Corridor Management: Identifying Corridors with Access Problems and Applying Access Management Treatments, A U.S. 20 Study

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**Introduction**
Many growing communities are experiencing the negative feedbacks from development. Drastic increases in commercial growth usually have negative safety impacts on traffic due to poor access management. Contributing factors which lead to poorly managed corridors can be reflected in the land use pattern, abundance of driveways, too many traffic signals, and poor road design. As a result, poorly managed corridors are more susceptible to crashes, due to increased conflict points. Through corridor management, poorly managed corridors can be corrected using different techniques, which vary depending on the corridor. In order to implement corridor management, there needs to be planning and cooperation between the jurisdictions involved. There are numerous roads in Iowa that need the attention of corridor management, however some more than others. The objective of this paper is to provide an example for identifying poorly managed corridors and to explore some remedies to correct the problem.

**Identifying Poorly Managed Corridors**
There are numerous characteristics to consider when identifying corridors with poor access management. The first significant indicator of poor access management is to look at crash frequencies along the corridor. Corridors with a significant portion of probable access-related crashes are typically those in urban and sprawling areas. Probable access-related crashes are those that are the result of areas with low access control, such as a heavily traveled urban corridor with a high density of commercial driveways, numerous traffic signals, and lack of turning lanes. Probable access-related crashes are identified from the total crashes that occurred along the corridor. Turning, broadside, and rear-end crashes are typically associated with access problems on roadways, therefore they are used to measure the amount of crashes due to poor access management.

Land use is an important factor when considering planning for future traffic along a corridor. Obtaining current and future land use information is important, usually from a city planning and zoning department or regional planning association. Land use maps are important because they indicate what type of traffic a corridor might currently have, and how it could possibly change in the near future. As well, observing the current and future land use can identify access management issues. For example, if a corridor currently has a mix of commercial and industrial use, one might assume (based on our knowledge of the roadway geometry and traffic characteristics) that there is a moderate to high amount of driveway locations that are indicators of probable access-related crashes. One can then look at the future land use to see if roadway changes will need to be made in order to safely accommodate the needs of its users. Additional commercial or residential use detected in the future land use along the corridor should be noted.
Commercial use typically receives heavier amounts of traffic, and increases the driveway density along the corridor. In rural areas, residential development can be problematic along corridors with higher speed limits.

Along with land use, the population of the corridor study area should be observed. Census information provides the actual population, which is important to indicate. Areas with a rapidly growing population experience higher volumes of traffic, which in turn create more conflict along any corridor, especially those with poor access management. Population projections indicate whether the population is expected to increase or decrease. It is important to consider the current and future populations in order to plan properly for a corridor.

Access locations along a corridor have a large impact on the safety of the corridor. A corridor with a low driveway density typically has lower crash rates compared to one with a high driveway density. Driveway density is the average of the total driveways per mile along the study corridor. To find driveway density, the total number of driveways must be divided by the total length of the study corridor. For urban arterial routes it is ideal to have a driveway density under ten (Preston, Howard). Urban arterials with ten to thirty driveways per mile are considered moderate and over thirty driveways are considered high (Preston, Howard). There is usually a significant increase in crashes along urban arterials with thirty or higher driveways per mile. For rural arterials, a driveway density of five or lower is ideal (Preston, Howard). When there is an excess of ten driveways per mile, crashes are more likely due to higher posted speed limits and turning movements at the access locations.

A high driveway density is not the only contributing factor to a poorly managed corridor. Other factors that lead to access related crashes include high density of traffic signals and poor road design. When there is a high density of traffic signals along a corridor, stop and go traffic is common, which results can result in numerous rear-end crashes. Collisions as the result of a turning movement are a big problem along urban arterials. They can be easily remedied through the proper use of medians non-traversable medians, with optional turn lanes where needed. Non-traversable medians work well because they eliminate the number of conflict points on the road, by prohibiting certain turning movements.
**U.S. 20: Corridor Management Study**

**Study Area**

U.S. 20 in Dubuque County, located in eastern Iowa is the study corridor. It was selected because of the growing population, increased development, high traffic volumes, and future growth that it has been exposed to. The study corridor is approximately 28.5 miles, extending from the City of Dyersville through the cities of Farley, Epworth, Peosta and into the City of Dubuque. Figure one shows a map of the study corridor.

**FIGURE 1. U.S. 20 STUDY AREA**

The corridor was broken up into three segments for the study due to different land use characteristics. The segments are in order from east to west, with segment one starting in the City of Dubuque. The first segment is approximately two miles in the urban setting of the City of Dubuque, from Devon Drive to Northwest Arterial. Segment two spans approximately eight miles from Northwest Arterial in the City of Dubuque to Peosta. This is a suburban segment, which is a transition from the urban setting of the City of Dubuque to the rural county. Segment three extends 18.5 miles in the rural setting of Dubuque County, which passes through the cities of Peosta, Epworth, Farley, and Dyersville.
Population
Demographic data including the past, current, and future populations have been observed for the county and city limits along the corridor study area. Historical and current population figures can be accessed from the U.S. Census Bureau, as they are beneficial since they can be used to project future populations. The future population of the study area is important to determine whether traffic volumes would be expected to increase. Figure two shows the population, by decade, for Dubuque County from 1850 to 2000. According to the 1850 Census there were slightly over 10,000 persons. The most current Census, from 2000, indicates that nearly 90,000 persons reside in Dubuque County.

![FIGURE 2. DUBUQUE COUNTY POPULATION](image)

Source: U.S. Census Bureau

Table one shows the population change for the county and cities from 1980 to 2000. The table indicates that all of the cities have increased in population from 1990 to 2000, with the exception of Farley. The City of Peosta has increased tremendously, by over 408 percent. More than likely this is attributed to the growth from the City of Dubuque, which is less than ten miles away. Figure three shows population projections for the county in five-year increments from 2005 to 2030. The projections indicate that the county is expected to increase to slightly over 119,000 persons in the year 2030. It is important to note that projections are based on past and current migration, birth, and mortality rates. They are to be used only for guidance, as they will not be exact, and in some cases they might be completely wrong.
As table two indicates, the number of commuters into Dubuque County has increased since 1990. The 1990 Census indicated that 7,896 persons commuted into the county for work, which made up 17 percent of the total workers in the county. According to the 2000 Census, that number has increased to 19 percent, which is nearly 10,000 persons who commute into the county on a daily basis. The majority of the commuter’s origin come in from Delaware County to the west of Dubuque County, with approximately 1,100 commuters. Other counties of commuter origins include Grant County (Wisconsin), Jo Daviess County (Illinois), Jackson and Delaware County (Iowa).
Land Use
For the study, ArcView 3.2, a Geographic Information System (GIS) software package was used for all of the data. Current and future land use data were obtained from East Central Intergovernmental Association and the Dubuque County Auditor’s Office in electronic format for the application of GIS software. ArcView 3.2 was used for the study because of its ability to integrate data with the maps. Figure four shows the current land use by parcel along segment one. As seen in the figure, segment one consists of predominately commercial land use. Future land use for the City of Dubuque was not available, so the most recent future land use map was observed. The future land use for segment one indicates that commercial development is likely to encroach into portions of segment two. The future land use for segment one is shown in figure five.

FIGURE 4. CURRENT LAND USE, SEGMENT ONE

FIGURE 5. FUTURE LAND USE, SEGMENT TWO

Source: The City of Dubuque Proposed Land Use Map, 11-02
Segment two, the suburban segment, is a transition from the urban environment of the City of Dubuque to the rural portions of the county. The land use along segment two is a mix of primarily commercial and agricultural use. The eastern portion of the segment is commercial development which is influenced primarily by the city. Agricultural land extends along the remaining portion of the corridor to the City of Peosta, as shown in figure six. The future land use for this segment indicates that much of the current agricultural land is to remain as is, with some designated for rural residential development. There are also additional patches of commercial land use just a few miles east of Peosta. Figure seven shows the future land use for segment two.

FIGURE 6. CURRENT LAND USE, SEGMENT TWO
Segment three located in the rural setting of Dubuque County consists of primarily agricultural land. There is currently some, but little commercial and residential land use near the city limits of Farley and Dyersville. The future land use, as shown in figure nine, suggests commercial/industrial growth to the west of Farley. If commercial growth occurs along this portion of the corridor, access problems will arise. It is important to stress the importance of containing the commercial use into one area, perhaps to the south of Farley where land use is already designated for commercial use.
**Crash Analysis**

Once the study area has been examined in terms land use and population, it necessary to look at the crashes that occur along the corridor. For the study, crash records from the Iowa D.O.T geospatial database were selected for the years from 1997 to 2000 using ArcView 3.2. Probable access-related crashes were queried in ArcView, indicating right turn, left turn, and rear end collisions. There were a total of 366 total crashes along the study corridor, with 128 or 35 percent of them being probable access-related crashes. Table three shows a breakdown of the total crashes along U.S. 20.

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>U.S. 20</td>
</tr>
<tr>
<td>--------</td>
</tr>
<tr>
<td>Total Crashes</td>
</tr>
<tr>
<td>Probable Access-Related Crashes</td>
</tr>
<tr>
<td>Rear End</td>
</tr>
<tr>
<td>Left Turn</td>
</tr>
<tr>
<td>Right Turn</td>
</tr>
</tbody>
</table>

Of the total probable access-related crashes the majority of them were rear end collisions. Over 73 percent were rear end collisions, 21 percent were right turn crashes and five percent were left turn crashes. The table below (table four) shows that of the total crashes, over 76 percent of the probable access-related crashes occurred from 1999 to 2000. The data for this study were found to be inconsistent, showing disproportionate amounts of low crashes in the year 1999 and high crashes in the year 2000. This was assumed to be due to data collection error (human error), and to account for this discrepancy crashes were broken into years 1997-1998 and 1999-2000.

<table>
<thead>
<tr>
<th>TABLE 4. PROBABLE ACCESS-RELATED CRASH FREQUENCY TRENDS, 1997 - 2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997-98</td>
</tr>
<tr>
<td>---------</td>
</tr>
<tr>
<td>Total Crashes</td>
</tr>
<tr>
<td>Probable Access-Related Crashes</td>
</tr>
<tr>
<td>Rear End</td>
</tr>
<tr>
<td>Left Turn</td>
</tr>
<tr>
<td>Right Turn</td>
</tr>
</tbody>
</table>

Probable access-related crashes were then observed per segment of the study corridor. As one would expect, the results as shown in table five, show that 44 percent of the probable access-related crashes occurred on segment one.
of the study area. Slightly over 35 percent of the probable access-related crashes occurred on segment two, and only six percent occurred on segment three. The majority of these crashes along segment one and two were rear-end collisions, signifying a possible problem with traffic signals. These results were not surprising, as it is expected that the majority of access related crashes would occur on the urban segment with intense commercial land use, high volumes of traffic, many access points, and traffic signals. Figures ten and eleven show the areas where probable access-related crashes are of most concern, primarily along segment one and two. Note that the majority of these crashes are rear-end collisions, clustered in areas of the urban segment near commercial access points and traffic signals (see figure twelve for a map with traffic signal locations).

**FIGURE 10. PROBABLE ACCESS-RELATED CRASH LOCATIONS, SEGMENT ONE**
TABLE 5. CRASH FREQUENCIES AND PERCENTAGE OF TOTAL CRASHES

<table>
<thead>
<tr>
<th></th>
<th>Segment One</th>
<th>% of total crashes</th>
<th>Segment Two</th>
<th>% of total crashes</th>
<th>Segment Three</th>
<th>% of total crashes</th>
<th>Total crashes</th>
<th>All segments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Crashes</td>
<td>194</td>
<td></td>
<td>108</td>
<td></td>
<td>64</td>
<td></td>
<td>366</td>
<td></td>
</tr>
<tr>
<td>Probable Access-Related Crashes</td>
<td>86</td>
<td>44.33%</td>
<td>38</td>
<td>35.19%</td>
<td>4</td>
<td>6.25%</td>
<td>128</td>
<td></td>
</tr>
<tr>
<td>Rear End</td>
<td>67</td>
<td>34.54%</td>
<td>27</td>
<td>25.00%</td>
<td>0</td>
<td>0.00%</td>
<td>94</td>
<td></td>
</tr>
<tr>
<td>Left Turn</td>
<td>1</td>
<td>0.52%</td>
<td>3</td>
<td>2.78%</td>
<td>3</td>
<td>4.69%</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Right Turn</td>
<td>18</td>
<td>9.28%</td>
<td>8</td>
<td>7.41%</td>
<td>1</td>
<td>1.56%</td>
<td>27</td>
<td></td>
</tr>
</tbody>
</table>

The probable access-related crashes were then broken down by percentage according to the type of collision that occurred per segment. Table six shows that rear end crashes account for the majority of access-related crashes on segments one and two. The clustering of crashes could indicate a possible roadway or driveway problem along segments one and two. As discussed earlier, traffic signals could explain the rear end collisions.
TABLE 6. BREAKDOWN OF PROBABLE ACCESS-RELATED CRASHES PER SEGMENT

<table>
<thead>
<tr>
<th>Probable Access-Related Crashes</th>
<th>Segment One</th>
<th>% of access crashes</th>
<th>Segment Two</th>
<th>% of access crashes</th>
<th>Segment Three</th>
<th>% of access crashes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rear End</td>
<td>67</td>
<td>77.91%</td>
<td>27</td>
<td>71.05%</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>Left Turn</td>
<td>1</td>
<td>1.16%</td>
<td>3</td>
<td>7.89%</td>
<td>3</td>
<td>75.00%</td>
</tr>
<tr>
<td>Right Turn</td>
<td>18</td>
<td>20.93%</td>
<td>8</td>
<td>21.05%</td>
<td>1</td>
<td>25.00%</td>
</tr>
</tbody>
</table>

Next, vehicle miles traveled (VMT) were calculated in order to calculate the crash rates for U.S. 20. The length of U.S. 20 (per segment) and Annual Average Daily Traffic (AADT) were needed in order to calculated the VMT. Segment length and AADT were obtained from the Iowa DOT geospatial database, then VMT was calculated in ArcView using the formula:

- \[ VMT = \text{Length of roadway} \times \text{Time period} \times \frac{\text{Weighted AADT}}{\text{Summed Corridor Length}} \]

Weighted AADT = \( \frac{\text{Length} \times \text{AADT}}{\text{Summed Corridor Length}} \)

Time period = 4 years (1997-2000)

Table seven shows the VMT, AADT, and corridor lengths per segment of the U.S. 20 study. The results showed that segment three was the longest segment in miles, however, its VMT was considerably lower compared to segments one and two. This is explained by the land use, as segment three lies within the rural setting of Dubuque County therefore it is traveled less compared to segment one which generates more trips due to its location in the City of Dubuque. With segment one being only two-miles, the VMT for the segment is rather high, suggesting that there is a high density of traffic along this urban portion of the corridor. With the highest AADT and a segment length of over eight miles, the VMT for segment two indicates that it is the most heavily traveled of the study segments.

TABLE 7. AADT, VMT, AND SEGMENT LENGTH

<table>
<thead>
<tr>
<th></th>
<th>Segment One</th>
<th>Segment Two</th>
<th>Segment Three</th>
</tr>
</thead>
<tbody>
<tr>
<td>AADT</td>
<td>761,300</td>
<td>1,363,300</td>
<td>1,066,400</td>
</tr>
<tr>
<td>VMT</td>
<td>2,524,727</td>
<td>3,081,151</td>
<td>2,148,827</td>
</tr>
<tr>
<td>Corridor Lengths (in miles)</td>
<td>2</td>
<td>8.023</td>
<td>18.583</td>
</tr>
</tbody>
</table>

With the data provided in table seven, crash rates were figured for U.S. 20. To figure crash rates, the crash frequency per corridor was first multiplied by one million, and then divided by the VMT and summed per corridor.
The crash rate is the approximate number of crashes on U.S. 20, for the two-year time span, per million vehicle miles. Total crash rates and probable access-related crash rates were found per segment as shown in table eight.

### TABLE 8. CRASH RATES BY SEGMENT PER MILLION VEHICLE MILES (1997-2000)

<table>
<thead>
<tr>
<th>Segment</th>
<th>Segment One</th>
<th>Segment Two</th>
<th>Segment Three</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Crash Rate</td>
<td>2.62</td>
<td>0.61</td>
<td>0.30</td>
</tr>
<tr>
<td>Probable Access-Related Crash Rate</td>
<td>1.16</td>
<td>0.22</td>
<td>0.02</td>
</tr>
<tr>
<td>Qualitative Assessment</td>
<td>Moderate</td>
<td>Low</td>
<td>Very Low</td>
</tr>
</tbody>
</table>

*Per million vehicles

As tables eight shows, there is a relationship between crash rates and land use. The urban segment, with commercial land use had the highest crash rate and the rural segment with primarily agricultural land use had the lowest crash rates. Crash rates for segment one are much higher compared to segments two and three primarily due to the commercial land use, which also can be explained higher traffic volumes, and higher signal and driveway densities. Since the VMT is rather low for segment three and there are hardly any driveway locations and no traffic signals, the crash rate for this segment is not of much concern.

Examination of crash severity helps one to determine the seriousness of accidents. There are different levels of crash severity, each imposing a different cost to society. The costs were totaled per segment of U.S. 20 to show the impact that each accident has along the study area. The severity levels and their corresponding valuation in dollars used for this study are: fatality crashes at $1 million each, major injury crashes at $150,000 each, minor injury crashes at $10,000 each, and possible injury or property damage only crashes at $2,500 each. Severity values are assigned by the DOT and included in the geospatial database for each crash record.

Table ten shows the total severity costs per segment for all of the crashes that occurred along U.S. 20 from 1997 to 2000. The crash severity for all three segments has totaled over $29,000,000 from 1997 to 2000. Segment one, being the urban segment, experienced the highest total crash severity of nearly $14,900,000. Crash severities were figured for probable access-related crashes as well. Approximately 43 percent, or $12,700,000, of the total crash costs were from probable access-related crashes, as shown in table eleven. Of the 43 percent of probable access-related crash costs, over half of them occurred along segment one, totaling over $7,600,000. These tables indicate that the rural segment poses less safety problems in terms of total and probable access-related crash severities compared to segments one and two.
TABLE 9. SEVERITY PER SEGMENT FOR TOTAL CRASHES ($DOLLARS)

<table>
<thead>
<tr>
<th></th>
<th>Segment One</th>
<th>Segment Two</th>
<th>Segment Three</th>
<th>U.S. 20</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997-98</td>
<td>7,512,500</td>
<td>2,632,500</td>
<td>2,750,000</td>
<td>12,895,000</td>
</tr>
<tr>
<td>1999-00</td>
<td>7,385,000</td>
<td>6,280,000</td>
<td>2,795,000</td>
<td>16,460,000</td>
</tr>
<tr>
<td>Total</td>
<td>14,897,500</td>
<td>8,912,500</td>
<td>5,545,000</td>
<td>29,355,000</td>
</tr>
</tbody>
</table>

TABLE 10. SEVERITY PER SEGMENT FOR PROBABLE ACCESS-RELATED CRASHES ($DOLLARS)

<table>
<thead>
<tr>
<th></th>
<th>Segment One</th>
<th>Segment Two</th>
<th>Segment Three</th>
<th>U.S. 20</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997-98</td>
<td>2,352,500</td>
<td>1,090,000</td>
<td>0</td>
<td>3,442,500</td>
</tr>
<tr>
<td>1999-00</td>
<td>5,290,000</td>
<td>3,635,500</td>
<td>340,000</td>
<td>9,265,500</td>
</tr>
<tr>
<td>Total</td>
<td>7,642,500</td>
<td>4,725,500</td>
<td>340,000</td>
<td>12,708,000</td>
</tr>
</tbody>
</table>

**Driveway Inventory**

A driveway inventory was taken next, to see how many driveways per mile are located along each segment of the corridor. Driveways were identified using orthophotos from 2002 (http://www.gis.iastate.edu) using ArcView. Once each driveway was identified, the density was found by taking the total number of driveways (per segment) and dividing it by the total length (in miles) of the segment. Table twelve below shows that the largest driveway density was along segment one, with four and half driveways per mile.

This is reflected in the crash frequencies, crash rates, and crash severity as displayed previously. As expected the driveway density was much higher for segments one and two compared to segment three. Segment one has the highest driveway density of 4.50 driveways per mile, and segment two has the highest count of driveways (due to the length of the segment) and a driveway density of 3.74. It is notable that the driveway densities are rather low in this study, however, segment two is prone to additional threat from the future commercial land use, which would increase the driveway density. Significantly the crashes tend to be clustered around certain driveways (and access points) along segment one and two, as shown previously.

**TABLE 11. DRIVEWAY DENSITY PER SEGMENT**

<table>
<thead>
<tr>
<th></th>
<th>Driveway Count</th>
<th>Segment Length (miles)</th>
<th>Driveway Density (per mile)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Segment One</td>
<td>9</td>
<td>2.00</td>
<td>4.50</td>
</tr>
<tr>
<td>Segment Two</td>
<td>30</td>
<td>8.02</td>
<td>3.74</td>
</tr>
<tr>
<td>Segment Three</td>
<td>5</td>
<td>18.58</td>
<td>0.27</td>
</tr>
</tbody>
</table>
Traffic Signal Inventory
Another reason for some of the probable access-related crashes can be related to the number of traffic signals along segment one. There are a total of eight signals along the study corridor, seven of them located along segment one. Table thirteen lists the location of each traffic signal and figure twelve shows the actual location of the signals. The abundance of traffic signals along segment one could explain the high amount of access-related crashes, particularly rear end crashes.

<table>
<thead>
<tr>
<th>Intersection</th>
<th>Segment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Devon Drive</td>
<td>One</td>
</tr>
<tr>
<td>Brunskill Road</td>
<td>One</td>
</tr>
<tr>
<td>Cedar Cross Road</td>
<td>One</td>
</tr>
<tr>
<td>Wacker Drive</td>
<td>One</td>
</tr>
<tr>
<td>Century Drive</td>
<td>One</td>
</tr>
<tr>
<td>Menard Court</td>
<td>One</td>
</tr>
<tr>
<td>Northwest Arterial</td>
<td>One</td>
</tr>
<tr>
<td>Old Highway Road</td>
<td>Two</td>
</tr>
</tbody>
</table>

Figure twelve shows driveway locations and traffic signals along segment one and a small portion of segment two. This figure illustrates that the combination of traffic signals and many access points can pose problems. With large volumes of traffic traversing this portion of the corridor, such features contribute to higher crash rates. As seen in figure twelve, many of the signals are within close distance to one another. Signals should not be spaced less than a half a mile apart, as this causes stop and go traffic, creating additional risk to rear end collisions, especially at peak hours (Access Management Handbook, 2000).
Access Management Solutions
“Access management provides access to land development while simultaneously preserving the flow of traffic on the surrounding road system in terms of safety, capacity, and speed (Koepke & Levinson, ).” There are numerous access management techniques, such as applying raised medians, frontage/backage roads, improved driveway design, and signal spacing/removal. Many of these techniques can be applied to U.S. 20, however, some might be more effective than others but all alternatives should be considered. For the U.S. 20 study, the use of access management techniques are primarily needed along segment one and two.

Limited Driveways
Of the access management techniques, limiting the number of driveways along U.S. 20 is the most ideal. Limiting the number of driveways reduces the number of conflict points along a corridor. Since the number of driveways along segment three is already low, municipal action should be taken to preserve the low driveway density. For arterials with a high driveway density, the addition of driveways should be restricted in the future. Alternatives to creating new driveways include the use of shared driveways and frontage or backage roads, which is discussed later in the report.

Driveway Spacing
It is important for municipalities to encourage wide spacing between driveways (Iowa Access Management Handbook, 2000). Driveways located close in proximity pose the risk of collisions due to unsafe sight distances and stop and go traffic (Iowa Access Management Handbook, 2000). Table fourteen, shows minimum driveway spacing
locations as suggested in the Iowa Access Management Handbook. U.S. 20, a major arterial, should have an adjacent driveway spacing of at least 275 feet and an opposite right driveway spacing of at least 300 feet (Iowa Access Management Handbook, 2000). These minimum values are violated along the urban portion of U.S. 20.

<table>
<thead>
<tr>
<th>Street Classification</th>
<th>Min. Adjacent Spacing (feet)</th>
<th>Min. Opposite Right Spacing (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local Street</td>
<td>150</td>
<td>125</td>
</tr>
<tr>
<td>Collector</td>
<td>185</td>
<td>175</td>
</tr>
<tr>
<td>Minor Arterial</td>
<td>230</td>
<td>225</td>
</tr>
<tr>
<td>Major Arterial</td>
<td>275</td>
<td>300</td>
</tr>
</tbody>
</table>

Iowa Access Management Handbook, 2000

Figure thirteen shows a good example of driveways within too close a distance to one another. The location of these driveways are at the eastern portion of segment two. The driveways shown provide access to commercial businesses. The distance between the two driveways is approximately 230 feet, which is unsafe according to the Iowa Access Management Handbook, as indicated in table fourteen. Driveways with such a close distance along a major arterial, such as U.S. 20, are more susceptible to access-related crashes. This could be easily remedied by consolidating the two driveways.
**Shared Driveways**

Sharing driveways is an easy and effective way to prevent access related crashes. This technique is most effective along corridors with a high density of commercial driveways. Sharing driveways works best in areas where driveways are within close distance together, since it is rather inexpensive compared to other alternatives. Using this technique, the driveway density would decrease, thus providing safer access along the corridor. Segment three has some good examples of shared residential driveway as seen in figure fourteen.
**Frontage/Backage Roads**

Frontage and backage roads are good solutions for corridors with a high driveway density due to commercial land development. Frontage/backage roads run parallel to the arterial providing access to commercial businesses. The use of frontage/backage roads eliminates driveways, thus reducing the driveway density along a corridor and providing safer access. Frontage/backage roads are a good strategy for areas experiencing suburban growth, such as segment two of U.S. 20. For the U.S. 20 study, there are numerous locations where frontage roads could be used to remedy the access problems particularly along segment one and two.

Figure fifteen, illustrates a possible location for applying a frontage road to U.S. 20. The frontage road would provide access to four commercial lots located west of Devon Drive along segment one. This particular frontage road would reduce the number of driveways in half, which could prevent a number of access-related crashes along the segment. Figures sixteen and seventeen show other possible locations for frontage roads along segment one of U.S. 20.
FIGURE 15. POSSIBLE FRONTAGE ROAD, SEGMENT ONE (WEST OF DEVON DRIVE)
FIGURE 16. POSSIBLE FRONTAGE ROAD, SEGMENT ONE (MENARD COURT AND WACKER DRIVE)

FIGURE 17. POSSIBLE FRONTAGE ROAD, SEGMENT TWO (WEST OF NORTHWEST ARTERIAL)
Signal Spacing/ Signal Removal
An abundance of traffic signals can produce access-related crashes, due to stop and go traffic. The amount of traffic signals along U.S. 20 is not a big issue, however, it could pose future threats along segment one and parts of segment two. Currently segment one has seven traffic signals and segment two has one traffic signal. Traffic signals are generally good for directing the flow of traffic on commercial corridors with heavy use, however, when there are too many traffic signals, which are spaced too closely together, accidents are bound to occur. Rear-end collisions are the most common accidents that occur in the event of numerous traffic signals within close distance. As well, this control delay can create driver discomfort and frustration.

The ideal spacing between traffic signals for urban areas is at least one half mile apart or 2,640 feet (Genesee Transportation Council). When traffic signals are closer in distance than one half-mile, vehicles are exposed to additional risk, decreasing speeds, and queuing. Figure eighteen shows the distance between traffic signals along segment one of U.S. 20. A couple of signals are spaced approximately 850-870 feet apart, which is considerably lower than suggested. To remedy this, the signal at Wacker Drive or Cedar Cross Road could be studied for removal. Depending on the roadway and its traffic characteristics, taking out signals will not always remedy the problem, however, it is important to consider.
Driveway Improvements

Other techniques that can be used to improve access management along a corridor include modifications to the physical features of the driveways. Driveways with a poor turning radius, very narrow width, or a steep slope can be held accountable for many access-related crashes. These type of physical features cause abrupt stops or a sudden decrease in the speed of the automobile making the turning movement, thus increasing risk (Iowa Access Management Handbook, 2000). Collisions typically occur when the vehicle behind the turning vehicle is not paying attention, speeding, does not have enough reaction time or a combination of each, therefore, a rear-end collision occurs.

Turning Radius

The turning radius of driveways and roads is important to consider when providing access along an arterial.

Driveways with no turning radius are bad in terms of access management because this forces the turning vehicles to slow to almost a stop in order to make the turn (Iowa Access Management Handbook, 2000). Roads/driveways with a better turning radius, as shown in figure nineteen allow vehicles to maneuver at average turning speeds. Driveways with hardly or no turning radius pose more safety risks along arterials with high traffic volumes, as rear end and turning collisions are common.
Driveway Width
For commercial use driveways should be wide enough for two vehicles to move freely, both in and out of the access point (Iowa Access Management Handbook, 2000). In order to turn into narrow driveways, automobiles tend to slow down drastically. The sudden deceleration of the automobile making the turn can cause traffic on the arterial to slow and possibly pose the risk of causing an accident. Driveways that are too wide, can also be a problem. Wide driveways make it hard for the driver to determine where to position the vehicle in the turn, which can be harmful to other vehicles or pedestrians traversing the path (Iowa Access Management Handbook, 2000). Commercial driveways ideally should be anywhere from 14 to 16 feet in width per lane (Access Management Handbook, 2000).

Driveway Slope
The slope of a driveway is also an important element to consider when looking for better access solutions. Steep driveways pose the same problem as narrow driveways in that they cause entering/exiting vehicles to slow or come to a stop unexpectedly (Iowa Access Management Handbook, 2000). Driveways with a steep slope are also notorious for damaging automobiles, such as scraping the exhaust, muffler, or low ground effects. Figure twenty, is an example of a driveway with a steep slope at an urban arterial.
Jurisdictional Agreements
In order to implement access management solutions to the corridor there must be cooperation between all jurisdictions involved. An intergovernmental agreement would be beneficial in order to gain cooperation of all jurisdictions in the corridors study area. For U.S. 20, the agreement would include the Iowa Department of Transportation, the Regional Planning Association, and the cities of Dyersville, Dubuque, Epworth, Farley, Peosta. The agreement would address specific issues and solutions to problems along the U.S. 20 corridor. For example, if the future land use is designated for commercial/industrial use in an area with a high density of commercial driveways and access-related crashes it would be addressed in the agreement. As a solution, the agreement should suggest re-directing the growth to another location where there would be less threat to the corridor study.

In the case that the agreement is not approved by all parties, adjustments will need to be made. When all jurisdictions come to consensus with the written agreement, it must be signed in order to implement it. Refer to the appendix to see an example of an intergovernmental agreement, “Intergovernmental Agreement Between the City of Durango and the State of Colorado Department of Transportation.”

Conclusion
Identifying corridors with a high number of access-related crashes is important in order to provide safer travel to users. The U.S. 20 study provides the basic steps to identify access-related problems and strategies to remedy them. If jurisdictions work together in land use planning and address these issues, access problems can be eliminated firsthand. For areas, such as U.S. 20, under the influence of sprawl, access management is a common problem. Identifying the problem and using the proper tools can provide a much safer road. Access management cannot completely eliminate crashes from occurring but it can significantly reduce the costs of crashes (in regards to saved lives, reduced injuries, and less property damage).
References:

5. Iowa State University Geographic Information Systems Support and Research Facility <http://www.gis.iastate.edu> 4-20-03
INTERGOVERNMENTAL AGREEMENT
BETWEEN
THE CITY OF DURANGO
AND
THE STATE OF COLORADO
DEPARTMENT OF TRANSPORTATION

THIS AGREEMENT is entered into this ___ day of _____________ 1997, by and between the City of Durango, (hereafter referred to as the "City"), and the State of Colorado, Department of Transportation (hereafter referred to as the "Department").

WITNESSETH:

WHEREAS, the Department and the City desire to enter into an agreement regulating vehicular access for those sections of State Highway 160 between State Highway 3 and State Highway 550 (hereafter referred to as the "Segment") which are within the City limits, and within La Plata County, in conformance with Section 2.12 of the State Highway Access Code, 2 CCR. 601-1 as amended August, 1985 (hereafter referred to as the "Code"); and

WHEREAS, regulation of vehicular access is necessary to maintain the efficient and smooth flow of traffic, to reduce the potential for traffic accidents, to protect the functional level and optimize the traffic capacity of State Highway 160, to provide an efficient spacing of traffic signals, and to protect the public health, safety and welfare; and

WHEREAS, the Department, and City desire to reach a comprehensive and mutually acceptable roadway access location plan for this Segment for the purpose of meeting current and future capacity demands and public safety criteria while also providing reasonable access needs for local planned development to the extent feasible given existing and future conditions along this section of State Highway.

NOW THEREFORE, for and in consideration of the mutual promises herein contained, the parties hereto agree as follows:

1. The Department and City shall regulate access to the Segment of State Highway 160 in compliance with the Access Code, this agreement, and Exhibit 'A' attached hereto and incorporated herein.

2. Vehicular access to the Segment shall be permitted only when such access is in compliance with Exhibit "A", Code section 1.3.2 and the design requirements of section 4 of the Code.
3. Private accesses which were in legal existence prior to the adoption of this Agreement may continue in existence until such time as a change is required by this agreement. When closure, modification, or relocation of a private access is required, appropriate processes of the City or the State Administrative Procedure Act will be followed.

4. Actions taken by the City and Department with regard to transportation planning and traffic operations within the area addressed by Exhibit 'A' shall not be inconsistent with this agreement.

5. Parcels created after the effective date of this Agreement, which adjoin the segment, shall not be provided with direct access to the Segment, unless such access location, use and design are consistent with the Code, section 4 and Exhibit "A".

6. This Agreement is based upon and is intended to be consistent with the Highway Access Law, §43-2-147 C.R.S., and the Code, both as from time to time amended. Any access decision made along the Segment may not be inconsistent with any amendment to the Code.

7. This Agreement supersedes and controls all prior written and oral agreements and representations of the parties regarding the Segment of State Highway 160 and is the complete integrated agreement of the parties regarding the subject matter hereof.

8. This Agreement may not be amended except by subsequent written agreement of the parties.

9. By signing this Agreement, the parties acknowledge and represent to one another that all procedures necessary to validly contract and execute this Agreement have been performed and the persons signing for each of the parties have been duly authorized to do so.

City of Durango, Colorado

______________________________
Name
Mayor

______________________________
ATTEST:
City Clerk

Approved as to Form:

______________________________
Name
City Attorney

State of Colorado
Department of Transportation

______________________________
Name
Chief Engineer

______________________________
Concur:
Name

______________________________
ATTEST:
Chief Clerk

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