MORPC'S TOP 100 REGIONAL HIGH-CRASH LOCATION METHODOLOGY

OVERVIEW

MORPC's method of identifying high-crash locations is one of many possible 'network screening' processes described in the transportation safety literature. The high-crash location lists are intended to serve as a starting point for the identification and resolution of traffic safety issues in the region. For any given location, a more detailed study is required to fully understand and address the relevant safety problems. Furthermore, the locations on the high-crash location list are not necessarily 'dangerous.' In many cases, the number of crashes is a function of the number of vehicles that enter the intersection, rather than an indication of a correctable safety problem.

In preparing its high-crash location lists, MORPC relies on crash data submitted by law enforcement agencies to the Ohio Department of Public Safety (ODPS). The data received by ODPS is processed by the Ohio Department of Transportation (ODOT), which makes it available to public agencies for download. Based on the information contained in the original crash report, ODOT provides latitude and longitude coordinates, which MORPC uses for its analysis.

To identify the top high-crash locations, MORPC uses crash data spanning a three-year period. The analysis includes all intersections in MORPC's transportation planning area except those involving ramps, freeways, and similar limited-access highways. Crashes are attributed to an intersection if they fall within 250 ft. of the center of the intersection, as explained below. No attempt is made to determine whether the crash is related to the engineering aspects of the intersection. It is simply intended to identify problem areas for further study.

The combination of criteria used to develop the high-crash location list reflect the fact that traffic safety can be measured in different ways, and there is not a single measure that completely encapsulates the notion of safety. The performance measures used in MORPC's intersection rankings are well-established metrics in the highway safety literature. The pros and cons of these measures are described in the *AASHTO Highway Safety Manual, Vol. 1*.

Definitions

- Crash Frequency: the total number of crashes within 250 ft. of the given intersection.
- Equivalent Property Damage Only Index (EPDO): the relative severity of crashes at a given intersection.
- Crash Rate (MEV Rate): the total number of crashes per million vehicles entering the intersection.

Formulas

*Equivalent Property Damage Only Index (EPDO) = (37.56 * Fatal & Ser Inj + 6.55 * Vis Inj + 4.44 * Pos Inj + PDO) / N, where*

Fatal & Ser Inj = Number of fatal & serious injury crashes at the given location;
Vis Inj = Number of visible injury crashes at the given location;
Pos Inj = Number of possible injury crashes at the given location
PDO = Number of property-damage only crashes at the given location; and
N = Total number of crashes at the given location (Fatal & Ser inj + Vis Inj + Pos Inj +PDO)

*Crash Rate = (N / 3) / (365 * ADT / 1,000,000), where*

N = Total number of crashes at the given location over 3 years; and
ADT = Average daily traffic entering the intersection

Rank Sum = Crash Frequency Rank + Severity Index Rank + Crash Rate Rank

ANALYSIS PROCESS

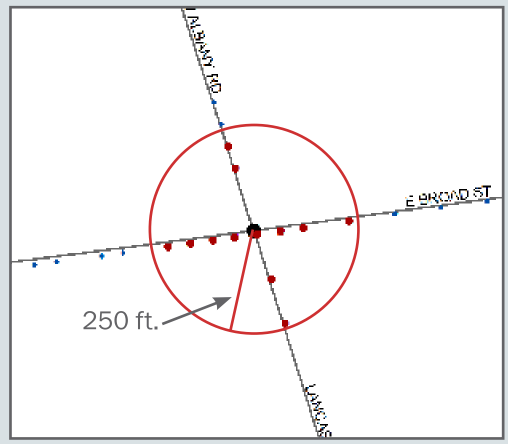
MORPC identifies regional high-crash intersections using a two-step process. First, the top 150 high-crash intersections are selected based on the total number of crashes (frequency). These locations are then further analyzed in terms of crash severity and rate. The final ranking reflects all three measures (frequency, severity, and rate).

IDENTIFYING THE TOP 100 CRASH INTERSECTIONS

Crash data downloaded from ODOT is imported into ArcGIS, and a spatial join process is used to assign each crash to the nearest intersection. The join is limited to 250 ft., so that crashes farther than 250 ft. from an intersection are not assigned to any intersection. After the spatial join is implemented, the number of crashes is tallied for each intersection, and the top 1,000 locations are selected for further analysis.

The spatial join process is then repeated a few more times, with a smaller number of intersections at each iteration until roughly 150 intersections remain. This iterative process is intended to address the situation where multiple intersections are in close proximity, causing crashes to be split amongst these intersections in the first pass. By constraining the analysis to intersections with a higher number of crashes, the lesser intersections are eventually excluded from consideration.

Although the mechanics differ slightly, the spatial join method is conceptually the same as drawing circles (buffers) around each intersection and counting the number of crashes within each circle, as shown in the image to the right. Unlike the buffer method, the spatial join method results in each crash being assigned to a single intersection.



Crashes in red are assigned to the intersection of Broad St. and Lancaster Ave/Reynoldsburg-New Albany Rd. as they are within 250 ft. of the center of the intersection. The blue points outside the red circle represent crashes that are not assigned to an intersection.

DEVELOPING THE TOP 100 RANKINGS

Once the top 150 high-crash locations are identified, the severity index and crash rate are calculated for each intersection using the definitions and formulas above. Each intersection is then ranked separately according to crash frequency, severity, and crash rate.

The separate rankings are then summed to produce a combined ranking (Rank Sum) for each intersection. The intersection with the lowest Rank Sum is deemed the top high-crash location on the list. The top 100 intersections resulting from this ranking are included in MORPC's regional high-crash intersection list.

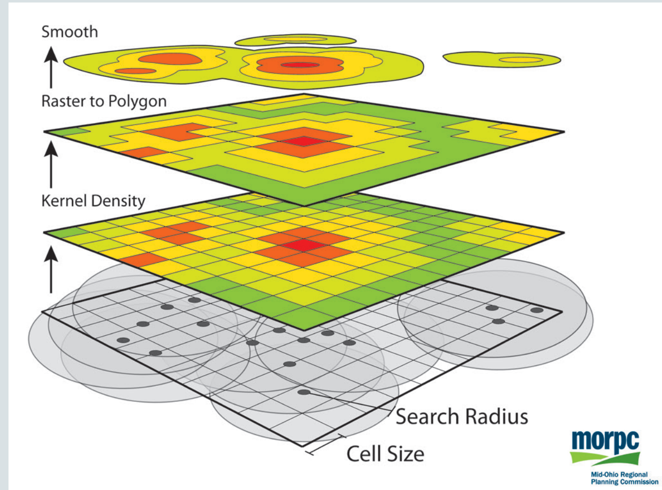
HIGH-CRASH LOCATIONS BY JURISDICTION

Since the majority of the intersections on MORPC's top 100 high-crash location list are within the City of Columbus, MORPC also produces a separate list of the top 5 high-crash intersections for each jurisdiction. The ranking on this list is based on crash frequency alone. Severity index is also reported, but does not factor into the rankings.

PEDESTRIAN AND BICYCLE HIGH-CRASH CLUSTERS

Although the number of pedestrian and bicycle crashes in Central Ohio is relatively low compared to other crash types, they tend to be much more severe, and therefore are an important area of concern. MORPC analyzes the locations of crashes involving these unit types differently than the overall high-crash location methodology due to several constraints:

- Lower frequency can result in extreme year-to-year variation, especially when factoring in severity.
- Pedestrian and bicycle traffic volumes are not measured or estimated for the entire roadway network, limiting the ability to calculate crash rates based on exposure.
- The nature of pedestrian and bicycle activity may lead to clusters away from intersections.



The kernel density tool in ArcGIS converts crash points into a high resolution raster image identifying high-crash clusters, which is then converted into polygon shapes.

Just as with the other analysis processes, crash data from ODOT is imported into ArcGIS. Data associated with these crash points allows for the following steps to focus on either crashes involving pedestrians or crashes involving bicyclists. Because of the lower frequency, the analysis considers five years worth of crashes, rather than the three years used in identifying the Top 100 intersections for all crash types.

Tools inside ArcGIS Spatial Analyst help identify and calculate the relative magnitude or density of pedestrian or bicycle crashes by overlaying a ten square foot grid on top of the crash points, then assigning a score to each grid based on the number of crashes within 500 feet of that grid cell. Various tools are used within ArcGIS to fit a smoothly tapered surface on that grid.

The number of crashes within each of the highest-crash clusters is then calculated through a spatial join process where only the pedestrian or bicycle crashes occurring within that cluster are counted. Each highest-crash cluster is then ranked separately according to crash frequency and severity. These two rankings are then summed for each cluster (crash frequency is weighted by 0.7 and severity is weighted by 0.3), producing a combined weighted ranking. The cluster with the lowest weighted ranking is deemed to be the top pedestrian/bicycle high-crash location on the list. The resulting list and map include other pedestrian or bicycle crash clusters to help identify patterns that may require further analysis.