 | 0.50 | 0.80 | 2.20 |
| | Statewide | 0.70 | 1.10 | 3.00 |
| Low volume (<15,000 ADT) & low speed (<45 mph) | MnDOT District 1 | 0.50 | 0.70 | 1.80 |
| | Statewide | 0.60 | 0.90 | 2.50 |

| Table 2: Average values for unsignalized intersections (MnDOT 2004-2005) | | | | |
|--|------------------|------------|---------------|-----------------------|
| UNSIGNALIZED INTERSECTIONS | REGION | CRASH RATE | SEVERITY RATE | AVG. CRASHES PER YEAR |
| Urban 4-way stop | MnDOT District 1 | 0.80 | 1.40 | 1.70 |
| | Statewide | 0.60 | 0.80 | 1.60 |
| Urban 2-way stop | MnDOT District 1 | 0.30 | 0.50 | 0.80 |
| | Statewide | 0.30 | 0.40 | 0.90 |

| Table 3: Average values for urban road segments (MnDOT 2004-2005) | | | | |
|---|------------------|------------|---------------|-----------------------------------|
| ROAD SEGMENTS | REGION | CRASH RATE | SEVERITY RATE | CRASH DENSITY (per mile/per year) |
| Urban 4-Lane Roadway Undivided | MnDOT District 1 | 3.10 | 4.70 | 11.80 |
| | Statewide | 4.70 | 6.50 | 24.60 |
| Urban 2-Lane Roadway > 8,000 ADT | MnDOT District 1 | 1.20 | 1.90 | 5.00 |
| | Statewide | 2.70 | 3.90 | 12.60 |
| Urban 2-Lane Roadway 5,000 to 7,999 ADT | MnDOT District 1 | 1.80 | 2.50 | 4.40 |
| | Statewide | 2.00 | 2.90 | 4.80 |
| Urban 2-Lane Roadway < 5,000 ADT | MnDOT District 1 | 1.90 | 2.40 | 2.20 |
| | Statewide | 2.10 | 3.10 | 2.40 |

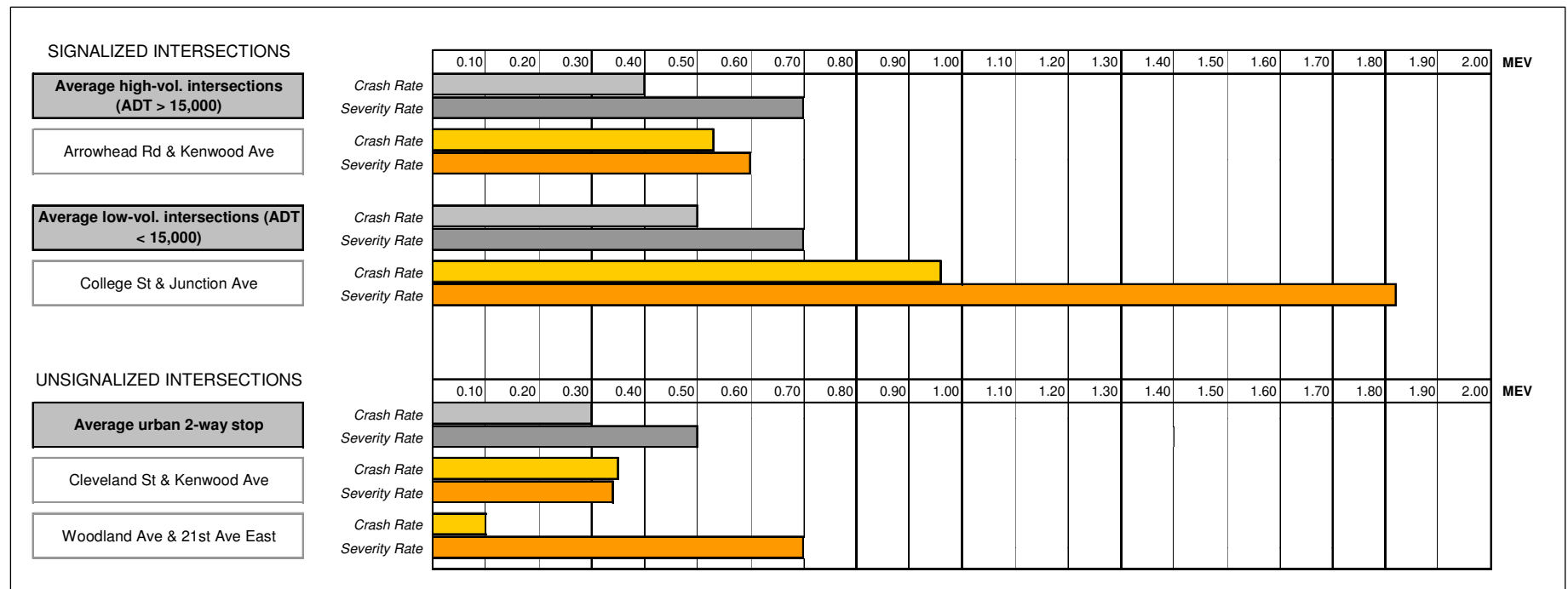
Table 4: Intersection Crashes in the UMD/CSS Study Area (years 2004-2006)

| Intersection | Total Crashes | Intersection ADT | Crash Rate (MEV)* | Severity Rate (MEV)* | Crash Cost Per Year ** |
|---------------------------------------|---------------|------------------|-------------------|----------------------|------------------------|
| Arrowhead Rd & Kenwood Ave | 17 | 27,600 | 0.53 | 0.60 | \$40,533 |
| College St & Junction Ave | 9 | 8,550 | 0.96 | 1.82 | \$88,666 |
| College St & Kenwood Ave | 7 | 16,700 | 0.38 | 0.49 | \$27,333 |
| College St & Woodland Ave | 4 | 23,000 | 0.16 | 0.24 | \$24,733 |
| Cleveland St & Kenwood Ave | 4 | 10,400 | 0.35 | 0.44 | \$14,400 |
| St Marie St & Carver Ave | 2 | 7,550 | 0.24 | 0.49 | \$21,800 |
| Woodland Ave & 21 st Ave E | 2 | 19,100 | 0.10 | 0.70 | \$11,466 |
| Arrowhead Rd & Woodland Ave | 2 | 29,500 | 0.06 | 0.06 | \$2,930 |
| St Marie St & Woodland Ave | 1 | 21,175 | 0.04 | 0.17 | \$93,333 |
| E 4 th St & Woodland Ave | 1 | 17,800 | 0.05 | 0.15 | \$20,333 |
| Clover St & Woodland Ave | 1 | 16,600 | 0.06 | 0.11 | \$10,000 |
| College St & Snelling Ave | 1 | 4,700 | 0.19 | 0.19 | \$1,466 |
| Martha St & Skyline Parkway | 1 | 16,300 | 0.06 | 0.06 | \$1,466 |
| Arrowhead Rd & Carver Ave | 0 | 17,350 | 0.00 | 0.00 | \$0 |

* MEV = million vehicles entering intersection.

** Crash cost = cost per intersection per year (values represent MnDOT 2006 crash cost estimates based on severity).

Figure 1: Intersections exceeding more than one regional average – comparison of crash rates and severity rates.



MEV (Million Entering Vehicles) represents the number of crashes expected for every million vehicles entering an intersection. In the case of crash severity, it represents the number of crashes expected for every million vehicles entering, if every crash's severity were converted to equivalent property-damage crashes (eg. one incapacitating-injury crash equals four property-damage crashes).

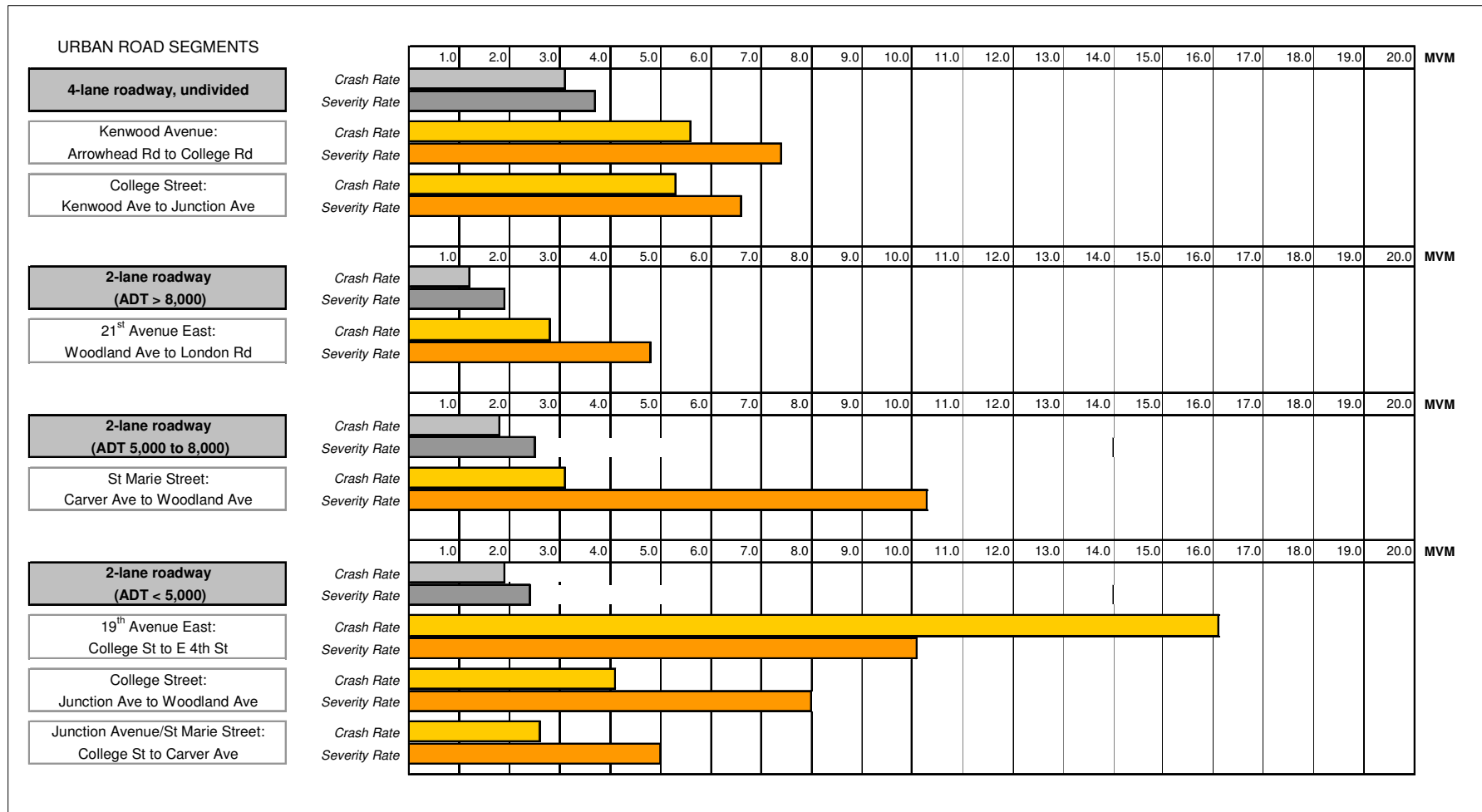
Table 5: Segment Crashes in the UMD/CSS Study Area (years 2004-2006)

| Segment | Distance (mi) | Segment ADT | Crashes (2004 – 2006) | Crash Density (per mile/year) | Crash Rate (MVM)* | Severity Rate (MVM)* | Crash Cost Per Year** |
|--|---------------|-------------|-----------------------|-------------------------------|-------------------|----------------------|-----------------------|
| College St: Kenwood Ave to Junction Ave | 0.51 | 6,500 | 16 | 10.05 | 4.41 | 6.61 | \$190,457 |
| St Marie St: Carver Ave to Woodland Ave | 0.25 | 5,300 | 6 | 8.00 | 4.14 | 10.34 | \$629,066 |
| College St: Junction Ave to Woodland Ave | 0.58 | 4,700 | 13 | 7.50 | 4.36 | 8.04 | \$207,126 |
| Arrowhead Rd: Kenwood Ave to Carver Ave | 1.07 | 15,100 | 16 | 5.00 | 0.91 | 1.19 | \$125,420 |
| Arrowhead Rd: Carver Ave to Woodland Ave | 0.38 | 11,800 | 4 | 3.50 | 0.81 | 0.81 | \$15,438 |
| Kenwood Ave: Arrowhead Rd to College St | 0.38 | 10,400 | 24 | 21.10 | 5.55 | 7.39 | \$451,403 |
| 21 st Ave E: Woodland Ave to London Rd | 0.61 | 14,500 | 27 | 14.80 | 2.79 | 4.75 | \$342,513 |
| Woodland Ave: College St to 21 st Ave E | 0.28 | 18,300 | 10 | 11.90 | 1.78 | 3.03 | \$272,142 |
| 19 th Ave E: College to East 4 th St | 0.74 | 3,050 | 25 | 11.30 | 16.09 | 10.12 | \$234,684 |
| Woodland Ave: St Marie to College St | 0.56 | 16,600 | 10 | 6.00 | 0.98 | 1.96 | \$188,214 |
| Junction Ave: College St to Carver Ave | 0.92 | 3,775 | 10 | 3.60 | 2.63 | 5.00 | \$107,246 |
| Kenwood Ave: College St to Martha St | 0.78 | 10,200 | 6 | 2.60 | 0.69 | 0.92 | \$33,162 |
| Woodland Ave: Arrowhead Rd to St Marie | 0.28 | 17,700 | 1 | 1.20 | 0.18 | 0.18 | \$5,238 |

* MVM = million vehicle miles traveled.

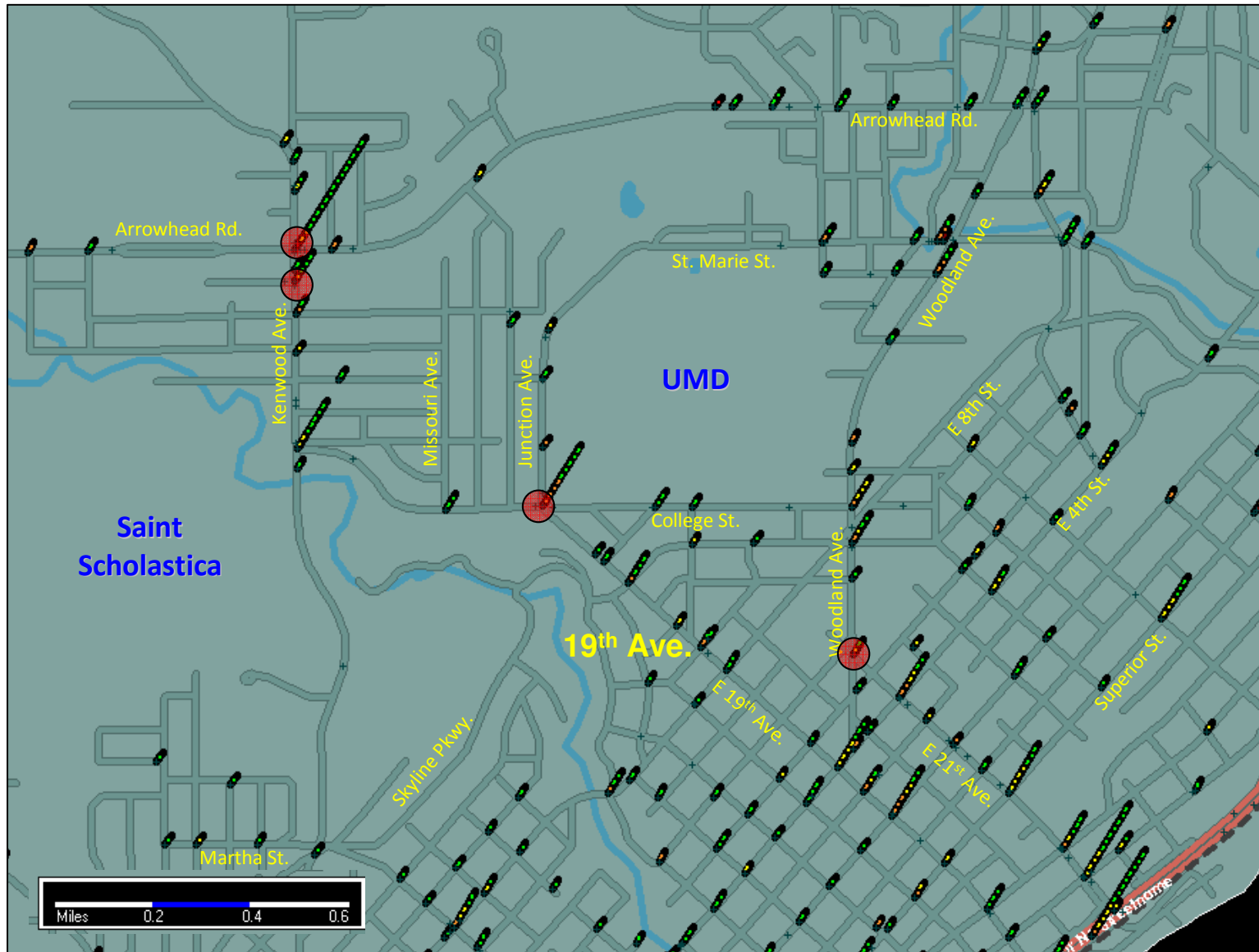
** Crash cost = cost per mile/per year (values represent MnDOT 2006 crash cost estimates based on severity).

Figure 2: Segments exceeding more than one regional average – comparison of crash rates and severity rates.



MVM (Million Vehicle Miles) represents the number of crashes expected for every million vehicle miles traveled along the segment. In the case of crash severity, it represents the number of crashes expected for every million vehicle miles traveled, if every crash's severity were converted to equivalent property-damage crashes (eg. one incapacitating-injury crash equals four property-damage crashes).

Map 1: Intersections exceeding more than one regional average – comparison of crash rates and severity rates.



Map 2: Segments exceeding more than one regional average.

