Houston, Texas, Metropolitan Traffic Safety Planning Program

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The metropolitan traffic safety planning program of the Houston–Galveston Area Council in Texas monitors safety in the eight-county region, identifies hazardous locations, and supports other safety efforts. With a spatial crash information system, safety analysis is conducted of counties, cities, roadways, and hot spots. Particular attention is paid to crashes involving fatalities, injuries, speeding, red light running, teenagers, driving under the influence, pedestrians, bicyclists, trucks, and railroad trains. Much of the effort involves distributing information about safety to local governments and to the public at large. In collaboration with local governments and with the Texas Department of Transportation, engineering analysis is conducted of specific safety hot spots to recommend measures to mitigate crashes. Partnerships are created to widen the scope of safety efforts in the region. In addition, major crash hot spots have been identified and are included in the long-range transportation plan. Finally, a Regional Safety Council has been established to allow a policy forum for integrating the various safety efforts of transportation, medical, law enforcement, industry, nonprofit, and other organizations. An annual safety summit is being planned, as are safety training courses for local governments.

The Houston–Galveston Area Council (H-GAC), the metropolitan planning organization (MPO) for the eight-county Houston, Texas, metropolitan region, developed a safety program over the past 5 years. This paper summarizes progress to date and indicates directions for the program. While the information is specific to the Houston region, it will be discussed in a context of metropolitan safety planning.

WHY HAS H-GAC BECOME INVOLVED IN SAFETY?

There are several reasons why an MPO, like H-GAC, should become involved in safety. While MPOs coordinate transportation plans for state departments of transportation (DOTs) and local governments both, they have their greatest impact on safety with local jurisdictions. First, many crashes and fatalities occur on local roads and not just state-managed roads. For example, in Texas about 44% of all serious crashes occurred on local roads between 1999 and 2001 (*1*). In the H-GAC region, this percentage was 54% of the serious crashes. Even for fatal crashes, a sizeable proportion occurred on local roads (39% in the region). The burden for fixing problems at these locations falls on local jurisdictions.

Second, transportation safety is a federally mandated program. The 1973 National Highway Safety Act, with subsequent amendments in 1982, 1991, 1998, and 2005 (SAFETEA-LU), requires that each state conduct surveys of all public roads to identify high crash locations for mitigation. The new legislation, further, requires the establishment of a Strategic Highway Safety Plan, actions that will require MPOs to coordinate safety planning in their region. In addition to roadway safety, safety at railroad–highway crossings, school safety, and other issues must be addressed. The new SAFETEA-LU legislation requires that state DOTs collaborate with other governmental organizations, including MPOs and local jurisdictions.

Safety is also one of the seven planning factors that MPOs must consider in developing their long-range plan. As the MPO for the Houston metropolitan area, H-GAC is committed to considering safety in a very active way. It is essential for the health of the region and critical to effective use of the transportation system. Crashes impose physical and emotional costs to those directly involved and huge financial costs to everyone else.

Third, though the responsibility for fixing safety problems on local roads belongs to jurisdictions, most small ones do not have the expertise. Crash information systems require technical infrastructure, and site analysis requires traffic safety engineering expertise. MPOs can play a role for local jurisdictions in providing the analysis for identifying problem locations and by acting as brokers to put local jurisdictions in contact with engineering firms that specialize in traffic safety.

Fourth, and finally, safety can be a good planning tool. If safety is brought in as a factor, land use and transportation plans might be modified to be more compatible than they would be otherwise. Safety is often the missing link in planning.

Five years ago, H-GAC decided to create a traffic safety planning program, as a result of a quite serious safety problem. From 1999 to 2001, the most recent 3-year period for which data are had, there were 252,241 serious crashes in the eight-county region, involving 1,699 fatal crashes and 162,811 injury crashes. In these crashes, 1,882 people were killed, and 281,914 were injured. Compared with the rest of Texas, the Houston region had the worst safety problem in the state, accounting for about 26% of all serious crashes in Texas (*1*). (Unfortunately, the data are more than 4 years out of date, a situation which makes it difficult for safety planning. The SAFETEA-LU legislation puts a priority on improving crash information systems, which should help eventually.) Injuries were 28% of the state's total, and fatalities were 17% of the state's total.

To compare these results with those in the rest of the United States, the fatal and injury crash rate per 100 million vehicle miles traveled

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(VMT) was calculated. The Houston region had a fatal and injury crash rate of 134, which is 36% higher than the state average (98) and 148% higher than the national average (54).

PURPOSE OF PROGRAM

There are three main goals for the safety program:

1. Identify and monitor safety. H-GAC has built a spatial crash information system. This allows identification of hazardous locations. Until H-GAC became involved, there was not a comprehensive evaluation of crashes in the region. Texas DOT monitors its roads, but crashes on local roads were not identified. This major deficiency prevented local governments from identifying safety problems.
2. Implement safety roadway improvements at hazardous locations. Once hazardous locations have been identified, H-GAC works with local governments, Texas DOT, the regional transit agency, and other relevant organizations to implement improvements in the road system.
3. Support other safety efforts. H-GAC deals primarily with roadway improvements. However, safety is improved not only by changes in the roadway system but also by increased public awareness and enforcement of traffic laws. Thus, H-GAC will partner with other organizations to support their safety efforts.

In short, the H-GAC safety program combines an analytic methodology with a policy framework for the goal of building a traffic safety program that can reduce crashes. It is a methodology that can be adopted by other MPOs throughout the country.

Motor Vehicle Crash Information System

The first step in developing a safety program is to obtain information on where crashes occur and where they are most concentrated. To do this, a spatial crash information system was developed, based on geographic information system (GIS) technology (*2*–*4*). While most agencies and firms that conduct crash analysis use a traditional tabular approach to data, for regional and local safety planning, a spatial crash information system offers the potential to link safety analysis with planning issues.

For the metropolitan region studied, the crash data come from the Crash Records Bureau of the Texas Department of Public Safety, which compiles data on all serious crashes collected by local police departments. The data, unfortunately, are old and cover only serious crashes. Initially, H-GAC tried to obtain crash data from local jurisdictions but found that was not practical. Each jurisdiction maintains the data in different forms and codes information in idiosyncratic ways. Only one jurisdiction even had the data in a GIS form. There was no way to integrate such information consistently. Still, for specific safety engineering studies, the actual crash reports held by the jurisdictions were used.

The Texas Department of Public Safety defines "serious" crashes as fatal crashes, injury crashes, and property damage only crashes in which one or more vehicles were towed. This information does not include property damage only crashes in which no one was injured and all vehicles were driven off. An extensive methodology was developed for georeferencing the serious crashes, using a GIS. The key is to clean the data before geocoding them so that street names correspond to the names existing in the base map file (*5*).

Spatial Analytical Tools

Mapping

To use the crash information system for analytical and policy purposes, a number of different tools are used. First, there are simple displays. Figure 1 shows a map of all serious crashes in the region. Each dot represents a crash location. Because many locations have more than one crash, density of the crashes is not completely captured with a simple map.

Visualization

Second, there are visualization tools. With use of the CrimeStat program, the number of crashes at each location was calculated (*6*). Figure 2 displays a map of the crash frequencies for the city of Galveston, an island city. The size of each circle is proportional to the number of crashes. As seen, the major arterial into the city has the highest concentration of crashes, though several major arterials also have concentrations, primarily the result of higher traffic volumes.

Hot Spot Analysis

Third, there are analysis tools. One of the most useful concepts is that of a hot spot, a small area where crashes are concentrated. As opposed to a single location or a single stretch of road, a hot spot frequently involves an interaction of several roads. That is, crashes occur within a small area because several intersecting roads can create a higher number of conflict points. For example, Figure 3 shows the location of major hot spots that averaged 78 or more crashes a year (one every 2 weeks) between 1999 and 2001. The hot spots are displayed as ellipses and were also calculated by the CrimeStat program. Most are along the heavily traveled freeways, but there are several smaller hot spots near downtown Houston. Figure 4 zooms into the downtown area. As seen, there is an interaction between the crashes on the freeways themselves and on the approaching access roads. One of the characteristics of urban crash hot spots is that crashes spill over onto adjacent roads, primarily due to congestion.

Hot spot analysis is a particularly useful tool for identifying hazardous locations and can help to identify safety projects. Typically, a safety study is conducted at these locations to identify remedial measures to reduce the number of crashes.

Crash Risk Analysis

Fourth, there are crash risk analysis tools. Typically, the number of crashes is related to traffic volume. Thus, it is not surprising that the major hot spots generally occur at locations with a high volume of traffic. An alternative approach is to relate the number of crashes to the volume of traffic. The National Safety Council uses crashes per 100 million VMT. This allows a comparison between different roads, areas, and cities, and it is often necessary to know whether a particular roadway is dangerous or not.

For example, for the region as a whole, there were on average 84,080 annual serious crashes between 1999 and 2001. For this period, annual VMT for the region was approximately 41.2 billion. Thus, serious crash risk in the region for the 3-year period was 204 per 100 million VMT. For comparison, the serious crash risk for the state of Texas was 149 per 100 million VMT for 1999 to 2001; because

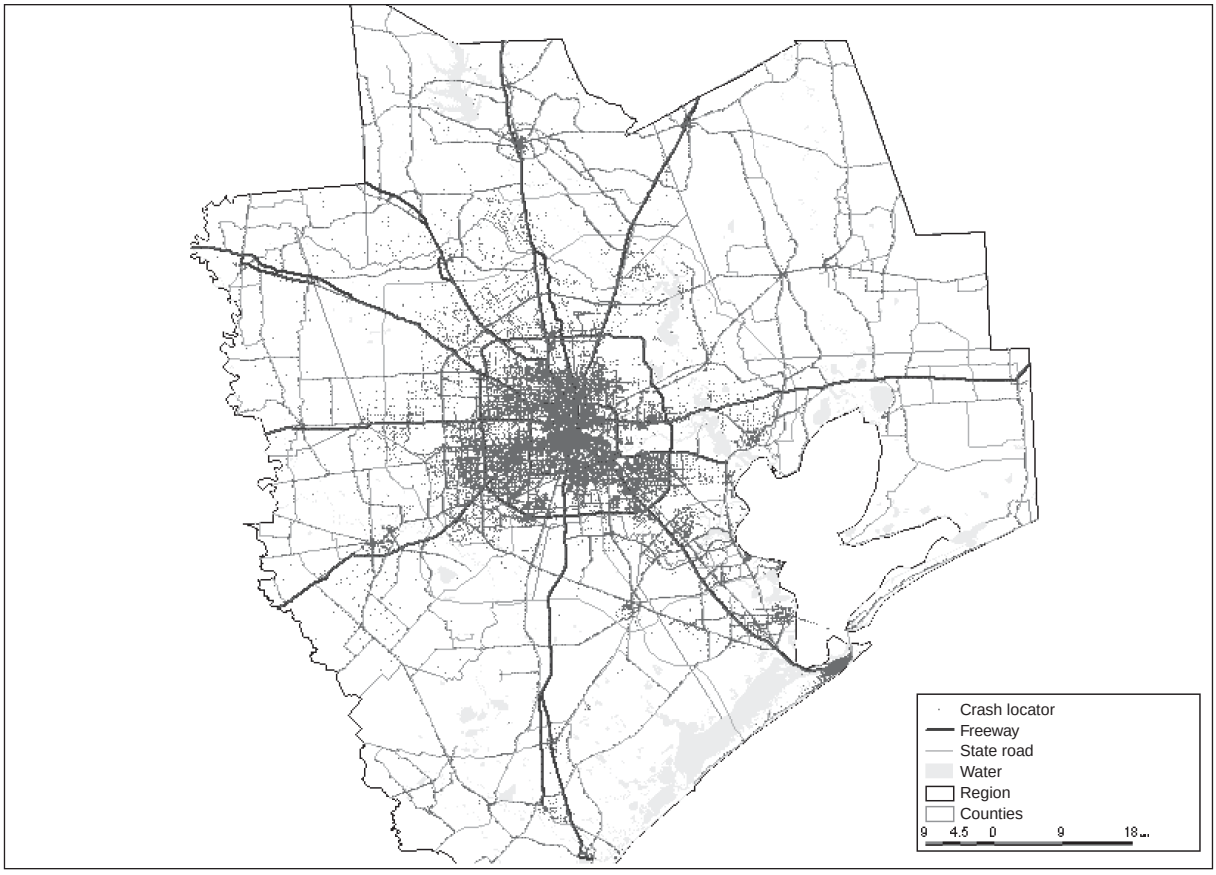

FIGURE 1 Safety in Houston metropolitan region—locations of serious crashes, 1999 to 2001.

FIGURE 2 City of Galveston—most frequent crash locations, 1998 to 1999.

FIGURE 3 Central Houston major crash hot spots—locations of hot spots with 78 or more crashes, 1999 to 2001.

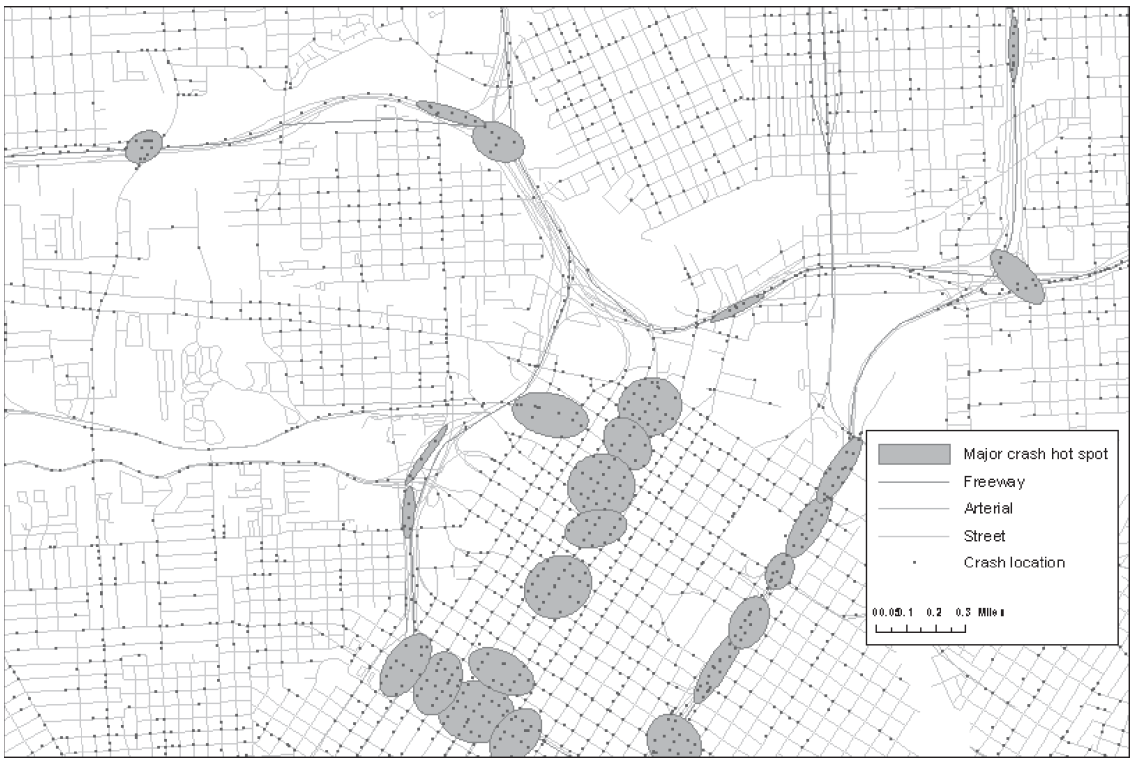

FIGURE 4 Downtown Houston major crash hot spots: locations of hot spots with 78 or more crashes, 1999 to 2001.

of the noncomparability of property damage crashes in Texas with those in the rest of the country, it was not possible to calculate serious crash risk for the nation.

County Crash Risk

Nevertheless, with the state baseline rate of 149, comparisons can be made. For example, the eight counties have different serious crash risks (Table 1). Three counties (Galveston, Harris, and Brazoria) have crash risks higher than the state average of 149. There are also substantial differences between cities in serious crash risk (data not shown).

Roadway Crash Risk

Probably the most important comparison is between different roads. In general, freeways have a lower risk, while major arterials have the highest. But there are exceptions. Serious crash risk was calculated for roadways shown in Table 2; the base years are indicated in parentheses. There are substantial differences in the safety of roadways, even controlling for traffic volume, which is what crash risk measures.

High-Risk Hot Spots

Analysis of crash risk can be combined with that of crash hot spots. There are hot spots that have a high concentration of crashes relative to the underlying traffic volume, and there are stretches where there are both a high number of crashes and a high number relative to the traffic volume.

In short, a spatial crash information system offers the potential to conduct both "traditional" crash analysis as well as spatial analysis to look for interactions around particular intersections or road segments.

SAFETY APPLICATIONS

H-GAC uses the crash information system for a variety of purposes. First, the system is used to provide statistical summaries, as illustrated earlier. Second, it is used to identify hot spots. H-GAC works with local governments and Texas DOT to study particular hot spots, with the aim of reducing crashes at those locations.

Third, H-GAC uses the crash information system to identify types of crashes to monitor particular types of policies. Fourth, H-GAC uses the crash information system to evaluate projects for inclusion in the long-range plan and in the Transportation Improvement Program list that is approved for funding from federal and state revenue sources. Fifth, H-GAC has developed a long-range safety goal of mitigating crashes in the worst hot spots. A brief discussion of these applications follows.

TABLE 1 Serious Crash Risk of Counties

County	Crash Risk
Galveston	225
Harris	217
Brazoria	170
Liberty	148
Montgomery	147
Fort Bend	141
Waller	93
Chambers	60

NOTE: Serious crashes per 100 VMT.

TABLE 2 Serious Crash Risk of Selected Roadways

Roadway	Crash Risk
John F. Kennedy Blvd. (1999)	505
Kirby Dr. (1998–2001)	433
FM 1960 (1998–2000)	260
FM 518 (1998–2000)	235
SH 35 (1999)	229
SH 288 (1998–2000)	199
FM 359 (1999)	173
US-59 S. (1999)	129
Spring Steubner Rd. (1999)	69
Nichols Sawmill Rd. (1999)	21

NOTE: Serious crashes per 100 VMT.

Statistical Crash Summaries

To improve public awareness of safety, H-GAC has established a safety web page and distributes a series of county, small area, and corridor safety analyses (*7*). One of H-GAC's major safety products is the analysis of crashes along particular roadways. These identify the overall volume of crashes, crash hot spots, and high-risk hot spots. H-GAC continually receives requests from cities, counties, and Texas DOT for crash analysis of particular roadways. Most of these write-ups are available on the H-GAC safety page.

Safety Projects and Hot Spot Mitigation

Aside from statistical reports, a major effort of the safety program is to mitigate crashes. Using hot spot analysis, H-GAC works with the particular local government, with Texas DOT, and with other safety partners to study the causes of crashes at the hot spot. This type of methodology is consistent with federal safety guidelines (*8*). To receive federal safety funds for mitigating a hot spot, it is necessary to first conduct a safety engineering study. For each location, the crashes that have occurred over a number of years are examined to identify a repeatable pattern and likely causes. Recommendations are then made for mitigation. Each of the recommendations, in turn, is evaluated with a cost–benefit analysis. The measures with the highest cost–benefit ratios are selected for funding.

The commitment H-GAC makes involves funding the project in cooperation with the local government. Typically, H-GAC will split the costs with the local government, though the exact split depends on resources of the jurisdiction. To date, H-GAC has completed five safety projects:

1. Two hazardous intersections along a major arterial in Houston, Westheimer Road. The consultant identified factors contributing to the crashes and proposed recommendations for improving safety. For

both intersections, the proposed recommendations were inexpensive involving changing traffic signals to larger, 12-in. backlit lights and repainting turn lanes;

2. A hot spot in the East End of Houston that covered about 90 blocks. The consultant recommended fairly inexpensive improvements to minimize sideswipe crashes (e.g., lane markers, clearer striping) and to reduce the number of red light running crashes (larger, backlit 12-in. traffic signals; clearer lane definition);

3. Five high crash intersections within the city of Pasadena. The consultant identified patterns of crashes at these intersections, mostly involving red light running, and proposed mitigation measures to improve safety at each;

4. Thirteen intersections in the city of Galveston. The consultant recommended specific modifications at each of the intersections. The total cost for mitigating all 13 intersections would be about $609,000 but would produce cost–benefit ratios from 2 to 72 times over the lifetime of the improvements.

5. Analysis of 12 intersections in the city of Sugar Land. The consultant made specific recommendations for improving safety at each of the intersections, involving mitigations such as new signal timing plans, restricting access at median openings, and removing confusing signs.

The reports from all the completed studies are put on the H-GAC safety web page. H-GAC aims to conduct studies of all major hot spots within the region eventually.

Analysis of Behavioral Factors

In addition to identifying hot spots and conducting safety projects with local governments, the spatial crash information system is used to monitor particular types of crashes. Driver error is involved in virtually every crash, and the state reporting form allows police officers to report the major causes. In the H-GAC region, the following factors were identified most frequently (Table 3). For each factor, if any of the drivers committed the error, the crash was identified as being associated with the behavior. Thus, multiple factors can be associated with a crash. Following is a brief look at the top five behavioral factors.

Speeding

By far, speeding is the most common behavioral factor associated with crashes, being involved in 39% of all crashes in the region. Of these, 0.5% had fatalities and 67% had injuries. Teenagers are slightly more likely to be involved in speeding crashes than nonteenagers (22% versus 20%). Most relevant for local safety planning, approximately half occurred on local or arterial roads, not freeways. It appears to be drivers going 50 mph in a 35-mph zone or going 60 mph in a 45-mph zone that are causing about half the crashes.

TABLE 3 Major Factors Contributing to Crashes

Attributed Cause	Percent
Speeding	39
Failing to yield to another vehicle	20
Failing to stop at a signal or stop sign	11
Running a red light	8
Driving under the influence	7
Following too close	3
Making an improper turn	2

NOTE: Identified on crash report by police officer.

Failing to Yield

The second most common behavioral factor associated with crashes is failing to yield the right-of-way to another vehicle (20% of all crashes). Again, the severity is fairly high: Of the crashes, 0.3% involved fatalities and 66% involved injuries. Teenagers are more likely to be involved in failing to yield crashes than are non-teenagers (26% versus 20%).

Failing to Stop and Red Light Running

Failing to stop at a traffic control sign accounts for 11.0% of the crashes. The severity levels are particularly high for this type of crash, for 0.6% involved fatalities and 70% involved injuries.

Running red lights is another major safety problem, associated with 8% of the crashes (national estimate is 5.9%) (*9*, p. 93). It is a failure to stop offense, but it is separated out as its own category on the state crash reporting form. Many occur on frontage roads at the intersection with arterials. Of the 19,012 red light running crashes in the region between 1999 and 2001, 0.6% involved fatalities and 71% involved injuries.

Reductions in failure to stop crashes will come about through increased enforcement, public support of actions, and improvement in signage and directional indicators. Sometimes drivers fail to stop because they are confused by signs. Most of the time, however, they do not want to take the time to properly stop or are speeding.

One quite effective measure is the use of automated cameras that photograph vehicles running a red light. There is substantial evidence that red light camera enforcement does reduce the number of red light running crashes (see discussion on the H-GAC website, Facts About Red Light Running Crashes 1999 to 2001, www.h-gac.com/safety) (*10*). However, FHWA and NHTSA issued joint operational guidelines on red light camera enforcement (*11*). Their report basically argues that intersections where the cameras are used should be carefully selected and should reflect a substantial red light running crash history; signal timing should be accurate and consistent with state standards; warning signs should be used to prepare drivers, to avoid an increase in rear-end crashes; and there should be substantial oversight of the process by an independent panel. H-GAC supports the use of red light running camera enforcement using the guidelines specified in the FHWA-NHTSA guidelines.

Driving Under the Influence and Driving While Intoxicated

Driving under the influence (DUI) of alcohol or drugs [or driving while intoxicated (DWI)] is a particularly dangerous behavior. It is involved in at least 7% of the region's serious crashes. Nationally, alcohol is the single largest cause of fatal crashes. In the H-GAC region, 37% of fatal crashes had alcohol or drugs identified by the investigating police officer; the percentage is probably higher because

the crash record is not updated after an autopsy. Overall, 4% of DUI crashes involved fatalities and 61% involved injuries (of which 10% were incapacitating injuries). Of DUI crashes, 13% involved teenagers, though the legal drinking age in Texas is 21. Serious drinking problems may start with teenagers, to become full-blown when they are adults.

Pedestrian and Bicycle Crashes

The region has a serious problem with pedestrian and bicycle safety.

Pedestrian Crashes

From 1999 to 2001, there were 3,579 pedestrian crashes in the eight counties, representing 26% of the state's total. Of these crashes, 276 involved fatalities and 3,303 involved injuries. Pedestrian crashes typically occur where there are concentrations of pedestrians. Some of these areas also have concentrations of low-income people, with immigrant populations. The higher use of transit, along with unfamiliarity with American road conditions, may be factors in some pedestrian crashes, though many counterexamples can be given.

Among the driving factors associated with pedestrian crashes are speeding (involved in 6% of pedestrian crashes), failure to yield (4%), and DUI (3%). In the case of DUI and failure to yield, it is not clear whether the driver or the pedestrian was at fault. National data suggest that less than half of pedestrian crashes occur at pedestrian crossings and that children and the elderly have particularly high rates (*9*, pp. 96, 97). H-GAC's data do not support a higher rate for the elderly; only 5% of pedestrian crashes involve the elderly (compared with their constituting 8% of the driving-age population).

Bicycle Crashes

In the region, there were 1948 bicycle crashes from 1999 to 2001, representing 28% of the state's total. Of these crashes, 5 involved fatalities and 1,689 involved known injuries. As with pedestrian crashes, bicycle crashes tend to be concentrated, though to a lesser extent.

Among the driving factors associated with bicycle crashes are speeding (7% of all bicycle crashes), failing to yield (14%), failing to stop (3%), and DUI (2%). Again, as with pedestrian crashes, it is not clear whether the driver or the bicyclist was at fault in failure to yield, failure to stop, or DUI crashes. Teenagers do not have a higher rate of bicycle crashes than do non-teenagers and, of course, the elderly have a much lower rate. National data suggest that the highest bicycle fatality rates are among the 25- to 44-year-old population, followed by the 5- to 14-year-old population (*9*, pp. 96, 97).

Crashes Involving Teenage and Elderly Drivers

Crashes by teenage drivers are a major problem. For the region as a whole, 21% of all the crashes involved teenage drivers. This is compared with their 9% share of the driving age population. However, the percentage of crashes involving teenagers is generally higher in the suburbs, with some surrounding counties having 28% to 29% of all crashes involving a teenager. The reason for this is not completely clear. The suburbs generally have an older population than does the central city. Thus, the higher suburban rates cannot be explained just by age distribution. Part of the reason may involve higher speeds that generally occur in the suburbs and another part may reflect higher incomes, because the more affluent suburban counties have higher rates than do the less affluent counties. There is some research suggesting that the high rate of teenage driver crashes is associated with teenager passengers, who increase substantially the likelihood of a crash for a teenage driver (*12*).

Another factor that has been suggested is lack of experience in driving; during the first few years of driving, at any age, an individual is more likely to make errors. Yet, even with inexperienced drivers, teenagers are more likely to make errors than are people of other age groups (*13*).

A higher crash among teenage drivers has been observed since the National Safety Council started gathering crash statistics in 1913. Teenagers are much more likely to be involved in serious crashes than are other age groups. For example, of the fatal crashes in the region from 1999 to 2001, 17% involved a teenage driver. Of the serious incapacitating type of crashes, 19% involved a teenage driver. Nationally, teenager drivers have the highest death rates per mile driven than does any other age group (*14*). The problem is particularly bad among 16-year-olds. This age cohort has a crash involvement 75% higher than that of 17-year-olds. Sixteen-year-old drivers are more likely to make driver errors, speed, and be involved in single vehicle crashes than are those in any other age group; they are also more likely to carry three or more passengers.

H-GAC believes that special attention should be devoted to teenage drivers. For one thing, restrictions on teenage drivers are warranted since doing so will save lives and prevent injuries. Most states have adopted graduated licensing laws whereby the teenage driver is supervised, and there are limits on the number of passengers, particularly other teenagers (*9*, p. 80). In 2002, Texas strengthened its laws controlling teenage drivers, earning a rating of "acceptable" by the Insurance Institute of Highway Safety. Unfortunately, the data that H-GAC had for this current study were gathered before changes in the law, so they are too early to evaluate. But it would be expected that the number of crashes involving teenagers should decrease. There is substantial evidence that graduated driver licensing will reduce crashes, injuries, and fatalities by teenage drivers (*15*).

Truck Crashes

Because of the economic importance of freight, truck safety is of paramount consideration. Again, the Houston metropolitan region has a serious safety problem. From 1999 to 2001, there were 15,369 crashes involving commercial motor vehicles. This was 6% of all motor vehicle crashes in the eight-county region. Comparing these data to the rest of the state is difficult. But a rough estimate can be obtained by calculating the per capita rate for 1999 (the only state data had). In 1999, the number of commercial motor vehicle crashes per 100,000 population was 98 for the region and 81 for the state of Texas. Unfortunately, there are not good data on the number of commercial motor vehicles, so that it is not clear whether the region's rate is high when compared with a more direct baseline.

Progress has been made in recent years due to increased weight enforcement on overweight trucks by the Houston Police Department and a "no trucks in the left lane" policy on several freeways. From all accounts, severe truck crashes have been reduced on the freeways where these policies were implemented.

Highway–Rail Grade Crossing Collisions

A major indicator of how railroad safety interfaces with road safety is the number of highway–railroad crashes. The region has a relatively severe problem, and it appears to be worsening. Between 1990 and June 2003, there were 1,183 crashes involving a railroad train and a motor vehicle in the eight-county region, an average of about 95 a year. Unfortunately, there are not good baseline data. Consequently, the region's highway–rail safety was compared with the state total for two 3-year periods. According to FRA, from 2000 to 2002, there were 247 highway–rail crashes in the region. These involved 13 fatalities and 74 injuries. The 247 crashes accounted for 23% of the state's total highway–rail crashes.

However, compared with 10 years earlier, the number of highway–railroad crashes in the region decreased only slightly, but it has increased as a share of the state's rail–highway grade crossing crashes. Total highway–rail crashes in Texas decreased from 1990 to 1992 through 2000 to 2002, from 1,594 to 1,073, whereas the H-GAC region showed no changes in these types of crashes. A hot spot analysis showed that there were 22 locations where there were 5 or more crashes between 1990 and June 2003 (*6*). These locations have been targeted in the long-range safety plan for mitigation.

LONG-TERM STRATEGIC SAFETY PLAN

H-GAC has developed a long-term safety plan for improving safety on the road system. First, there are 344 major hot spot locations that accounted for about 20% of all crashes in the region between 1999 and 2001 (see Figures 3 and 4). These hot spots were identified with the CrimeStat III program and were defined as those small areas having 78 or more serious crashes between 1999 and 2001 (average of 1 every 2 weeks). As part of the strategic safety plan, these hot spots are prioritized for safety improvements. Reducing crashes at these locations will have a large benefit in regard to congestion relief as well as human costs (personal, medical, insurance).

Without a detailed engineering study, the actual costs of mitigation cannot be calculated, but a rough estimate of the benefits and costs for mitigating these hot spots was made (Table 4). On the assumption that each hot spot would cost on average $500,000 to mitigate (in 1999 dollars), the total costs would be around $172 million; clearly, some hot spots (e.g., on freeways) would cost more while others would cost less.

Benefits would derive from the number of crashes reduced. On the assumption that mitigating each hot spot would reduce the total number of crashes at that location by 20% (again, some more and some less), it was estimated that each year there would be 22 fewer fatal crashes, 2,125 fewer injury crashes, and 1,143 fewer serious property damage only crashes. With the National Safety Council methodology for estimating comprehensive costs and assuming that the distribution of fatalities and injuries for the crashes at these locations follows the same distribution as for all crashes, the approximate annual benefit was estimated as $79 million. On average, for the region as a whole, each fatal crash produced 1.13 fatalities and each injury crash produced 1.75 injuries. These multipliers have been applied to the crash distribution for the 344 hot spots. The National Safety Council estimate for 1999 of comprehensive costs (both economic costs and value of lost quality of life associated with deaths and injuries) was $3,100,150 for a fatality, $153,453 for an incapacitating injury (Type A), $39,481 for a nonincapacitating evident injury (Type B), $18,782 for a possible injury (Type C), and $1,787 for a property damage-only crash (*9*, p. 79).

Given the annual benefit expected from mitigation at the hot spots, the payback period would take slightly more than 2 years. In addition, there would be cumulative benefits for many years thereafter—3,200 fewer victims each year, fewer medical costs, less pressure on emergency services, and less pressure on insurance rates (which are among the highest in the country). In short, mitigating these hot spots will cost more than for other hot spots, but the benefits will also be greater.

Evaluating Projects for Long-Range Plan

H-GAC's transportation planning process includes a long-range plan that is developed every 3 years. Roadway and transit projects are submitted by Texas DOT, transit agencies, and local governments for inclusion in the long-range plan. The projects are selected on the basis of an evaluation. The Transportation Improvement Plan includes those projects that are ready for implementation; all the engineering has been completed and financing has been arranged.

As part of the project evaluation processes, safety is a significant factor and is assigned points in the evaluation. Projects that improve safety are given more points than those that do not. The process distinguishes between safety projects, which have their methodology dictated partly by federal regulations, and nonsafety projects, for which safety considerations can be integrated. Details can be provided on request.

Other Safety Activities

In addition to the aforementioned activities, H-GAC supports other safety efforts.

Safety Partnerships

H-GAC has developed safety partnerships with state agencies and many local governments within the region. In addition, partnerships have been created with several nonprofit organizations. H-GAC views these partnerships as critical for building a coalition to improve

TABLE 4 Costs and Benefits of Hot Spot Mitigation, 1999 to 2001

Type of Facility	Number	Number of Crashes	Estimated Cost to Mitigate	Estimated Annual Benefit
Freeway segments	150	7766	$75 million	$37 million
Intersection between freeway and arterial road	70	3756	$35 million	$18 million
Arterial road segments	124	4930	$62 million	$24 million

NOTE: 1999 dollars.

safety in the region. Without multiple partners encouraging safety, no real improvements will be made, because engineering improvements are limited for improving safety. Only when they are combined with education, improvements in operations and management, quick emergency medical response, and law enforcement will the very high crash and severity levels be reduced.

Regional Safety Council

In February 2006, H-GAC launched a Regional Safety Council (RSC). The aim is to provide a policy forum for multiple disciplines to discuss traffic safety issues. The RSC will allow for an interdisciplinary approach toward safety. It is made up of representatives from transportation, local government, law enforcement, emergency medical services, medical treatment, insurance, trucking, nonprofit safety advocacy, and research organizations. The RSC has just started, so it is too early to gauge any outcomes of the endeavor. But several committees have been created, which will allow more in-depth discussion of particular safety topics (e.g., reducing DWI/DUI crashes; reducing aggressive driving; improving freight safety; improving safety information systems). In addition, an annual safety conference is being planned. The aim is to allow a variety of safety organizations to participate and to encourage sharing of information and ideas.

Safety Education

The last activity being considered is safety courses. To date, there have not been any courses conducted on safety planning. However, numerous requests have been received from city engineers for refresher courses on traffic safety engineering; requests have also come from elected officials for courses on safety policy, safety funding, and legislative issues. An important role for such courses is seen for the near future.

SUMMARY

In summary, the Houston metropolitan traffic safety program is an integral part of transportation planning efforts of H-GAC. Safety has a central role in transportation planning—not just as words but as real criteria that are integrated into road plans, construction, and maintenance. Too often, safety has not been a critical factor in roadway design and shortcuts are taken in the name of mobility or cost control. The result is a high number of motor vehicle crashes, something one should not be proud of. Nevertheless, by bringing the issue to the forefront of planning, it is hoped that some improvements in traffic safety can materialize.

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