City of Winston-Salem
Department of Transportation

Winston-Salem

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INTRODUCTION

Statistically speaking, traffic crashes are rare events and most people go through their daily routines without experiencing them. However, the number of opportunities for crashes to occur is staggering. When the low probability of occurrence and a large number of opportunities to occur are combined and spread over a sizeable geographical area, crashes go unnoticed, quietly extracting a sizeable toll in both human and economic terms.

In human terms, 42,643 people died and 2,889,000 people were injured in traffic crashes in the United States last year. This is the equivalent of a jet liner, with 117 people onboard, crashing each day of the year without survivors. In North Carolina, the toll was 1,552 people killed and 134,472 injured. Forty of these fatalities and 4,457 of these injuries happened in Forsyth County.

In economic terms, traffic crashes cost the United States $230.6 billion annually. This is well above the cost associated with traffic congestion, which is usually cited as the major problem facing transportation. As an illustration, a recent report estimated that congestion in the Charlotte Metropolitan area cost residents $303 million last year. For the same period, the cost of traffic crashes in Mecklenburg County was placed at $719million: 2.4 times the costs imposed by congestion. While congestions cost estimates are not available for Forsyth County, the Department of Motor Vehicles placed the cost of traffic crashes at $273 million for calendar year 2003.

Congestion is an obvious, pervasive and real time phenomena that motorists experience each day and it impacts a community's quality of life. Crashes, on the other hand, are rare events that seem to have the most profound impact on the people involved, their families, friends and loved ones. However, they quietly extract costs well beyond those imposed by congestion. It is clear that efforts to reduce both crashes and congestion should be major emphasis areas.

TRAFFIC SAFETY PROGRAMS

While producing an efficient transportation system is clearly the responsibility of transportation agencies, the responsibilities for traffic safety are shared. Safety oriented public information campaigns are used to educate. Law enforcement agencies implement special enforcement programs. Vehicle manufacturers improve their vehicle designs. Improvements in emergency medicine increase crash survivability and traffic engineers make modifications to the roadway environment.

Public education campaigns have a limited shelf life and tend to measure their effects in terms of public awareness. Enforcement efforts measure their effectiveness in terms of citations written. Better vehicle designs can make crashes more survivable and perhaps even more avoidable. However, these benefits are only available to those driving new cars. Improved emergency medicine makes crashes more survivable but doesn't prevent them. Traffic engineering improvements reduce crashes, a benefit shared by all road users.

State DOT's usually have a traffic safety section with a designated amount of money specifically earmarked for safety projects. These agencies develop a list of crash locations and assign some rank or priority to each location on the list. Locations are analyzed and countermeasures are designed and implemented in the order they appear on the priority list. This process continues until the funding for safety projects is gone. At the next funding cycle, a new list is prepared, and the process starts anew. It is a logical process that has produced meaningful reductions in traffic crashes. However, it is not without shortcomings. First among these is the lack of money. There is never enough money to fix all the problems that appear on an organization's priority list. As a result, many locations, that make these lists don't get treated. Secondly, there are many locations that don't make the list but have simple low-cost solutions. These are ignored.

In addition to these shortcomings, the traditional traffic engineering model does not transport well to the local government level. Most local governments do not have and cannot afford crash record systems that can produce sophisticated priority lists. Fewer still have the ability to earmark funds specifically for safety improvements and even fewer have the ability to allocate entire sections of their traffic engineering programs solely for safety issues. However, local governments can participate in efforts to reduce the impact of crashes and while doing so, expand and deepen the safety efforts of the federal and state governments.

A **Low Cost Safety Improvement Program** is a derivative of the traditional approach. While it employs many of the same type analytical tools used by larger organizations, it does not rely on the production of elaborate priority lists or funds designated only for safety projects. Instead, these programs combine safety concerns with their everyday traffic engineering activities and using the traffic signs, traffic signals and traffic markings available to them, produce quick, and inexpensive safety improvements. Low cost programs don't look at crash numbers. Instead they look for places where crashes form patterns. Then they try to remedy the patterns by changing the driving environment.

The philosophy of the low cost approach is simple and straightforward. If a location displays a pattern or patterns of crashes and a possible remedy is evident, the location is treated and the treatment is evaluated. This places the emphasis on finding and treating problems. It removes the notion that crashes, at any location, must exceed some threshold before they are termed problematic. Locations can be identified in any number of ways including: inquiries from citizens or the press, problems discovered while conducting other traffic engineering studies, complaints, computerized listings, etc. While the program does not require a sophisticated computer system, it does require the ability to accumulate and access police crash reports for any particular intersection or location.

For the past 18 years Winston-Salem's DOT has operated a low-cost safety improvements program. This report summarizes our efforts over the past year. It is produced in two volumes. Volume I reports on the program as a whole, summarizing its history and activities and impacts over the past year. Volume II provides detailed information on each location in the program. It includes collision diagrams and a narrative about each location.

PROGRAM HISTORY

In the 18 years Winston-Salem's Safety Improvement Program has been in existence, 524 before and after studies have been completed. (Fifty-five were concluded this year.) The results of completed studies are cataloged into a safety library that is evolving into a growing body of knowledge about crash problems and the effectiveness of countermeasures used to solve them. Information from this library is a valuable safety resource that has been shared with transportation agencies and scientific and professional organizations inside and outside North Carolina.

Table I presents the results achieved by the Program since its inception. The data is from 524 locations where before & after studies have been completed. The table shows the aggregate number of Targeted Crashes, Total Crashes, Injuries and Dollar Value of Property Damage before and after treatments. The percentage change in each of these categories is also shown. (The percentage change figures have been adjusted to reflect a small difference in aggregate lengths of the before & after periods.) Before continuing, the terms Targeted and Total Crashes must be defined. **Total Crashes** are all crashes occurring at a location. **Targeted Crashes** are the subset of all crashes that a countermeasure is expected to reduce or eliminate. The concept of Targeted Crashes is important because rarely are countermeasures evident or available to address all crashes at a location. It also helps to explain the discrepancy in the percentage change for Targeted and Total Crashes. (At any location, the change in Total Crashes attributable to a particular countermeasure is at best proportional to the change in Targeted Crashes.)

TABLE I
SUMMARY OF RESULTS FOR
524 COMPLETED BEFORE & AFTER STUDIES

	BEFORE	AFTER	%CHANGE
TARGETED CRASHES	**5,279**	**2,564**	**-50%**
TOTAL CRASHES	**11,348**	**9,416**	**-15%**
NUMBER OF INJURIES	**7,214**	**5,038**	**-28%**
PROPERTY DAMAGE	**$30,313,634**	**$24,700,897**	**-17%**

By reducing Targeted Crashes by 50%, Total Crashes have decreased 15%, injuries by 28% and the dollar value of property damage by 17%. ***These results only reflect the change measured between before and after periods of equal or nearly equal lengths. Therefore, the safety benefits presented in Table I are understated because the changes made to produce these safety benefits continue to accumulate well beyond the length of the study period.***

THE PROGRAM'S OPERATION & RESULTS

The operation of Winston-Salem's program is simple. **Before & After** studies are used. Crash data for each location are diagramed using vectors to indicate vehicle movements. If the diagram shows a pattern or patterns of crashes, the site is visited, traffic operations are observed, existing condition noted and the collection of any other relevant data occurs. The before study closes and the after study begins following implementation of a countermeasure. Unless dictated by circumstances, the length of the after study at any location, will equal, or nearly equal the length of the before study. In this year's report, the average before period was 4.2 years. Because of the length of time required to determine a countermeasure's effectiveness, interim evaluations are conducted using the number of crashes per month from the before period to estimate the number of expected crashes in the interim period.

Evaluation is an important element of this program and it is conducted on several levels. The Program History that was shown in Table I is the broadest evaluation, documenting the programs overall impact on crashes, injuries and property damage over time. However, each case study is also evaluated individually. Before & after changes in targeted & total crashes are measured, at each location, using the Poission Distribution. The percentage decline in crash activity is compared to the value specified at the 95% confidence limit. If it meets or exceeds this value the change is statistically significant, and the countermeasure is judged successful. (The 95% confidence limit is the number at or above which chance can be ruled out as the agent responsible for the change.)

Table II shows Targeted & Total crashes at the 201 locations in this year's program. The table shows the number of months and the number of targeted and total crashes in the Before & After periods. The evaluation section shows the expected number of these crashes and the percentage change. The column titles STAT. SIG.? notes whether the change is statistically significant according to the Poisson Distribution test. The column contains two responses separated by a slash. The first pertains to Targeted Crashes; the second to Total Crashes. **Yes** means the change is statistically significant, **No** means it is not and **NA** mean it can't be measured. (Too few crashes in the sample.) The last column entitled EVAL. TYPE notes the location's status in the program. **Final** means the study has ended this year. **Interim** indicates the study is continuing, and **New** means it was initiated this year. New cases do not have evaluation data available. The appendix contains a similar table that summarizes injury and dollar value of property damage data for each location in this year's program.

HIGHLIGHTS

Table II is lengthy, presenting data on each location in the Program. Highlights from the table follow.

- Of the 201 locations in this year's program, 55 locations had final evaluations, 98 locations are in the interim phase and 45 new locations entered the program.

- Among the 55 locations with final evaluations, Targeted Crashes were reduced by 55%.

- Among the 98 locations with interim evaluations, there is currently a 48% reduction in Targeted Crashes.

- Of the 55 locations with final evaluations, 31 of the measured declines in Targeted Crashes were statistically significant at the 95% confidence limit. Under random conditions, one might expect to find 3 statistically significant declines.

- Nine of the 55 locations with final evaluations had too few Targeted Crashes during the before period to permit an individual statistical evaluation. In three cases, Targeted Crashes were eliminated. In two case, Targeted Crashes were reduced by 80%. In one case there was a 50% decline in another a 25% decline and no change in one case.

- In 48 of the 55 final cases Targeted Crashes declined, in 1 cases there was no change and in 6 cases they increased. When tested statistically, the likelihood of observing 48 declines in 54 cases (ties must be omitted) is less than 1 in 1,000, ruling out chance as the agent of change.

- Of the 98 locations with interim evaluation data, 45 of the measured declines in Targeted Crashes are currently statistically significant at the 95% confidence limit.

- Fourteen of the 98 interim cases have too few Targeted Crashes in the before period to be statistically evaluated. There have been no Targeted Crashes at eleven of these locations. Targeted crashes have declined at three others.

- Presently, in 74 of the 98 cases with interim data, Targeted Crashes are declining. They are increasing in 14cases. The likelihood of observing 74 declines in 98 cases is less than 1 in 1,000 ruling out chance as the agent that is producing these changes.

Clearly, Winston-Salem's effort to find and treat crashes during the past year made a positive difference at the locations under study. Data on the locations with interim evaluations suggest that improvements will continue to be made into the future.

COUNTERMEASURES

Table III lists the types of countermeasures typically employed in our program and give a ball park estimate of the cost associated with each one. The number of times these measures were employed at the 55 locations with final evaluations contained in this year's program are shown under the frequency of use column. There are more countermeasures than crash locations because multiple countermeasures can be used at one location.

TABLE III

COUNTERMEASURES, THEIR COST & UTILIZATION

COUNTERMEASURE	COST RANGE	FREQUENCY OF USE
MAJOR CONSTRUCTION	>$25,000	2
NEW TRAFFIC SIGNAL	$20,000-$25,000	2
MINOR CONSTRUCTION	<$10,000	3
NEW FLASHER	$5,000-$8,000	0
MODIFY TRAFFIC SIGNAL OPERATION	$500- $3,000	9
MODIFY TRAFFIC MARKINGS	$1,000-$1,500	7
MODIFY TRAFFIC SIGNAL DISPLAY	$300-$1,000	17
NEW TRAFFIC MARKINGS	$500-$1,000	9
NEW/ADDITIONAL TRAFFIC SIGNS	$200-$300	21
MODIFY EXISTING TRAFFIC SIGNS	$75-$150	0
TRIM TREES OR SHRUBBERY	$50-$100	0

The emphasis on low cost easily implemented solutions is evident from the table. The projects in the major construction category were modification to entrance/exit ramps and were funded by the NCDOT.

DISCUSSION & CONCLUSIONS

Effective safety programs, those that demonstrate the ability to reduce crashes and/or the injuries they cause, are difficult to find. For this reason, crashes continue to extract a sizeable toll in both human and economic terms.

For 18 years, Winston-Salem's Safety Improvement Program has demonstrated the ability to produce meaningful reductions in crashes, injuries and property damage and has done so using low cost, easily implemented solutions. The 55% reduction in targeted crashes, at the fifty-five locations with final evaluations, shows the continued effectiveness of the program. The 48% reduction in targeted crashes, among the 98 locations with interim evaluations, points to the program's promise for the future.

There is also other evidence of the program's contribution to crash reduction. In the booklet entitled, "North Carolina Crash Facts 2003," published by the North Carolina Department of Transportation's Division of Motor Vehicles, 64 cities with 10,000 or more population are given a composite raking based on reported crashes, crash severity and crash rates based on population. Winston-Salem, which is the state's 4th largest city, ranked 14th in this composite scale. This ranking is better than any of our peer cities, Charlotte, Greensboro, or Durham.

Forsyth County is listed as the 4th most populous county in the state, has the 4th highest number of registered motor vehicles and also ranks 4th in annual vehicle miles of travel. Despite ranking near the top of each of these categories, Forsyth County's crash rate was ranked 12th in the state , and is well below the crash rates for Mecklenburg, Wake, Durham and Guilford Counties . Its injury crash rate ranked 21^{h} in the state, and its fatal crash rate ranked 86th in the state.

We believed our Safety Improvement Program contributes to the city and county's good safety rankings.

In the end Winston-Salem's Safety Improvement Program is:

Responsive- looking for locations suggested by citizens, the press and other sources, where patterns of crashes suggest a possible countermeasure.
Accountable- defining, in advance, the reduction in crashes necessary for any improvement to be judged successful.
Responsible- using information on the program's past successes and failures to help choose future countermeasures.
Economical - using low cost, easily implemented solutions.