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EVALUATION OF UNMANNED RADAR INSTALLATIONS

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16. Abstract

Several unmanned radar devices were installed on I75 in northern Kentucky in an attempt to reduce speeds. It was assumed that drivers use radar detectors to exceed the speed limit with a resulting variance between their speeds and others in the traffic stream. Therefore, a reduction in overall speeds and variance was expected to reduce the probability of accidents. Historical data indicated an unusually high accident rate for the study area.

Emphasis was placed on collection and analysis of speed-related data. In addition, a survey of radar detector usage was made and accident patterns were documented.

Speed measures analyzed included mean speed, standard deviation in speed, numbers of vehicles exceeding specified speed levels, and 85th percentile speed.

Results indicate that unmanned radar was an effective means of reducing the number of vehicles traveling at excessive speeds. The differences in mean speeds were small and the impact of unmanned radar was less obvious than it was for the percentage of vehicles exceeding speed levels of 65, 70, 75, and 80 mph. The speeds of vehicles with radar detectors decreased significantly as a result of unmanned radar while the speeds of vehicles without detectors were not affected. Radar detector usage was found to be 42 percent in trucks and 11 percent in cars. When comparing accident data three years before and one year after truck diversion and unmanned radar installations, there was a reduction in truck-related and speed-related accidents.

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EXECUTIVE SUMMARY

The section of I 75 in northern Kentucky covering a length of approximately four miles from Ft. Mitchell to the Ohio River has been previously noted for its exception to the general interstate guidelines for grade and curvature. Most of I 75 in the study area (Figure 1) was constructed in the early 1960's and the problems associated with excessive grade and curvature in an urban area have been documented since. Improvements have been made over the years but the positive impact of improved safety has generally been offset by increased volume of traffic and resulting congestion. Another recent change in an attempt to improve safety was the diversion of through trucks from I 75 onto the I 275 circle route around Cincinnati.

In an attempt to improve safety by reducing speeds on I 75 in northern Kentucky, five unmanned radar units were installed in the summer of 1986 between Florence and the Ohio River. These units remained in operation for approximately three months, and were then turned off after the Federal Communications Commission ruled that unmanned radar transmitters were in violation of their regulations. Legislation was subsequently passed by the U.S. Congress that exempted a short section of I 75 in northern Kentucky from Federal Communications Commission requirements and mandated that a demonstration project be conducted to assess the benefits of continuous use of unmanned radar equipment.

An evaluation study was to be performed by the University of Kentucky's Transportation Research Program, in cooperation with the Kentucky Department of Highways and the Federal Highway Administration. After additional radar units were installed in the spring of 1987, there was full coverage of the radar signal for northbound traffic from about 0.5 mile south of the Ft. Mitchell (US 25) interchange to the Ohio River (Figure 1). Partial coverage extended from 1.0 mile south of Florence to 0.5 mile south of Ft. Mitchell. The full coverage area was approximately four miles long and the partial coverage area was about nine miles long. The radar units were positioned so that the radar signal could be received over about one-half of the partial coverage area. While the radar units were installed for northbound traffic, the signal could be picked up by southbound traffic.

Because of the geometric characteristics of I 75 in northern Kentucky and other documentation of the speed-safety relationship, it was assumed that reducing speeds would result in a reduction in the frequency of accidents. Accident histories on this section of highway have shown that an unusually high rate of accidents does occur. The accident rate for the section of I 75 between the Ft. Mitchell interchange and the Ohio River was calculated to be 245 accidents per 100 million vehicle miles (ACC/100 MVM) for a three-year period preceding July 1986. This rate was substantially above the statewide average of 156 ACC/100 MVM for urban interstate highways and was also above the critical rate of 171 ACC/100 MVM, which is calculated using the section length and traffic volume.

The objective of this study was to evaluate the speed effects of unmanned radar installations on I 75 in northern Kentucky. Emphasis was placed on the collection and analysis of speed-related data. In addition, a survey of radar detector usage was made and historical accident patterns were documented. The following types of data were collected and analyzed:

1) Automatic speed data,
2) Manual speed data,
3) Speed data for vehicles with and without radar detectors,
4) Speed data with and without the presence of active police enforcement,
5) Radar detector usage data, and
6) Accident data.

Speed measures analyzed included mean speed, standard deviation (variance) in speed, percentages or numbers of vehicles exceeding specified speed levels, and 85th-percentile speed. Statistical tests were used to evaluate the effects of radar.

Results indicate that unmanned radar was an effective means of reducing the number of vehicles traveling at excessive speeds on the study section of I 75. The daily reduction in number of vehicles exceeding the speed limit (55 mph) by 15 mph was determined to be approximately 900 at Florence. At Ft. Wright (where the speed limit was 50 mph for cars and 45 mph for trucks), the number exceeding the speed limit (50 mph) by 15 mph was approximately 350 vehicles per day. When comparing mean speeds with "radar on" and "radar off", there was no statistical difference at Ft. Wright. At Florence, the mean speeds showed a statistically significant decrease with "radar on".

Results from the data collected manually did not reveal any significant differences when comparing mean speeds with "radar on" and "radar off". Apparently the sampling periods were insufficient to identify differences that were shown at locations where automatic equipment was used to collect continuous data.

Approximately 42 percent of the trucks and 11 percent of the cars were found to be equipped with radar detectors.

The use of radar detectors had a significant effect on vehicle speeds. With "radar on" the speeds of vehicles with radar detectors decreased significantly compared to the "radar off" speeds, while the speeds of vehicles without detectors were not affected.

Accidents in the northbound direction of I 75 between Ft. Mitchell and the Ohio River decreased in the one-year period after July 1986, as compared to the three-year period before. Data after July 1986 corresponded to the start of the truck diversion and original installations of the unmanned radar units.

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This study was a cooperative effort with the Kentucky Department of Highways. Primary credit for the idea of unmanned radar as a speed control device on I 75 in northern Kentucky should be given to Dale Appel, a Traffic Engineer in District 6. His active participation in the installation and maintenance of radar devices was a major contribution to the overall evaluation. In addition, there were several other employees of the Department of Highways in District 6 who were involved and contributed to the installation and maintenance. A special mention of appreciation is given to Tim McCarthy for his efforts.

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Data collection efforts by the Kentucky Transportation Cabinet's Division of Motor Vehicle Enforcement were beneficial. The presence of radar detectors in trucks could not have been determined without their assistance.

This report was prepared in consultation with and through the guidance of the following members of the Study Advisory Committee:

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INTRODUCTION

In an attempt to improve safety by reducing speeds on I 75 in northern Kentucky, five unmanned radar units were installed in the summer of 1986. These units remained on for approximately three months, and were then turned off after the Federal Communications Commission ruled that unmanned radar transmitters were in violation of their regulations. In the fall of 1986, legislation was passed by the U.S. Congress that exempted a short section of I 75 in northern Kentucky from Federal Communications Commission requirements (1). Copies of the Federal Communications Commission ruling and the legislation are included as Appendix A. This legislation mandated that a demonstration project be conducted to assess the benefits of continuous use of unmanned radar equipment. After the legislation was signed by the President on October 27, 1986, plans were made for conducting the demonstration project. As a result of a meeting in Frankfort on December 21, 1986, between representatives of the Kentucky Transportation Cabinet, the Federal Highway Administration, and the Federal Communications Commission, the units were turned on again.

Preliminary plans were made for an evaluation study to be performed by the University of Kentucky's Transportation Research Program, in cooperation with the Kentucky Department of Highways and the Federal Highway Administration. Additional radar units were installed in the spring of 1987, with all except one unit operational by June 11, 1987. The last unit to be installed began operating in early August 1987. The study area was divided into two sections of radar signal coverage as shown in Figure 1: 1) the full coverage area included nine unmanned units and extended from Milepoint 187.2, 0.5 mile south of the Ft. Mitchell (US 25) interchange, to Milepoint 191.2 at the Ohio River and 2) the partial coverage area included six units and extended from Milepoint 178.2, about 1.0 mile south of Florence, to 0.5 mile south of the Ft. Mitchell interchange at Milepoint 187.2. The full coverage area was approximately four miles long and the partial coverage area was nine miles long. In the partial coverage area, the radar units were spaced intermittently; however, there were approximately equal distances (4.5 miles) where the radar signal could and could not be received with a radar detector. A listing of the locations of unmanned radar units in the partial coverage area and the full coverage area is presented in Table 1. While the radar units were installed for northbound traffic, the signal also could be received by southbound traffic.

STUDY AREA CHARACTERISTICS

The section of I 75 in northern Kentucky covering a length of approximately four miles from Ft. Mitchell to the Ohio River has been noted for its exception to the general interstate guidelines for grade and curvature. Most of I 75 in the study area (Figure 1) was constructed in the early 1960's and the problems associated with excessive grade and curvature in an urban area have been documented since. Parts of the study area have grades of five percent (downgrade for northbound traffic) and curves of six degrees. In 1971, a Congressional Subcommittee held a public hearing in Covington to discuss the hazardous nature of that section of I 75. Soon afterwards, the Department of Highways' Division of Research conducted an evaluation of various safety features that had been installed on the subject section of I 75 and the results indicated a reduction in accidents (2). Other improvements have been made over the years but the positive impact of improved safety has generally been offset by increased volume of traffic and resulting congestion. Another recent change in an attempt to improve safety was the diversion of through trucks onto the I 275 circle route around Cincinnati (started on July 8, 1986).

The section between Ft. Mitchell and the Ohio River has six lanes of through traffic and carries the highest volumes of any roadway in Kentucky. Average daily volumes for this section are in the range of 120,000 vehicles. This compares to an AADT of about 60,000 at Florence, which is approximately 10 miles south. For northbound traffic, the percentage of trucks ranged from approximately 26 percent just south of the I 275 interchange to 9 percent in Covington.

The speed limit on I 75 is 55 mph in the southern part of the study area and changes to 50 mph for cars at Milepoint 188.0, 0.3 mile north of the Ft. Mitchell (US 25) interchange. In the area of 50-mph speed limit for cars, the limit for trucks is 45 mph. It also should be noted that the breakpoint for change from the 65-mph speed limit (effective June 8, 1987 for rural interstates in Kentucky) to 55 mph is at the KY 338 interchange (MP 175.4), just south of the study area.

RELATIONSHIP BETWEEN SPEED AND SAFETY

Speed has been determined to be one of the most common contributing factors in vehicular accidents. In Kentucky, speed is listed as a contributing factor in 8.9 percent of all accidents and 36.7 percent (the most frequently cited factor) of fatal accidents (3). Consideration of speed presents a dilemma in highway transportation because it affects both safety and efficiency. The basic relationship between speed and stopping distance indicates that stopping distance increases in relation to the square of the speed and the result can be a higher accident potential. Conversely, increased speed can reduce travel costs and increase the operating efficiency of a highway.

The relationship between speed variance and safety has been investigated and it has been shown that the greater the variation in speeds, the higher the probability of an accident, assuming equal exposure (4, 5). Another study examined speed variance and it was found that both slow drivers and fast drivers had accident rates that were approximately six times that of drivers operating close to the mean traffic speed (6).

It also has been documented that the greater the absolute speed, the greater the likelihood of increased accident severity (7). The energy dissipated during a collision is directly proportional to the vehicle's weight and to the square of its speed. Therefore, increased speed results in more energy dissipation, which translates into greater damage to the vehicle and more injuries to the occupants.

The question of whether the use of radar detectors results in increased accidents remains unanswered. Insufficient research has been conducted to address the issues that are necessary for proper evaluation. Those issues include: 1) socio-economic characteristics of drivers using radar detectors as compared to the normal driving population, 2) accident rates based on exposure by type of highway, and 3) overall safety and handling characteristics of vehicles in which radar detectors are used.

EFFECT OF ENFORCEMENT ON SPEED

The presence of police enforcement has been shown to have the effect of decreasing speeds (8, 9). The use of speed enforcement, a speed-check zone, or a parked patrol vehicle produced significant reductions in speeds in the vicinity of the enforcement unit in another study (10). Increased police enforcement in work zones has produced positive effects in terms of speed reduction (11). Active police enforcement in conjunction with the use of radar units has been used in many situations to reduce speed.

Because of the geometric characteristics of I 75 in northern Kentucky, it was assumed that reducing speeds would result in a reduction in the frequency of accidents. Accident histories on this section of highway have revealed an unusually high rate of accidents. The accident rate for the section of I 75 between the Ft. Mitchell interchange and the Ohio River was calculated to be 245 accidents per 100 million vehicle miles (ACC/100 MVM) for a three-year period proceeding July 1986. This rate is substantially above the statewide average of 156 accidents per 100 MVM for urban interstate highways and also above the critical rate of 171 accidents per 100 MVM (3). The critical rate is a calculated value based on statistical tests to determine whether the accident rate for a specific class of highway is high as compared to similar highways.

In an attempt to reduce speeds and accidents on the section of I 75 between Ft. Mitchell and the Ohio River, a decision was made to install unmanned radar units at several locations on I 75 where they would be directed primarily at northbound traffic. The decision was based on the assumption that one practical method to achieve the effect of active police enforcement would be to install unmanned radar units that would simulate the effect of active police units over a long period of time. The assumption also was made that a significant number of drivers used radar detectors in their vehicles to alert them to the presence of police so that their speeds could be reduced accordingly. If drivers use radar detectors to exceed the speed limit and create a condition where there is a wider variance between their speeds and the speeds of other vehicles in the traffic stream, then the probability of accidents would be increased. It also has been speculated that a small percentage of drivers noted the presence of radar detectors in other vehicles and travel behind those vehicles in order to maintain a higher level of speed. It was surmised that if those vehicles with radar detectors and others that may be following in a queue could be affected by unmanned radar units, then the reduction in speeds would have the potential of resulting in a reduction in accidents.

DATA COLLECTION

Several types of data were collected in an attempt to evaluate the impact of unmanned radar installations on speed. In addition to speed-related data, a survey of radar detector usage was made and historical accident patterns were documented.

AUTOMATIC SPEED DATA

Automatic speed data were collected at two locations. The speed monitoring station at Ft. Wright (MP 189.7), installed specifically to collect data for this study, became operational on July 6, 1987. Data were collected for approximately 70 days, with some gaps, through November 1, 1987. During the period of data collection, each of the three northbound lanes of I 75 were monitored separately and data for a sample of 2,180,512 vehicles were collected with "radar on" and 1,576,615 vehicles with "radar off".

The second speed monitoring station was located at Florence (MP 179.2), approximately 10.5 miles south of the Ft. Wright location. This site is among those included in the 55 MPH Compliance Speed Monitoring Program of the Kentucky Department of Highways. Problems associated with the equipment and the form of the data collected during the summer months resulted in data that was questionable for use as part of this evaluation. Useful data were, therefore, limited to an 18-day period in October. The sample size was 236,471 vehicles with "radar on" and 266,267 vehicles with "radar off". While this sample size is considerably smaller than that at Ft. Wright, it is sufficiently large for reliable statistical analysis. It should be noted that the accuracy of speed monitoring equipment was recognized and considered as part of the data collection procedure. For example, the equipment used at Ft. Wright had an accuracy level of plus or minus 1.0 mph for speeds of 60 mph or less and plus or minus 2.0 mph for speeds greater than 60 mph. Because of the procedure used, it was assumed that accuracy-related differences would be equally distributed with "radar on" and "radar off". The locations of the two automatic speed monitoring stations and four manual data collection points are identified in Table 2.

MANUAL SPEED DATA

Manual speed data were collected to supplement the automatic data so that speed data could be collected at additional points in the study area. Data were collected using time-distance methods (stopwatch measurements over a pre-selected distance) rather than radar to insure that radar signals would not be present in the "radar off" condition. Data were collected by three observers at four locations in the study area (Table 2) between June 11 and August 27, 1987. A sample of 150 vehicles was collected for each of the three lanes on each of 15 days. The result was a total sample of 2,250 vehicles per lane at each location. The proportions of cars and trucks, by lane, was determined by means of lane distribution counts in the study area prior to beginning speed data collection.

The sample size of 150 vehicles in each of the three lanes of travel was sufficient to insure, at the 95-percent confidence level, that estimates for the mean speed were statistically reliable within plus or minus 1.0 mph. The procedures for determining sample size were obtained from the publication titled Manual of Traffic Engineering Studies, published by the Institute of Transportation Engineers (12).

Vehicles were classified as cars and trucks. Cars were defined as passenger cars, station wagons, pickups, and vans. Trucks were defined as single-unit trucks and tractor trailers with three axles or more (vehicles with 2 axles and 6 or more tires were also classified as trucks).

SPEED DATA - WITH AND WITHOUT RADAR DETECTORS

A determination was made that, in addition to automatic and manual speed data, it would be desirable to determine the speeds of individual vehicles and also be able to note the presence of radar detectors in those vehicles. This type of data was collected at the Ft. Wright speed monitoring location with the speed-classifier unit used to determine speed, and the presence of radar detectors determined by visual inspection. An observer was stationed on the side of the road at the speed-classifier unit so that speeds of vehicles could be noted at the same time as detectors were observed. Data were collected on 14 days between September 1 and November 19, 1987. Total samples were 1,223 with "radar off" and 2,074 with "radar on".

SPEED DATA - WITH AND WITHOUT POLICE ENFORCEMENT

In an attempt to assess the impact of police enforcement on speeds in the study area, additional data were collected with "radar on" and "radar off" in the vicinity of the Ft. Wright speed monitoring station. The Kentucky State Police cooperated in this effort and data were collected on October 21 with "radar on" and October 28 with "radar off". There were three hours of active enforcement on each day. Speed citations issued by the police officers numbered 23 on October 21 and 28 on October 28. The speed limit in the area of enforcement was 50 mph for cars and 45 mph for trucks. Most of the citations issued were for speeds in excess of 65 mph.

RADAR DETECTOR DATA

Samples of data were collected throughout the study period in order to determine the percentages of vehicles in the I 75 corridor with visible radar detectors. The samples of cars were collected manually by observers as they were traveling on I 75 from Lexington to northern Kentucky. Visual observations were made as they passed or were passed by other vehicles. It also was recognized that some vehicles have built-in detectors that are not visible to observers positioned in another vehicle. Approximately half of the data for cars were collected without distinguishing whether they had in-state or out-of-state licenses. In the second part of the data collection, a distinction was made.

Additional radar detector data were collected by the Kentucky Transportation Cabinet's Division of Motor Vehicle Enforcement. These data were collected as part of vehicle/driver safety inspections (at the truck weight station on I 75 in Scott County) during which truck cab interiors were checked and the presence of radar detectors was noted.

ACCIDENT DATA

Accident data were obtained from the Department of Highways' Division of Traffic and analyzed for the period July 1, 1983 through June 30, 1987. This included three years before the initial radar installations in the summer of 1986 and one year during which radar was on part of the time and trucks were being rerouted. The accident data were collected for two sections of I 75; one section representing the area between MP 175.4 (the KY 338 interchange) and MP 187.7 (the Ft. Wright interchange) and the other for the section between MP 187.7 and MP 191.7 (the Ohio River bridge). These sections represent contrasting conditions in terms of geometrics and volume levels. The section between MP 175.4 and MP 187.7 is relatively straight and level with AADT's in the range of 50,000 to 60,000. By contrast, the section starting at MP 187.7 and continuing to the Ohio River at MP 191.7 is the area of sharp curvature and steep grades with AADT's in excess of 100,000.

ANALYSIS OF DATA

AUTOMATIC SPEED DATA

Highway safety researchers generally agree that the safest traffic conditions include those in which vehicles travel at uniform speeds and those in which excessive speeding is minimized. Since any likely impact of radar on safety stems from its effect on speed, measures of primary interest to this study included those which measure both lack of uniformity--that is, speed variability--and those which measure excessive speeding--that is, the fractions of vehicles in the traffic stream exceeding stipulated speeds. Speed levels chosen for analysis herein included several at the high end of the speed spectrum, namely, 65, 70, 75, and 80 miles per hour. Other speed measures chosen for analysis included the mean speed and the 85th percentile speed, two measures often examined by traffic engineers in speed studies. The statistical procedure used to analyze these data depended on the speed measure of interest as well as how other factors affecting these speed measures were treated.

The major hypothesis being examined herein is that radar signals can beneficially impact these speed measures, reducing both variability and level of speeds. To test this hypothesis, speed measurements were taken on I 75 during both "radar on" and "radar off" conditions. Unfortunately, simple differences between these two conditions may be quite misleading: many factors affect speeds and it is imperative to assure that the analysis is conducted to isolate effects of radar from those of such other factors.

Factors potentially affecting speed that were controlled in the collection of the automatic data included radar (on or off), day of week (weekday or weekend), light condition (daylight or darkness), and lane of travel (median, center, or shoulder). Unfortunately, other variables possibly affecting speed, such as amount of truck traffic and amount of precipitation, could be neither measured nor controlled. Since data were collected over a sufficiently long interval, the potential confounding effects of these other variables was considered to be small enough to be treated as part of measurement error. An effect not thought to be minimal, however, is that due to volume. That speeds are reduced by the congestion of increased volume levels is an established fact. Volume, however, can not be controlled in the sense that the above factors can and is therefore treated as a covariate in the analysis of mean speeds and variability of speeds described below.

For the mean speed, the analysis considers the experiment to be a 2^3 factorial (factors: radar, day, and light) with repeated measures (the three lanes of traffic) each with a separate covariate (volume of vehicles in a given lane). The unit of analysis was the mean speed for one hour of observation. Evaluation of such an experiment requires an analysis of covariance procedure for a split plot experiment with a covariate for each unit in the split plot (lanes). Due to the size of the data base and the number of factors and their levels, separate analyses were performed for each lane of travel.

Variance of vehicle speeds, a second speed measure computed for each hour of observation, is not normally amenable for investigation using analysis of covariance techniques because variances are distributed as Chi-Squared variates and not normal variates. However, for large sample sizes, the Chi-

Squared distribution is well approximated by the normal distribution. Because speeds were measured for a large number of vehicles during each hour of data collection, it was assumed that variance could be treated as a normal variate and that standard analysis of covariance routines could be used for analyzing variance of speed as well as for its mean.

Excessive speeding was measured by the proportions or numbers of vehicles exceeding certain high speed levels. At very high levels, use of the standard analysis of covariance technique becomes suspect because of the small numbers of vehicles involved. An alternate statistical procedure, attributed to Campbell (14), is available, however, and is not constrained by the small numbers or proportions of affected vehicles. This procedure, adopted for the analysis herein, treats traffic volume not as a covariate but as a factor similar to day of week and lane of travel. Five levels of volume, representing approximately equal numbers of observed vehicles at Ft. Wright, were analyzed; 0-299, 300-599, 600-899, 900-1,200, and more than 1,200 vehicles per lane per hour. While effects of radar can be accurately assessed, the Campbell procedure does not allow analysis of the statistical significance of interactions among the experimental factors. The Campbell procedure is described in Appendix B.

MANUAL SPEED DATA

Data collected with "radar on" and "radar off" were separated and all data for each condition were combined. Using the combined data, the average speed and standard deviation were calculated as well as the percentage of vehicles exceeding 55, 60, 65, and 70 mph. The t-test was used to test the statistical significance of the differences in the mean speeds and the F-test was used to test differences in standard deviations (13).

SPEED DATA WITH AND WITHOUT RADAR DETECTORS

Speeds of vehicles with and without radar detectors were summarized as a function of whether the radar was on or off. For each set of data, the average speed and standard deviation were calculated as well as the percentages of vehicles exceeding 60, 65, 70, and 75 mph. An "analysis of variance" procedure, with appropriate contrasts, was used to compare mean speeds between the four conditions formed by the combinations of the factors of radar on and off and cars with and without detectors. Bartlett's procedure was used to compare the variability of speeds between these four conditions and a contingency table analysis was used to compare the proportion of vehicles exceeding 60, 65, 70, and 75 mph between these four conditions.

SPEED DATA WITH AND WITHOUT POLICE ENFORCEMENT

The data used for evaluating the impact of police enforcement on speeds with "radar on" and "radar off" consisted of three hours of data during each of the conditions. Time periods for data collection were limited because of the availability of enforcement personnel; however, the total sample of vehicles included in each three-hour period was approximately 8,000. These data were combined into four sets representing 1) active enforcement - "radar off", 2) no enforcement - "radar off", 3) active enforcement - "radar on", and 4) no enforcement - "radar on". The combined sets of data were compared statistically by calculating the mean speed, standard deviation, and percentages of vehicles exceeding 65, 70, 75, and 80 mph. The t-test was used to test for statistical differences in mean speeds and the Chi-Squared test was used to determine if differences in the number of vehicles exceeding the speed levels of 65, 70, 75, and 80 mph were different (13).

ACCIDENT DATA

The data were summarized into two location categories and two time categories. The location categories were 1) from the KY 338 interchange to the Ft. Mitchell (US 25) interchange and 2) from the Ft. Mitchell interchange to the Ohio River. The time periods were the three-year period from July 1, 1983 to June 30, 1986 before the start of the unmanned radar and the truck diversion and the one-year period of July 1, 1986 through June 30, 1987. For each category, the total number of accidents per year and the accident rate were calculated along with the percentages of accidents involving trucks, injuries or fatalities, speed as a contributing factor, darkness, and a wet or snowy pavement.

RESULTS

AUTOMATIC SPEED DATA

A comparison of the mean speeds at the Ft. Wright and Florence speed monitoring stations is presented in Tables 4 and 5. Specifically, Table 4 lists the mean speeds at each station with "radar on" and with "radar off" for each lane of traffic under all other conditions, by type of day (weekday and weekend), and by type of light (daylight and darkness). Mean speeds were computed by first regressing average speed on traffic volume for each hour of study via an analysis of covariance and then computing the predicted mean speed at the average level of traffic volume in the resulting regression equation. These "adjusted" mean speeds were next compared using the analysis of covariance, and the P values for these comparisons are listed in Table 5. The results given below are based on these P values.

At the Ft. Wright station, the adjusted mean speeds for both the median and center lanes with "radar on" were lower than the corresponding adjusted mean speeds with "radar off" for each type of condition listed above. None of these differences were determined to be statistically significant based on the results shown in Table 5 where the main effect of radar and the two- and three-factor interactions involving radar and the effects of day and/or light all had P values greater than 0.05. However, for the median lane, the difference in the adjusted mean speeds between "radar off", 62.98, and "radar on", 62.58, was marginally significant ($P = 0.0529$). Although the adjusted mean speeds were not consistently lower in the shoulder lane when radar was on, there was no statistically significant difference between adjusted mean speeds when "radar off" was compared to "radar on" for this lane. As expected, the adjusted mean speeds were significantly lower in darkness compared to daylight ($P < 0.0001$) for all three lanes). Weekend speeds were significantly higher when compared to the weekday ($P < 0.0001$ for the shoulder lane, $P < 0.001$ for the center lane) and the interaction between day and light is significant ($P < 0.0001$ for the median and center lanes).

At the Florence station, the adjusted mean speed with "radar on", 64.50 mph, in the median lane is significantly lower than the corresponding adjusted mean speed with "radar off", 66.36 ($P < 0.0001$); the adjusted mean speed with "radar on", 62.06, in the center lane is significantly lower than the corresponding adjusted mean speed with "radar off", 63.72 (P < 0.0001); and the adjusted mean speed with "radar on", 57.15, in the shoulder lane is significantly lower than the corresponding adjusted mean speed with "radar off", 58.61 (P < 0.0001). Hence, the use of the unmanned radar installation at Florence produced significantly lower mean speeds with "radar on" when compared to "radar off" for all three lanes of traffic. According to Table 4, the effect of radar varied by day of week, with radar producing a larger reduction in speeds on weekends for all three lanes. The effect of radar also varied by type of light, with radar producing a larger reduction in speeds at night for both center and shoulder lanes.

Adjusted mean speeds at the Florence station were higher than at the Ft. Wright station, which was expected due to the lower speed limit, higher traffic volumes, and restricted roadway geometrics at the Ft. Wright station. The speed limit at Florence was 55 mph as compared to 50 mph for cars and 45 mph for trucks at Ft. Wright. Average ADT's at Florence were in the range of 50,000 to 60,000 as compared to 100,000 to 120,000 at Ft. Wright. In addition, roadway geometrics at Florence were generally straight and level as compared to relatively sharp curves and steep grades at Ft. Wright.

A comparison of the actual and expected number of vehicles above various speeds is shown in Table 6. The actual number of vehicles was the number of vehicles traveling above the given speed with "radar on". This was compared to an expected number of vehicles traveling above a given speed, which was calculated using the data obtained with "radar off" (see illustrative procedure in Appendix B).

The data in Table 6 show what was found to be a statistically significant decrease in vehicles traveling above the high speeds of 65 to 80 mph at both locations. The reduction was more at Florence than at Ft. Wright which would be logical since the speeds at the Florence station were higher. The traffic volume at the Florence station was about one-half that at Ft. Wright. The high traffic volume combined with the restrictive roadway geometrics at Ft. Wright could result in a greater safety benefit from the reduction in excessive speeding than at Florence even though fewer vehicles were affected. Daily reductions in the number of vehicles exceeding the various speeds are listed. The reductions per day vary from 2,199 exceeding 65 mph at the Florence station to 6 exceeding 80 mph at Ft. Wright.

A comparison of the actual and expected number of vehicles traveling above various speeds is shown in Table 7 as a function of lane. At Florence, the reductions in speed were generally highest for the median lane while the reductions were generally highest for the shoulder lane at Ft. Wright. There were reductions in each lane at both locations, with all the differences determined to be statistically significant.

The differences in actual and expected number of vehicles traveling above various speeds, as a function of day of the week, are presented in Table 8. There was a larger reduction in excessive speeds on the weekend at Florence than on weekdays; no such difference was detected at Ft. Wright. All reductions of Table 8 were statistically significant.

The differences in actual and expected number of vehicles traveling above various speeds, as a function of light condition, are shown in Table 9. At Florence, the reductions during darkness were slightly higher than those during daylight. There were no substantial differences between daylight and darkness at Ft. Wright. All of the differences were statistically significant.

Presented in Table 10 are comparisons of actual and expected numbers of vehicles above various speeds as a function of traffic volume. There were reductions in every category and almost all were statistically significant; however, no trend was detected in which the reductions could be related to traffic volume.

A comparison of the variation of speeds at the two stations is presented in Tables 11 and 12. Specifically, Table 11 lists the adjusted standard deviations of speeds at each station with "radar on" and with "radar off" for each lane of traffic and for various combinations of radar with type of day and type of light. These standard deviations were computed by first regressing the variance of speed on traffic volume for each hour of study via an analysis of covariance; then computing the predicted variance of speed at the average level of traffic volume in the resulting regression equations; and finally converting the predicted variances to predicted standard deviations. These adjusted standard deviations of speeds were compared using the analysis of covariance; the P values for these comparisons are listed in Table 12. A summary of the significant comparisons follows.

At the Ft. Wright station the adjusted standard deviation of speeds with "radar on", 4.97, in the median lane is significantly lower than the corresponding standard deviation with "radar off", 5.08 ($P < 0.0097$); the standard deviation with "radar on", 4.66, in the center lane is significantly lower than the corresponding standard deviation with "radar off", 4.79 ($P < 0.0005$). For the shoulder lane the adjusted standard deviation with "radar on" is significantly lower than the standard deviation with "radar off" for weekdays but not weekends or for daylight but not darkness. For both the center and shoulder lanes the adjusted standard deviation of speeds was significantly higher on weekdays as opposed to weekends and during daylight as opposed to darkness.

At the Florence station, similar results were obtained for the effect of radar in that the adjusted standard deviation of speeds was significantly lower when radar was on compared to when radar was off for both the center and shoulder lanes. For the median lane there was a significant "radar by light" interaction ($P = 0.054$) that can be explained as follows: with "radar on" in darkness the adjusted standard deviation is 5.67, which is considerably lower than the corresponding figure with "radar off" (6.24); however, there is no effect during daylight (standard deviations of 5.38 and 5.36 when radar is on and off, respectively). The effect of light is different at the Florence station with darkness producing more variable speeds for the median lane, less variable speeds for the shoulder lane, and no significant effect for the center lane. Finally, the adjusted standard deviation of speeds is significantly higher on the weekend when compared to the weekday for the shoulder lane at this station while the opposite is true for this same lane at the Ft. Wright station.

The 85th-percentile speed is a measure commonly used to describe traffic speeds. A summary of the actual and expected 85th-percentile speeds at the Ft. Wright and Florence stations for the various categories is presented in Table 13. The actual speeds with "radar on" were lower than the expected speeds, using the "radar off" data, for every category. The differences, while small, were larger than those found for the mean speeds at the Ft. Wright station. The differences were larger at Florence than at Ft. Wright and were very similar to those found for the mean speeds. No statistical analyses were performed to compare the 85th-percentile speeds.

MANUAL SPEED DATA

The manual data collected at the four locations are summarized in Table 14. The average speed, standard deviation, and the percentage of vehicles exceeding various speeds are presented. Statistical tests indicated that none of the differences in average speed were significant. There was no general trend in the speeds with "radar on" or "radar off" at either the District Office or Jefferson Street locations. Speeds at the Ft. Mitchell location were lower with "radar on". The results show that the sample of speed data collected manually was apparently insufficient to include all the conditions that would identify differences expected by time of day, day of week, light conditions, and traffic volumes.

All speeds increased from the shoulder to the center to the median lane. Speeds decreased as traffic proceeded northbound from the "rest area" location to the "Jefferson Street" location.

SPEED DATA - WITH AND WITHOUT RADAR DETECTORS

The summary of speed data for vehicles with and without a radar detector is presented in Table 15. The data also are summarized with "radar on" and "radar off". All data were collected in the median lane at the Ft. Wright speed monitoring station. The analysis showed that, when the radar was off, the percentage of vehicles with a speed over specified high speeds was higher for vehicles with radar detectors. Conversely, when the radar was on, the percentage of vehicles with speeds over these high speeds was higher for vehicles without a radar detector. It is also interesting to note the reduction in the percentage of vehicles with detectors traveling above these speeds when the radar was on. For example, the percentage of vehicles exceeding 65 mph was about 36 percent for vehicles with radar detectors during "radar off" conditions and this percentage decreased to about 20 percent with "radar on". Conversely, this percentage did not change for vehicles with no radar detector, with 28 percent during "radar off" and 27 percent during "radar on".

A comparison of mean speeds between the four conditions given in Table 15 using a one-way analysis of variance F test, indicated statistically significant differences in the means. This permitted the construction of the following three contrasts of interest: 1) a contrast for testing the difference between the effect of radar for cars with detectors and the effect of radar for cars without detectors (interaction between radar and detectors), which was significant ($P < 0.0001$); 2) a contrast for testing the effect of radar for cars with detectors, which was significant ($t = 3.56$, $P < 0.0001$); and 3) a contrast for testing the effect of radar for cars without detectors, which was not significant ($P > 0.50$). These data show that, while mean speeds decreased significantly for cars with detectors when comparing "radar off" and "radar on" conditions (64.64 mph compared to 62.60 mph), mean speeds did not change significantly for cars without detectors (63.57 mph compared to 63.49 mph). With "radar off", the average speeds of vehicles with detectors were higher than vehicles without detectors (64.64 mph compared to 63.57 mph); and conversely, with "radar on", the average speeds of vehicles without detectors were higher than vehicles with detectors (63.49 mph compared to 62.60 mph).

A statistical analysis of the percentage of vehicles exceeding the various speed levels was performed. For each speed level, Chi-Square tests were performed for the four conditions given in Table 15. When this result was significant, Chi-Square tests were conducted comparing radar on and off for vehicles with and without detectors as well as data for vehicles with and without detectors for the radar on and off. When the data for vehicles with radar detectors were analyzed, it was found that the percentage exceeding 65 mph was reduced by a statistically significant amount with the "radar on" (19.8 percent) compared to "radar off" (36.4 percent). No significant differences were found comparing the data for vehicles without radar detectors when "radar on" and "radar off" conditions were compared. Under "radar off" conditions, the percentage of vehicles exceeding 65 mph (36.4 percent compared to 27.7 percent) and 70 mph (10.6 percent compared to 5.0 percent) was statistically higher for vehicles with radar detectors (the percent of vehicles exceeding 60 mph was statistically (marginally) higher for vehicles with detectors). Under "radar on" conditions, the percentage of vehicles exceeding 60 mph (80.4 percent compared to 71.9 percent) was found to be statistically (marginally) higher for vehicles without a radar detector.

The change in the variability of speeds can be shown in the standard deviations. A comparison between the standard deviation of speeds under the four conditions given in Table 15 was made using Bartlett's statistic ($P < 0.05$). In light of this significant result, F statistics were used to compare the standard deviations between radar on (3.74) and off (4.64) for cars with detectors ($P < 0.01$) and to compare the standard deviations between radar on (4.02) and off (4.21) for cars without detectors ($P < 0.05$). These data show that the variability of speeds was decreased significantly under the "radar on" condition for vehicles with radar detectors as well as for those without detectors. For vehicles with radar detectors, the standard deviation decreased substantially (4.64 compared to 3.74) as a result of radar. When the radar was off the standard deviation of speeds of vehicles with detectors was higher than without detectors (4.64 compared to 4.21); when the radar was on, the standard deviation of speeds of vehicles without detectors was higher than with detectors (4.02 compared to 3.74). These data show that the variability of speeds was decreased under the "radar on" condition, especially for vehicles with radar detectors.

SPEED DATA - WITH AND WITHOUT POLICE ENFORCEMENT

The effect of active enforcement on speeds is shown in Table 16. The data show that both the mean speeds and the percentages of vehicles exceeding various speeds were reduced as a result of active police enforcement. These reductions occurred both with "radar on" and "radar off". The reductions in mean speed and the percentage exceeding 65 mph and 70 mph were determined to be statistically significant.

RADAR DETECTOR DATA

A sample of 318 trucks was inspected by the Division of Motor Vehicle Enforcement during its regular inspection activities at the Scott County weigh station on I 75 between May 15 and June 1, 1987. A visual inspection of the truck cab interiors revealed that 135, or 42.4 percent, of the trucks had radar detectors.

Observations of the number of vehicles with visible detectors were conducted on 14 days between June 2 and August 22, 1987, on I 75 during trips between Lexington and northern Kentucky. A sample of 768 cars between June 2 and July 30 showed that 66, or 8.6 percent, had radar detectors. Another sample between August 4 and August 22 classified the cars into in-state and out-of-state. There was very little difference between in-state and out-of-state with 13.5 percent (55 of 406) in-state cars and 12.9 percent (55 of 426) out-of-state cars having radar detectors. Combining all the data yielded 11.0 percent of cars with detectors.

ACCIDENT ANALYSES

A summary of the analysis of accident records is presented in Table 17. The summary for the 12.3-mile section between the KY 338 interchange and the Ft. Mitchell (US 25) interchange was tabulated separately from the 4.1-mile section between the Ft. Mitchell interchange and the Ohio River. The section between KY 338 and Ft. Mitchell had an average ADT of about 82,000 over the four-year study period compared with about 102,000 for the section between Ft. Mitchell and the Ohio River. During the time covered by the radar experiment, there was basically full radar coverage of the section between Ft. Mitchell and the Ohio River and partial coverage for the other section.

The number of accidents and accident rate were much higher for the section between Ft. Mitchell and the Ohio River. The accident rate for this section during the three years prior to truck diversion and initial radar installations was 245 accidents per 100 MVM. This was above the statewide average of 156 accidents per 100 MVM and a three-year critical rate of 171 accidents per 100 MVM for urban interstates. Critical rates for various types of highways in Kentucky were determined as part of other research (3). In general, the critical rate for a type of highway is calculated using statistical tests to determine whether the accident rate for a specific class of highway is abnormally high compared to a predetermined average for highways with similar characteristics. The statistical tests are based on the commonly accepted assumption that accidents approximate the Poisson distribution.

The accident rate for the section between the KY 338 and Ft. Mitchell interchanges was much lower (a rate of 42 accidents per 100 MVM during the three years prior to truck diversion and radar installations). Although this section of I 75 is classified as an urban interstate, some parts are more representative of a rural interstate. The average rate for rural interstates is 69 accidents per 100 MVM and for similar urban interstates the rate is 156 accidents per 100 MVM.

The data were summarized for a three-year period prior to July 1986 and a one-year period after that date. That date coincided with a diversion of northbound trucks from I 75 onto I 275 and also represents the approximate date when the unmanned radar was started. Both of these factors could have the potential for affecting accidents within the northbound lanes in the July 1986 through June 1987 time period. Also, the impact should be most obvious on the section between Ft. Mitchell and the Ohio River since both factors would apply to the total length of this section. However, only a portion of the section between the KY 338 and Ft. Mitchell interchanges would be affected.

A comparison between the two roadway sections and two time periods showed that the major change was on the section between Ft. Mitchell and the Ohio River. Specifically, the accident rate was reduced during the July 1986 to June 1987 time period. This was primarily the result of a reduction in the number of accidents in the northbound direction, which was shown to be related to a reduction in the number of truck accidents. This would be related to the truck diversion. It also should be noted that there was a reduction in the percentage of speed-related accidents for northbound traffic in this section, which could be related to the unmanned radar.

SUMMARY AND CONCLUSIONS

Following is a summary of the major findings and conclusions from the analyses performed during this study.

1. At the Ft. Wright speed monitoring station, there was no statistical difference in mean speeds with "radar on" and "radar off".

2. At the Florence speed monitoring station, data indicated the mean speeds showed a statistically significant decrease with "radar on".

3. At both speed monitoring stations, there were statistically significant reductions in the numbers of vehicles exceeding speed levels of 65 to 80 mph when "radar on" (actual) and "radar off" (expected) speeds were compared.

4. Unmanned radar was demonstrated to be an effective means of reducing the number of "high-speed" drivers. The reduction per day in numbers of vehicles exceeding the speed limit (55 mph) by 15 mph was determined to be approximately 900 at Florence as compared to approximately 350 vehicles per day exceeding the speed limit (50 mph) by 15 mph at Ft. Wright.

5. The variability of speeds at the speed monitoring stations (as measured by the standard deviation) decreased with "radar on" as compared to "radar off".

6. The 85th-percentile speeds were lower with "radar on" at the speed monitoring stations. The differences were very small at the Ft. Wright station.

7. The manual data collection did not reveal any statistically significant differences when comparing mean speeds with "radar on" and "radar off". Results indicated that the sampling periods were apparently insufficient to include all conditions that might identify differences that were shown at locations where automatic equipment was used to collect continuous data.

8. About 42 percent of trucks and 11 percent of cars were observed to have radar detectors. There was no substantial difference in the percentage of in-state and out-of-state cars with radar detectors.

9. Speeds of vehicles with and without detectors for "radar on" and "radar off" conditions indicated that the use of radar detectors had a significant effect on vehicle speeds. With "radar on" conditions, the speeds of vehicles with radar detectors decreased significantly compared to the "radar off" conditions, while the speeds of vehicles without detectors were not affected by the radar. These data also indicated that the variability of speeds was decreased under the "radar on" condition, especially for vehicles with radar detectors.

10. Active police enforcement was found to produce a statistically significant reduction in mean speeds and the percentage of vehicles exceeding various speeds.

11. Accidents in the northbound direction on I 75 between Ft. Mitchell and the Ohio River were found to have decreased in the one-year period after July 1986 compared to the three-year period before. This reduction was apparently related to the truck diversion and, possibly, the unmanned radar. There was a reduction in the percentage of truck-related and speed-related accidents for northbound traffic in this section.

RECOMMENDATIONS

The results from analyses of data at the speed monitoring stations demonstrated that the unmanned radar had the significant effect of reducing the number of vehicles traveling at excessive speeds. It should be noted that even though the effect of unmanned radar was dramatic at Florence, it is questionable whether continuation of unmanned radar is justifiable at a location where the accident rate is relatively low. However, data at the Ft. Wright location show that unmanned radar may have a positive effect and reduce speeds at a location where higher speeds have a much greater potential of increasing accidents. For the purposes of evaluation, the data support continuation of the use of unmanned radar throughout the study area at least until a determination is made of the impact on accidents.

To determine whether the speed-reducing effect of unmanned radar has resulted in a reduction in accidents, a longer-term in-depth accident study should be conducted.

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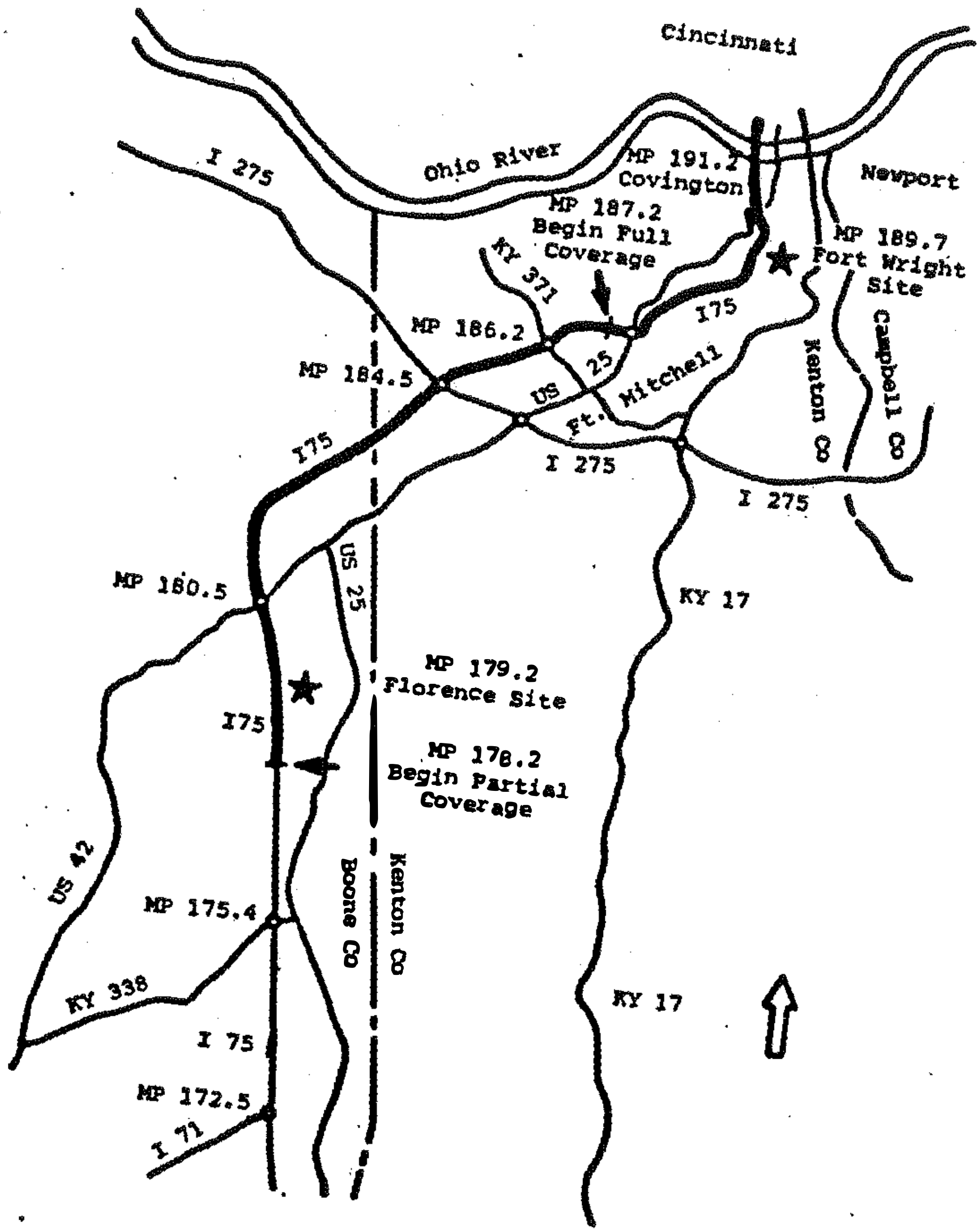

FIGURE 1. MAP SHOWING SIGNIFICANT POINTS IN STUDY AREA

TABLE 1. LOCATION OF UNMANNED UNITS IN PARTIAL AND FULL COVERAGE AREAS

NUMBER	MILEPOINT	LOCATION DESCRIPTION
	178.2	Beginning of Partial Coverage Area
1	179.2	At Existing Speed Monitoring Station
2	180.5*	US 42 Interchange
3	182.9*	Turfway Road Interchange
4	184.5	I 275 Interchange (unit aimed south)
5	184.5	I 275 Interchange (unit aimed north)
6	186.2*	Buttermilk Pike - KY 371 (District Office)
	187.2	Beginning of Full Coverage Area
7	187.7*	Ft. Mitchell - Dixie Highway Interchange (US 25)
8	188.0	Between Ft. Mitchell and Ft. Wright Interchange
9	188.6	Ft. Wright - Kyles Lane Interchange
10	189.2	North of Ft. Wright - Kyles Lane Interchange
11	189.7*	Covington City Limits - New Speed Monitoring Station (unit aimed south)
12	189.7	Covington City Limits - New Speed Monitoring Station (unit aimed north)
13	190.3	Jefferson St. (unit aimed north)
14	190.3	Jefferson St. (unit aimed south)
15	191.2	On Bridge Approach at Ohio River

* Locations where radar units were initially installed in the summer of 1986.

TABLE 2. LOCATION OF DATA COLLECTION SITES

NUMBER	MILEPOINT	LOCATION DESCRIPTION	TYPE
1	176.8	Rest Area	Manual
2	179.2	Speed Monitoring Station	Automatic
3	186.2	Highway District Office	Manual
4	187.7	Ft. Mitchell Interchange	Manual
5	189.7	Speed Monitoring Station	Automatic
6	190.3	Jefferson St. Overpass	Manual

TABLE 3. CALIBRATION OF SPEED DISTRIBUTION MODEL[a]

SPEED INTERVAL (i)	RANGE IN SPEEDS (mph)	MIDPOINT OF SPEED RANGE (MS_i)	a_0	a_1	R^2
1	< 35	33	0.00532975	0.000171737	0.10
2	36-40	38	0.00512458	0.000223322	0.26
3	41-45	43	0.0140188	0.00083977	0.48
4	46-50	48	0.0702431	0.00623933	0.76
5	51-55	53	0.028337	0.0310620	0.92
6	56-60	58	0.195454	0.0290890	0.88
7	61-65	63	0.415943	-0.0153434	0.57

[a]Equation 1.

TABLE 4. ADJUSTED MEAN SPEEDS FROM ANALYSIS OF COVARIANCE[a]

VARIABLE	CATEGORY	LANE: MEDIAN RADAR ON	MEDIAN RADAR OFF	CENTER RADAR ON	CENTER RADAR OFF	SHOULDER RADAR ON	SHOULDER RADAR OFF
FLORENCE							
All	All	64.50	66.36	62.06	63.72	57.15	58.61
Day of Week	Weekday	65.07	66.45	62.52	63.79	57.41	58.58
	Weekend	63.93	66.28	61.60	63.65	56.90	58.64
Light	Daylight	65.42	67.27	63.11	64.45	57.75	58.88
	Darkness	63.58	65.46	61.01	62.99	56.56	58.34
FT. WRIGHT							
All	All	62.82	62.98	57.85	57.88	54.57	54.46
Day of Week	Weekday	62.74	62.91	57.71	57.77	53.58	53.52
	Weekend	62.89	63.05	57.99	58.00	55.56	55.40
Light	Daylight	64.26	64.40	59.01	59.11	55.65	55.48
	Darkness	61.38	61.56	56.69	56.66	53.48	53.44

[a]Mean speeds are adjusted to the average level of traffic volume in the lane.

TABLE 5. P-VALUES FROM ANALYSIS OF COVARIANCE - MEAN SPEEDS[a]

VARIABLE	LANE: MEDIAN	LANE: CENTER	LANE: SHOULDER
FLORENCE			
Covariate			
Volume	0.0001	0.0001	0.0001
Main Effects			
Radar	0.0001	0.0001	0.0001
Day	0.0002	0.0001	0.0356
Light	0.0001	0.0001	0.0001
Two-Factor Interactions			
Radar*Day	0.0048	0.0016	0.0105
Radar*Light	0.9304	0.0083	0.0035
Day*Light	0.0255	0.1490	0.9267
Three-Factor Interaction			
Radar*Day*Light	0.3469	0.2122	0.7898
FT. WRIGHT			
Covariate			
Volume	0.0001	0.0001	0.8246
Main Effects			
Radar	0.0529	0.6649	0.2599
Day	0.0817	0.0010	0.0001
Light	0.0001	0.0001	0.0001
Two-Factor Interactions			
Radar*Day	0.9222	0.7638	0.6041
Radar*Light	0.8478	0.4061	0.4706
Day*Light	0.0001	0.0001	0.0010
Three-Factor Interaction			
Radar*Day*Light	0.2683	0.1594	0.2675

[a]An effect of mean speed is statistically significant for small values of P, generally those less than 0.0500. P-values are based on Type I sum of squares for the covariate and Type III sum of squares elsewhere.

TABLE 6. RADAR EFFECTS ON NUMBER OF VEHICLES ABOVE VARIOUS SPEEDS

LOCATION	SPEED	NUMBER OVER SPEED		PERCENT OVER SPEED		PERCENT REDUCTION DUE TO RADAR	NUMBER OVER SPEED PER HOUR***		REDUCTION PER DAY
		RADAR ON (ACTUAL)*	RADAR OFF (EXPECTED)**	RADAR ON (ACTUAL)	RADAR OFF (EXPECTED)		RADAR ON (ACTUAL)	RADAR OFF (EXPECTED)	
Florence	80	751	1,265	0.32	0.53	40.6	3.5	5.0	36
	75	2,336	4,396	0.99	1.86	46.9	11.0	20.8	234
	70	11,954	19,828	5.06	8.38	39.7	56.5	93.7	894
	65	55,631	75,023	23.53	31.73	25.8	262.8	354.5	2199
Ft. Wright	80	983	1,240	0.05	0.06	20.6	1.0	1.3	6
	75	5,018	6,228	0.23	0.31	25.8	5.2	6.5	31
	70	44,940	50,668	2.07	2.53	18.2	46.8	52.8	144
	65	258,991	273,301	11.90	13.42	11.3	269.7	284.6	358

* Actual number of vehicles recorded above given speed with "radar on".
** Expected number of vehicles above given speed using data obtained with "radar off".
*** Based on number of hours of data obtained with "radar on" (635 lane-hours at Florence and 2,881 lane-hours at Ft. Wright).

Note: All differences were significant at the 0.05 level of significance.

TABLE 7. RADAR EFFECTS ON NUMBER OF VEHICLES ABOVE VARIOUS SPEEDS AS A FUNCTION OF LANE

LOCATION	CATEGORY	SPEED	NUMBER OVER SPEED: RADAR ON (ACTUAL)	NUMBER OVER SPEED: RADAR OFF (EXPECTED)	PERCENT OVER SPEED: RADAR ON (ACTUAL)	PERCENT OVER SPEED: RADAR OFF (EXPECTED)	PERCENT REDUCTION
Florence	Median Lane	80	290	528	0.63	1.15	45.1
		75	975	1,918	2.13	4.18	49.2
		70	5,049	8,560	11.01	18.67	41.0
		65	21,218	27,593	46.29	60.19	23.1
	Center Lane	80	362	599	0.34	0.56	39.6
		75	1,116	2,100	1.05	1.97	46.9
		70	5,842	9,554	5.49	8.98	38.9
		65	28,551	38,823	26.84	36.50	26.5
	Shoulder Lane	80	99	139	0.12	0.16	28.8
		75	245	378	0.29	0.45	35.2
		70	1,063	1,714	1.26	2.03	38.0
		65	5,862	8,608	6.96	10.22	31.9
Ft. Wright	Median Lane	80	652	758	0.09	0.11	14.0
		75	3,437	4,214	0.48	0.59	18.4
		70	33,540	37,453	4.70	5.25	10.4
		65	191,890	200,978	26.92	28.19	4.5
	Center Lane	80	204	257	0.02	0.03	20.6
		75	1,000	1,226	0.11	0.14	18.4
		70	7,933	9,162	0.88	1.02	13.4
		65	48,657	53,016	5.41	5.90	8.2
	Shoulder Lane	80	127	226	0.02	0.04	43.8
		75	581	789	0.10	0.14	26.4
		70	3,467	4,053	0.61	0.72	14.4
		65	18,444	19,308	3.27	3.42	4.5

Note: All differences were significant at the 0.05 level of significance.

TABLE 8. RADAR EFFECTS ON NUMBER OF VEHICLES ABOVE VARIOUS SPEEDS AS A FUNCTION OF DAY OF WEEK

			NUMBER OVER SPEED		PERCENT OVER SPEED		
LOCATION	CATEGORY	SPEED	RADAR ON (ACTUAL)	RADAR OFF (EXPECTED)	RADAR ON (ACTUAL)	RADAR OFF (EXPECTED)	PERCENT REDUCTION
Florence	Weekday	80	610	1,002	0.34	0.55	39.1
		75	1,909	3,494	1.06	1.93	45.4
		70	9,744	15,489	5.39	8.57	37.1
		65	44,004	57,538	24.36	31.85	23.5
	Weekend	80	141	264	0.25	0.47	46.6
		75	427	901	0.76	1.61	52.6
		70	2,210	4,339	3.96	7.77	49.1
		65	11,627	17,485	20.83	31.32	33.5
Ft. Wright	Weekday	80	689	862	0.04	0.05	20.1
		75	3,513	4,394	0.20	0.26	20.0
		70	32,542	36,644	1.90	2.14	11.2
		65	193,566	204,756	11.33	11.99	5.5
	Weekend	80	294	378	0.06	0.08	22.2
		75	1,505	1,834	0.32	0.39	17.9
		70	12,398	14,025	2.65	3.00	11.7
		65	65,425	68,546	13.99	14.66	4.6

Note: All differences were significant at the 0.05 level of significance.

TABLE 9. RADAR EFFECTS ON NUMBER OF VEHICLES ABOVE VARIOUS SPEEDS AS A FUNCTION OF LIGHT CONDITION

			NUMBER OVER SPEED		PERCENT OVER SPEED		
LOCATION	CATEGORY	SPEED	RADAR ON (ACTUAL)	RADAR OFF (EXPECTED)	RADAR ON (ACTUAL)	RADAR OFF (EXPECTED)	PERCENT REDUCTION
Florence	Daylight	80	538	867	0.33	0.55	37.9
		75	1,725	3,223	1.06	1.93	46.5
		70	9,131	15,050	5.59	8.57	39.3
		65	43,083	57,301	26.40	35.10	24.8
	Dark	80	213	399	0.29	0.55	46.6
		75	611	1,173	0.84	1.60	47.9
		70	2,823	4,779	3.86	6.54	40.9
		65	12,548	17,722	17.20	24.20	29.2
Ft. Wright	Daylight	80	646	835	0.04	0.05	22.6
		75	3,616	4,486	0.22	0.27	19.4
		70	35,166	39,579	2.15	2.42	11.1
		65	206,133	217,200	12.60	13.28	5.1
	Dark	80	337	405	0.06	0.08	16.8
		75	1,402	1,742	0.26	0.32	19.5
		70	9,744	11,089	1.80	2.05	12.1
		65	52,858	56,102	9.79	10.39	5.8

Note: All differences were significant at the 0.05 level of significance.

TABLE 10. RADAR EFFECTS ON NUMBER OF VEHICLES ABOVE VARIOUS SPEEDS AS A FUNCTION OF TRAFFIC VOLUME

			NUMBER OVER SPEED		PERCENT OVER SPEED		
LOCATION	CATEGORY	SPEED	RADAR ON (ACTUAL)	RADAR OFF (EXPECTED)	RADAR ON (ACTUAL)	RADAR OFF (EXPECTED)	PERCENT REDUCTION
Florence	Less than 300 VPH	80	202	393	0.46	0.89	48.6
		75	667	1,243	1.51	2.82	46.3
		70	2,946	4,810	6.69	10.92	38.8
		65	11,366	15,230	25.80	34.57	25.4
	300-599 VPH	80	281	448	0.26	0.42	37.3
		75	849	1,621	0.79	1.51	47.6
		70	4,496	7,571	4.19	7.05	40.6
		65	20,928	28,236	19.51	26.28	25.9
	600-899 VPH	80	234	374	0.31	0.50	37.4
		75	729	1,376	0.98	1.84	47.0
		70	3,960	6,597	5.30	8.84	40.0
		65	20,093	27,501	26.91	36.84	26.9
	900-1,200 VPH	80	34	51	0.33	0.49	33.3*
		75	91	155	0.88	1.50	41.3
		70	552	851	5.35	8.24	35.1
		65	3,244	4,056	31.42	39.29	20.0
Ft. Wright	Less than 300 VPH	80	154	192	0.16	0.20	19.8*
		75	580	756	0.61	0.79	23.3
		70	2,993	3,415	3.15	3.59	12.4
		65	11,599	12,435	12.20	13.08	6.7
	300-599 VPH	80	176	214	0.08	0.10	17.8*
		75	761	948	0.35	0.44	19.7
		70	5,530	6,369	2.57	2.96	13.2
		65	27,283	28,675	12.69	13.34	4.8
	600-899 VPH	80	280	371	0.05	0.07	24.5
		75	1,469	1,784	0.27	0.33	17.6
		70	13,057	14,057	2.41	2.59	7.1
		65	68,404	70,708	12.63	13.05	3.2
	900-1,200 VPH	80	249	293	0.05	0.05	15.0*
		75	1,359	1,664	0.25	0.31	18.3
		70	14,445	15,850	2.67	2.93	8.9
		65	86,790	91,287	16.05	16.88	4.9
	Over 1,200 VPH	80	124	170	0.02	0.02	27.0
		75	849	1,075	0.11	0.14	21.0
		70	8,915	10,978	1.14	1.40	18.8
		65	64,915	70,196	8.29	8.97	7.5

* All differences were significant at the 0.05 level of significance except those noted with an asterisk.

TABLE 11. STANDARD DEVIATION OF SPEED FROM ANALYSIS OF COVARIANCE[a]

VARIABLE	CATEGORY	MEDIAN RADAR ON	MEDIAN RADAR OFF	CENTER RADAR ON	CENTER RADAR OFF	SHOULDER RADAR ON	SHOULDER RADAR OFF
FLORENCE							
All	All	5.52	5.82	5.38	5.51	5.41	5.58
Day of Week	Weekday	5.57	5.60	5.35	5.47	5.31	5.48
	Weekend	5.48	6.02	5.42	5.55	5.51	5.68
Light	Daylight	5.38	5.36	5.41	5.44	5.55	5.65
	Darkness	5.67	6.24	5.36	5.57	5.28	5.51
FT. WRIGHT							
All	All	4.97	5.08	4.66	4.79	6.02	6.08
Day of Week	Weekday	4.95	5.08	4.71	4.83	6.27	6.39
	Weekend	4.99	5.08	4.61	4.74	5.76	5.76
Light	Daylight	4.82	4.91	4.71	4.80	5.93	6.05
	Darkness	5.12	5.24	4.62	4.77	6.11	6.12

[a]Mean variances of speed are adjusted to the average level of traffic volume in the lane. Standard deviations reported above are square roots of the adjusted mean variances.

TABLE 12. P-VALUES FROM ANALYSIS OF COVARIANCE - MEAN VARIANCE OF SPEED[a]

VARIABLE	LANE: MEDIAN	LANE: CENTER	LANE: SHOULDER
FLORENCE			
Covariate			
Volume	0.0001	0.0001	0.0025
Main Effects			
Radar	0.0683	0.0114	0.0001
Day	0.2860	0.1355	0.0001
Light	0.0037	0.5561	0.0002
Two-Factor Interactions			
Radar*Day	0.1069	0.9690	0.8921
Radar*Light	0.0540	0.0564	0.1172
Day*Light	0.5915	0.7538	0.0009
Three-Factor Interaction			
Radar*Day*Light	0.1571	0.6218	0.6195
FT. WRIGHT			
Covariate			
Volume	0.0001	0.0001	0.0001
Main Effects			
Radar	0.0097	0.0005	0.0456
Day	0.6856	0.0127	0.0013
Light	0.0001	0.2232	0.0001
Two-Factor Interactions			
Radar*Day	0.6341	0.9130	0.0441
Radar*Light	0.5915	0.4107	0.0616
Day*Light	0.0003	0.0284	0.0001
Three-Factor Interactions			
Radar*Day*Light	0.4248	0.1845	0.7211

[a]An effect of mean variance of speed is statistically significant for small values of P, generally those less than 0.0500. P-values are based on Type I sum of squares for the covariate and Type III sum of squares elsewhere.

TABLE 13. RADAR EFFECTS ON 85TH PERCENTILE SPEED

		85TH PERCENTILE SPEED			
		FT. WRIGHT		FLORENCE	
VARIABLE	CATEGORY	RADAR ON (ACTUAL)	RADAR OFF (EXPECTED)	RADAR ON (ACTUAL)	RADAR OFF (EXPECTED)
All	All	65.41	65.55	67.31	68.58
Day of Week	Weekday	64.14	64.28	67.47	68.62
	Weekend	64.79	64.93	66.73	68.47
Lane	Median	67.68	67.88	69.44	71.27
	Center	62.21	62.39	67.77	68.91
	Shoulder	59.60	59.63	63.01	64.04
Light Conditions	Daylight	64.46	64.61	67.74	68.88
	Dark	63.69	63.85	65.81	67.61
Traffic Volume (Vehicles per Hour)	Less than 300	64.22	64.45	67.82	69.14
	300-599	64.44	64.61	66.46	67.93
	600-899	64.40	64.50	67.76	68.90
	900-1,200	65.39	65.68	68.15	68.91
	Over 1,200	63.36	63.48	*	*

* There was no data in this traffic volume category.

TABLE 14. SUMMARY OF MANUAL DATA COLLECTION

LOCATION	VARIABLE	SHOULDER LANE RADAR ON	SHOULDER LANE RADAR OFF	CENTER LANE RADAR ON	CENTER LANE RADAR OFF	MEDIAN LANE RADAR ON	MEDIAN LANE RADAR OFF
Rest Area	Average Speed (mph)	*	57.6	*	62.0	*	69.1
	Standard Deviation	*	4.72	*	4.89	*	4.50
	Percent over 55 mph	*	69.5	*	92.2	*	99.8
	Percent over 60 mph	*	26.0	*	59.7	*	97.8
	Percent over 65 mph	*	4.0	*	20.9	*	79.0
	Percent over 70 mph	*	0.6	*	4.8	*	36.8
District Office	Average Speed (mph)	50.8	50.9	57.8	57.0	61.8	61.9
	Standard Deviation	4.09	4.16	4.40	4.24	4.22	3.96
	Percent over 55 mph	11.5	11.6	69.0	61.2	94.0	94.5
	Percent over 60 mph	2.1	1.9	25.5	16.7	62.4	63.9
	Percent over 65 mph	0.4	0.4	4.6	4.5	17.4	17.5
	Percent over 70 mph	0.0	0.0	0.7	0.4	2.2	1.6
Ft. Mitchell	Average Speed (mph)	49.8	49.9	54.5	55.0	55.9	57.1
	Standard Deviation	4.14	4.13	4.20	4.41	3.92	3.74
	Percent over 55 mph	8.8	9.0	37.0	41.8	54.8	66.4
	Percent over 60 mph	1.3	1.6	7.3	10.7	12.3	17.4
	Percent over 65 mph	0.2	0.3	1.5	2.2	1.3	1.3
	Percent over 70 mph	0.0	0.1	0.3	0.4	0.2	0.2
Jefferson Street	Average Speed (mph)	48.4	48.3	49.8	49.5	55.6	55.7
	Standard Deviation	4.28	4.41	4.19	3.91	3.64	3.99
	Percent over 55 mph	5.3	5.3	7.8	7.0	48.2	51.9
	Percent over 60 mph	0.8	1.1	1.5	1.0	9.3	11.5
	Percent over 65 mph	0.4	0.1	0.7	0.2	0.6	1.6
	Percent over 70 mph	0.0	0.0	0.2	0.2	0.0	0.1

* Data taken outside area covered by radar.

Note: None of the differences between the average speeds were found to be significant at the 0.05 level of significance. Statistical testing was not performed on other speed measures.

TABLE 15. RADAR EFFECTS ON SPEEDS OF VEHICLES WITH AND WITHOUT DETECTORS*

	RADAR OFF		RADAR ON	
	WITH DETECTOR	NO DETECTOR	WITH DETECTOR	NO DETECTOR
Sample Size	132	1,091	121	1,953
Average Speed (MPH)**	64.64	63.57	62.60	63.49
Standard Deviation	4.64	4.21	3.74	4.02
Percent Speeds Over 60 MPH	81.8	79.9	71.9	80.4
Percent Speeds Over 65 MPH	36.4	27.7	19.8	26.7
Percent Speeds Over 70 MPH	10.6	5.0	4.1	4.1
Percent Speeds Over 75 MPH	2.3	1.0	0.0	0.9

* All data taken in median lane at Ft. Wright speed monitoring station.

TABLE 16. RADAR EFFECTS ON SPEEDS WITH AND WITHOUT ACTIVE POLICE ENFORCEMENT

	RADAR OFF		RADAR ON	
	PERCENTAGE	STATISTICAL SIGNIFICANCE*	PERCENTAGE	STATISTICAL SIGNIFICANCE*
Reduction in Mean Speed	5.7	S	6.4	S
Reduction in Percentage Exceeding 65 mph	48	S	65	S
Reduction in Percentage Exceeding 70 mph	53	S	78	S
Reduction in Percentage Exceeding 75 mph	25	NS	43	NS
Reduction in Percentage Exceeding 80 mph	74	NS	81	NS

* Statistical tests were conducted at the 0.05 level of significance. An "S" notation notes a statistical significance. A "NS" notation notes the reduction was not statistically significant.

TABLE 17. ACCIDENT ANALYSIS

	LOCATION			
	KY 338-FT. MITCHELL		FT. MITCHELL-OHIO RIVER	
	7/1/83 - 6/30/86	7/1/86 - 6/30/87	7/1/83- 6/30/86	7/1/86 - 6/30/87
Total Accidents	441	147	1,122	310
Accident/Year				
Total	147	147	374	310
Northbound	82	77	170	121
Southbound	65	70	204	189
Accidents/Mile/Year	120	120	91.2	75.6
Accident Rate(ACC/100 MVM)	42	40	245	204
Percent Truck Accidents				
Total	26.8	23.8	28.9	20.0
Northbound	26.1	23.4	27.6	16.5
Southbound	27.6	24.3	30.3	22.2
Percent Injury or Fatal Accidents				
Total	23.8	25.9	30.7	35.5
Northbound	22.4	23.4	31.2	32.2
Southbound	25.5	28.6	30.5	37.6
Percent Speed Related Accidents				
Total	10.9	6.8	8.0	7.4
Northbound	9.4	9.1	8.0	6.6
Southbound	12.8	4.3	8.1	7.9
Percent During Darkness				
Total	30.6	28.6	33.6	32.3
Northbound	29.0	31.2	26.0	31.4
Southbound	32.7	25.7	40.7	32.8
Percent on Wet or Snowy Pavement				
Total	33.6	22.4	30.6	18.7
Northbound	29.0	23.4	35.2	22.3
Southbound	39.3	21.4	28.5	16.4

APPENDIX A

FEDERAL COMMUNICATIONS COMMISSION RULING AND U.S. CONGRESS LEGISLATION

12/24/87

7310-03

Mr. Robert T. Dillon
New York State Police
Public Security Building
State Campus
Albany, New York 12226

Dear Mr. Dillon:

This is in response to your December 3, 1987 letter concerning the use of unmanned radar units to discourage motorists with radar detection devices from speeding.

Recently, we have received several inquiries concerning the use of radar units by state or local government agencies in programs designed to lower vehicle speeds. Such operations also have been proposed by others over the last decade, but the Commission has ruled against them. We have generally expressed concern about such unmanned radar operations because of the potential of interference to authorized users in the Radiolocation Service that employ radar frequencies for activities permitted under our rules. For example, radar frequencies are used by licensees for purposes such as security, liquid level control, manufacturer production control, and determination of distance, speed and direction.

Congress, in H.T. 5484, the Drug Enforcement Education and Control Act of 1986 (P.L. 99-570), authorized the Commonwealth of Kentucky to conduct a two year demonstration project beginning October 27, 1986 to assess the benefits of using unmanned radar equipment for speed reduction purposes on a specific section of a Kentucky interstate highway. It is expected that the results of that demonstration project also will provide information regarding the extent to which operation of unmanned "drone" radar units causes interference to authorized operations.

Therefore, the Commission's present policy is not to authorize unmanned "drone" radar operations. When the results of the Kentucky project are known, we will take that information into account in setting future policy.

Sincerely,

Richard J. Shiben
Chief, Land Mobile & Microwave Division

cc:
Chief, LM&M
Rules Files

NEWS

Federal Communications Commission
1919 M Street, N.W.
Washington, D.C. 20554

Report No. 4872 GENERAL ACTION May 19, 1978 - G

FCC RULES OUT DRONE RADARS, WARNS AGAINST THEIR USE

The Commission has denied the State of Washington permission to test solar power drone radars intended to trigger speed radar detectors. The FCC also told the State that it did not believe the Commission's rules should be changed to allow regular operation of these devices.

The Commission, in denying Washington State's request, said the devices would emit a signal similar to that of police radar units used to enforce highway speed laws. It noted that although the drone devices would trigger motorists' radar detectors, inducing drivers to slow down, they would have great potential for interfering with police radar as well as other radiolocation operations and security systems using field disturbance sensors on the same band.

The Commission said manufacturers had recommended that these devices be set up at 10-mile intervals along a highway. The FCC noted that this would further increase interference and pollution of the radio spectrum.

At the same time, the FCC's Safety and Special Radio Services Bureau warned that the devices were illegal and could not be used, sold or offered for sale.

The Bureau added that it had learned a number of State and local police agencies were contemplating using these units to transmit false or drone radar signals, particularly on the 10,525 MHz frequency.

That frequency is within the 10,500-10,550 MHz band, which is allocated to the radiolocation service, the Bureau pointed out. Also authorized in the 10,525 MHz band are speed measuring devices, field disturbance sensors and low power units with very limited duty cycle (transmit one second, silent 30 seconds).

The Bureau emphasized that the drone units were not permitted by current Commission rules. It noted that the devices merely transmitted radar-like signals and were not used for speed measuring or radiolocation and did not qualify as field disturbance sensors or low power devices, and therefore could not be operated under Part 15 of the Rules.

The Commission has not type-accepted or certified any antiradar detector or drone radar transmitting device, and therefore they could not be used, sold or offered for sale.

It added that a type-accepted radar transmitter modified to be used as an antiradar detector would lose its type-accepted status and could not be operated or sold under any conditions.

Action by the Commission May 18, 1978, by letter. Commissioners Ferris (Chairman), Lee, Quello, Washburn, Fogarty, White and Brown.

PUBLIC NOTICE

FEDERAL COMMUNICATIONS COMMISSION
1919 M STREET N.W.
WASHINGTON, D.C. 20554

6138

News media information 202/254-7674. Recorded listing of releases and texts 202/632-0002.

- R E V I S E D - August 1, 1985

FCC REGULATES RADAR TRANSMITTERS, BUT NOT RADAR DETECTORS

The FCC continues to receive many inquiries about regulations governing police radar, radar detectors, and other radar devices used on the highways. This Notice explains the scope of FCC regulation over these devices. It updates and supersedes the Bulletin on the same subject dated July 18, 1980.

Traffic radars used by police to enforce highway speed limits are transmitters. As such, they are type-accepted and authorized by the FCC under Parts 2 and 90 of its rules. These rules permit any state or local government with an FCC license for its radio communications system to operate speed radars without getting separate licenses for them. The radar frequencies and number of units do not have to be shown on the license itself.

FCC rules spell out how radars may be operated as transmitters but not how they may be used by police to measure vehicle speeds. The FCC has no jurisdiction over the calibration of radars or over the reliability of their readings.

[The U.S. Department of Transportation's National Highway Traffic Safety Administration (NHTSA) is the federal agency concerned with the enforcement of highway speed limits and with the operation of police radars as enforcement tools. For more information, write to NHTSA's Office of Enforcement and Emergency Services, 400 Seventh St., S.W., Washington, D.C. 20590. Or call the state or local police department for information about how radar is used in a particular area.]

Radar jammers are transmitters tuned to interfere with ("jam") a radar signal. The intentional use of jammers is considered "malicious interference," which is strictly prohibited by the Communications Act of 1934, as amended, and by FCC rules. Anyone using a jammer risks such penalties as losing any FCC licenses, paying a fine, or even facing criminal prosecution.

Radar detectors are radio receivers popularly known for being tuned to receive police radar signals and to warn motorists of radar "traps" ahead of them. In this regard, the FCC regulations pertaining to receivers are limited in scope and, as currently drafted, do not address the subject of radar detectors. The use of radar detectors by members of the public, therefore, does not constitute in itself a violation of FCC Rules. The FCC is aware that other agencies have addressed the subject of radar detectors but the FCC has not to date and has no future plans to address the activities of these other agencies.

In summary, the FCC regulates transmitters but exercises only limited jurisdiction over receivers, with the subject of radar detectors not being addressed in the FCC Rules. From a policy standpoint the FCC favors authorizing the use of radio, including radars, to promote safety on the public highways and elsewhere.

-FCC-

This notice is a revision of Public Notice 5947, released July 23, 1985. For more information about the subject of this notice, contact Richard Kenney in the Private Radio Bureau at (202) 632-6497.

99TH CONGRESS
2D SESSION

H. R. 5484

To strengthen Federal efforts to encourage foreign cooperation in eradicating illicit drug crops and in halting international drug traffic, to improve enforcement of Federal drug laws and enhance interdiction of illicit drug shipments, to provide strong Federal leadership in establishing effective drug abuse prevention and education programs, to expand Federal support for drug abuse treatment and rehabilitation efforts, and for other purposes.

IN THE HOUSE OF REPRESENTATIVES

SEPTEMBER 8, 1986

Mr. WRIGHT (for himself, Mr. MICHEL, Mr. RANGEL, Mr. GILMAN, Mr. FOLEY, Mr. LOTT, Mr. GEPHARDT, Mr. LEWIS of California, Ms. OAKAR, Mr. KEMP, Mr. FASCELL, Mr. ROSTENKOWSKI, Mr. JONES of Tennessee, Mr. ST GERMAIN, Mr. RODINO, Mr. HOWARD, Mr. HAWKINS, Mr. ASPIN, Mr. DINGELL, Mr. FORD of Michigan, Mr. BROOKS, Mr. JONES of Oklahoma, Mr. HUGHES, Mr. ENGLISH, Mr. AKAKA, Mr. ALEXANDER, Mr. ANDREWS, Mr. ANNUNZIO, Mr. ANTHONY, Mr. ATKINS, Mr. AUCOIN, Mr. BARNARD, Mr. BENNETT, Mr. BEVILL, Mr. BIAGGI, Mr. BLAZ, Mr. BLILEY, Mr. BOEHLERT, Mr. BOLAND, Mr. BONER of Tennessee, Mr. BONKER, Mr. BORSKI, Mr. BOUCHER, Mr. BREAUX, Mr. BROOMFIELD, Mr. BROWN of California, Mr. BRUCE, Mr. BRYANT, Mrs. BURTON of California, Mr. CALLAHAN, Mr. CAMPBELL, Mr. CARR, Mr. CHAPMAN, Mr. CHAPPELL, Mr. CHENEY, Mr. CLINGER, Mr. COELHO, Mr. COLEMAN of Missouri, Mr. COLEMAN of Texas, Mrs. COLLINS, Mr. COMBEST, Mr. COOPER, Mr. COUGHLIN, Mr. COURTER, Mr. COYNE, Mr. DANIEL, Mr. DARDEN, Mr. DASCHLE, Mr. DAUB, Mr. DAVIS, Mr. DELLUMS, Mr. DERRICK, Mr. DEWINE, Mr. DICKINSON, Mr. DIOGUARDI, Mr. DIXON, Mr. DONNELLY, Mr. DORGAN of North Dakota, Mr. DORNAN of California, Mr. DOWNEY of New York, Mr. DUNCAN, Mr. DURBIN, Mr. DWYER of New Jersey, Mr.

SEC. 12016. RADAR DEMONSTRATION PROJECT.

(a) PROJECT DESCRIPTION.—Notwithstanding any other provision of law, the Secretary, in cooperation with State and local law enforcement officials, shall conduct a demonstration project to assess the benefits of continuous use of unmanned radar equipment on highway safety on a section of highway with a high rate of motor vehicle accidents. Such project shall be conducted in northern Kentucky on a hilly section of Interstate Route I–75 between Fort Mitchell and the Brent Spence Bridge over the Ohio River during the 24-month period beginning on the date of the enactment of this title.

(b) REPORTS.—

(1) INTERIM REPORT.—Not later than 18 months after the date of the enactment of this title, the Secretary shall transmit to Congress an interim report on the results of the demonstration project conducted under subsection (a), together with any recommendations on whether or not to extend the duration of such demonstration project and whether or not to expand the scope of such project.

(2) FINAL REPORT.—Not later than 60 days after completion of the demonstration project conducted under subsection (a), the Secretary shall transmit to Congress a final report on the results of such project, together with any such recommendations.

APPENDIX B

STATISTICAL ANALYSIS OF PROPORTIONS OF VEHICLES EXCEEDING SPECIFIED SPEED LEVELS

Statistical analysis of the proportions of vehicles exceeding specified speed levels was patterned after analysis originally used by Campbell in his 1968 evaluation of the injury-reduction effects of seat belts in automobile crashes (14). Campbell was aware that factors other than seat-belt usage affected the likelihood that drivers would sustain injuries in crashes. Such factors, identifiable within his data base, included type of accident (single vehicle, car vs. car, and car vs. truck), part of car struck (front, side, rear, and unspecified), and travel speed (0-29 mph, 30-49 mph, and 50 or more mph). Direct comparisons between the proportions of crashes resulting in injury between belted and unbelted drivers were limited to the elemental analysis units, each comprising a unique combination of type of accident, part of car struck, and travel speed. For aggregations, adjustments were made to assure proportional representation among the elemental analysis units for both belted and unbelted drivers. Essentially, within each elemental unit, the proportion of injury crashes for unbelted drivers was applied to the number of crashes for belted drivers to obtain the number of injury crashes in the belted driver sample that would be "expected" had the driver not been belted. Aggregated comparisons were between the expected sums and the actual sums for belted drivers.

The Campbell procedure was adopted for use herein because of its simplicity and its intuitive appeal. Essentially, data collected under "radar off" conditions was adjusted so that the proportion of total observations occurring within each elemental analysis unit was identical to that occurring under "radar on" conditions. Each speed measure, so adjusted, is considered to be the expected value in the absence of radar: it is compared with the actual value measured with "radar on" to identify the most likely effects of the radar.

Table B1 illustrates computations for the number of vehicles exceeding 65 miles per hour at Florence. The first line of data represents that collected in the median lane during daylight hours of weekdays under the lowest volume condition. The proportion of vehicles exceeding 65 miles per hour with "radar off" is 0.647 (5,571/8,611). If radar has no effect, the expected number of vehicles exceeding 65 mph in the sample observed with "radar on" is 5,572, the product of the number of vehicles observed with "radar on" (8,613) and the above proportion (0.647). Thus, for this elemental analysis unit, the effect of radar was to reduce the number of vehicles exceeding 65 mph by 1,062, from 5,572 to 4,510.

To determine the composite effect of radar, it is necessary to aggregate data tabulated for each of the elemental analysis units. The proportion of observations within each elemental unit for the "radar on" condition was used as the representative condition. Again referring to Table B1 for illustrative purposes, the composite effect of radar at Florence was to reduce the number of vehicles exceeding 65 miles per hour during a representative period of 635 lane hours, about 212 clock hours, from 75,023 to 55,631, a reduction of about 26 percent. Therefore, 55,631 is the actual number of vehicles exceeding 65 mph that was observed, and 75,023 is the expected number obtained by summing over the 35 elemental analysis units.

Effects of radar were evaluated not only for the entire data set, as illustrated above, but also for subsets by day of week, lane of travel, light condition, and volume level. In this way, conditions possibly enhancing or diminishing the effects of radar may be identified.

Effects of radar on vehicle speeds were generally tested for their statistical significance. The level of significance for hypothesis testing was set at 0.05. As illustrated in Figure B2, a Chi-Squared test was used for testing the significance of differences in the proportions of vehicles exceeding stated speed levels (14, 15).

TABLE B1. ILLUSTRATION OF COMPUTATION OF EXPECTED CONDITIONS

				RADAR OFF			RADAR ON			RADAR OFF
DAY	LANE	LIGHT	VOL	NO. OF HOURS	ACTUAL NO. OF VEHICLES	ACTUAL NO. OF VEHICLES EXCEEDING 65 MPH	NO. OF HOURS	ACTUAL NO. OF VEHICLES	ACTUAL NO. OF VEHICLES EXCEEDING 65 MPH	EXPECTED NO. OF VEHICLES EXCEEDING 65 MPH
1	1	1	1	39	8611	5571	37	8613	4510	5572
1	1	1	2	30	12077	7655	43	16933	8394	10733
1	1	2	1	67	4408	2239	82	6355	2739	3228
1	1	2	2	5	1672	948	2	659	293	374
1	2	1	2	16	9073	3332	12	6952	2212	2553
1	2	1	3	50	35073	14038	66	48199	14519	19292
1	2	1	4	3	2773	1234	3	2915	914	1297
1	2	2	1	42	7438	2357	47	8374	1804	2654
1	2	2	2	23	9146	2926	31	12996	3137	4158
1	2	2	3	7	4705	1354	6	3870	871	1114
1	3	1	2	65	32793	3592	78	39409	3160	4317
1	3	1	3	4	2458	345	3	1962	216	275
1	3	2	1	50	10726	781	53	11776	468	857
1	3	2	2	22	8771	840	31	11637	767	1114
2	1	1	1	16	2124	1521	8	1065	581	763
2	1	1	2	21	8727	5226	9	3480	1217	2084
2	1	1	3	7	5088	3229	5	3832	1781	2432
2	1	1	4	2	1883	994	2	1916	841	1011
2	1	2	1	41	2741	1252	22	1880	432	859
2	1	2	2	5	2076	1001	1	472	183	228
2	1	2	3	2	1407	685	1	636	247	310
2	2	1	1	3	608	238	2	459	172	180
2	2	1	2	10	4458	2034	4	1785	640	814
2	2	1	3	20	15253	5582	11	8172	1686	2991
2	2	1	4	13	13685	4597	4	4489	1273	1508
2	2	2	1	30	5111	1745	13	2079	442	710
2	2	2	2	9	3760	985	7	2948	318	772
2	2	2	3	6	4023	1021	3	2135	347	542
2	2	2	4	3	2996	714	1	1004	216	239
2	3	1	1	5	1068	173	3	689	72	112
2	3	1	2	27	13574	1614	14	7294	498	867
2	3	1	3	14	9615	927	7	5187	397	500
2	3	2	1	34	6017	643	16	2770	146	296
2	3	2	2	12	5039	391	7	2864	109	222
2	3	2	3	2	1290	90	1	665	29	46
TOTALS				705	260267	81874	635	236471	55631	75023

Day:
1 Weekday
2 Weekend

Lane:
1 Median
2 Center
3 Shoulder

Light:
1 Daylight
2 Darkness

Vol (vplph):
1 < 300
2 300-599
3 600-899
4 900-1,200
5 > 1,200

TABLE B2. ILLUSTRATION OF STATISTICAL TESTING, VEHICLES EXCEEDING 65 MPH (ALL DATA AT FLORENCE)

				RADAR OFF		RADAR ON		RADAR OFF	
DAY	LANE	LIGHT	VOL	NO. OF VEH	ACTUAL NO. OF VEHICLES EXCEEDING 65 MPH	NO. OF VEH	ACTUAL NO. OF VEHICLES EXCEEDING 65 MPH	EXPECTED NO. OF VEHICLES EXCEEDING 65 MPH	CHI SQUARED DENOMINATOR
1	1	1	1	8611	5571	8613	4510	5572	3935
1	1	1	2	12077	7655	16933	8394	10733	9440
1	1	2	1	4408	2239	6355	2739	3228	3878
1	1	2	2	1672	948	659	293	374	226
1	2	1	2	9073	3332	6952	2212	2553	2853
1	2	1	3	35073	14038	48199	14519	19292	27470
1	2	1	4	2773	1234	2915	914	1297	1477
1	2	2	1	7438	2357	8374	1804	2654	3854
1	2	2	2	9146	2926	12996	3137	4158	6845
1	2	2	3	4705	1354	3870	871	1114	1446
1	3	1	2	32793	3592	39409	3160	4317	8463
1	3	1	3	2458	345	1962	216	275	426
1	3	2	1	10726	781	11776	468	857	1668
1	3	2	2	8771	840	11637	767	1114	2345
2	1	1	1	2124	1521	1065	581	763	325
2	1	1	2	8727	5226	3480	1217	2084	1169
2	1	1	3	5088	3229	3832	1781	2432	1558
2	1	1	4	1883	994	1916	841	1011	963
2	1	2	1	2741	1252	1880	432	859	786
2	1	2	2	2076	1001	472	183	228	145
2	1	2	3	1407	685	636	247	310	231
2	2	1	1	608	238	459	172	180	192
2	2	1	2	4458	2034	1785	640	814	620
2	2	1	3	15253	5582	8172	1686	2991	2912
2	2	1	4	13685	4597	4489	1273	1508	1330
2	2	2	1	5111	1745	2079	442	710	658
2	2	2	2	3760	985	2948	318	772	1017
2	2	2	3	4023	1021	2135	347	542	619
2	2	2	4	2996	714	1004	216	239	243
2	3	1	1	1068	173	689	72	112	154
2	3	1	2	13574	1614	7294	498	867	1175
2	3	1	3	9615	927	5187	397	500	696
2	3	2	1	6017	643	2770	146	296	386
2	3	2	2	5039	391	2864	109	222	321
2	3	2	3	1290	90	665	29	46	65
TOTAL				260267	81874	236471	55631	75024	89891

Day:
1 Weekday
2 Weekend

Lane:
1 Median
2 Center
3 Shoulder

Light:
1 Daylight
2 Darkness

Vol (vplph):
1 < 300
2 300-599
3 600-899
4 900-1,200
5 > 1,200

TABLE B2. ILLUSTRATION OF STATISTICAL TESTING, VEHICLES EXCEEDING 65 MPH (ALL DATA AT FLORENCE) (CONTINUED)

x_a, n_a = actual number of vehicles exceeding 65 mph and actual number of observed vehicles with "radar off"

x_b, n_b = actual number of vehicles exceeding 65 mph and actual number of observed vehicles with "radar on"

x_b' = expected number of vehicles exceeding 65 mph with "radar off" (adjusted to reflect "radar on" counting frequencies)

$$\text{Chi Squared} = \frac{[\text{sum}(x_b - \text{sum}(x_b'))]^2}{\text{sum}[(x_a/n_a*n_b)*(1-x_a/n_a)*(1+n_b/n_a)]}$$

$$= \frac{[55,631 - 75,024]^2}{89,891} = 4,184$$

ls = level of significance = 0.05

$\text{Chi Squared}_{1-ls}$ = 3.84 (From chi-squared table with one degree of freedom)

Since Chi Squared > $\text{Chi Squared}_{1-ls}$, conclude that the proportion of vehicles exceeding 65 mph without radar exceeds the proportion of vehicles exceeding 65 mph with radar at a level of significance of 0.05.

APPENDIX C

SUMMARY TABLES SHOWING MEAN SPEEDS, 85TH PERCENTILE, STANDARD DEVIATION, AND NUMBER OF VEHICLES EXCEEDING VARIOUS SPEED LEVELS

TABLE C1. COMPARISON OF MEAN SPEEDS
(AUTOMATIC DATA AT FT. WRIGHT)

				RADAR OFF			RADAR ON		
DAY	LANE	LIGHT	VOLUME	NO. OF HOURS	NO. OF VEHICLES	MEAN SPEED	NO. OF HOURS	NO. OF VEHICLES	MEAN SPEED
1	1	1	1	0	0	-	2	355	66.099
1	1	1	2	2	1,180	63.648	4	2,090	64.151
1	1	1	3	74	59,669	64.256	100	78,738	64.131
1	1	1	4	98	102,910	63.650	164	172,126	63.337
1	1	1	5	70	114,908	59.129	123	196,679	59.750
1	1	2	1	108	8,792	63.231	165	14,286	62.991
1	1	2	2	64	28,274	63.324	93	39,943	62.996
1	1	2	3	28	19,922	62.634	46	32,202	62.437
1	1	2	4	5	5,221	61.708	4	4,094	61.872
1	1	2	5	15	22,765	61.303	19	28,027	61.188
1	2	1	2	0	0	-	2	911	60.656
1	2	1	3	3	2,480	58.351	4	3,430	57.853
1	2	1	4	99	111,034	58.525	127	141,476	58.603
1	2	1	5	140	198,726	56.688	260	370,882	56.723
1	2	2	1	90	15,714	58.142	130	24,251	58.087
1	2	2	2	36	16,597	58.628	64	30,621	58.364
1	2	2	3	48	36,660	57.738	71	54,278	57.409
1	2	2	4	26	26,567	57.177	40	39,995	57.145
1	2	2	5	17	24,265	56.615	21	29,795	56.575
1	3	1	1	2	423	56.097	3	606	56.845
1	3	1	2	7	3,931	54.692	18	9,474	54.908
1	3	1	3	164	127,341	54.564	283	219,290	54.607
1	3	1	4	23	23,541	53.856	49	50,468	53.967
1	3	1	5	22	33,001	48.711	30	47,059	49.373
1	3	2	1	93	17,674	51.682	152	26,899	51.750
1	3	2	2	81	36,638	54.463	137	60,150	54.089
1	3	2	3	13	8,864	54.269	21	14,142	54.235
1	3	2	4	15	15,681	53.335	16	16,729	53.347
1	3	2	5	0	0	-	1	1,295	51.514
2	1	1	1	14	2,471	66.543	11	1,906	65.629
2	1	1	2	19	9,203	65.983	18	8,541	65.537
2	1	1	3	42	32,270	64.487	37	28,629	64.475
2	1	1	4	57	59,260	63.505	40	40,306	63.625
2	1	1	5	27	35,427	62.644	26	33,898	62.299
2	1	2	1	71	7,719	63.559	64	6,826	63.437
2	1	2	2	35	15,488	62.455	29	12,192	62.256
2	1	2	3	11	7,965	61.380	13	8,554	61.819
2	1	2	4	3	3,097	61.466	4	3,868	61.232
2	1	2	5	0	0	-	2	2,647	60.376
2	2	1	2	15	6,476	60.377	11	4,704	60.163
2	2	1	3	19	14,804	60.478	19	14,714	59.793
2	2	1	4	56	61,137	58.917	48	52,524	58.833
2	2	1	5	67	89,037	58.356	54	72,598	58.175
2	2	2	1	40	7,639	58.244	36	7,436	58.420
2	2	2	2	35	14,575	58.095	34	14,687	58.197
2	2	2	3	30	22,629	57.159	23	17,230	57.243
2	2	2	4	11	11,052	56.039	16	16,061	56.398
2	2	2	5	1	1,253	55.989	3	3,899	55.596
2	3	1	1	7	1,591	57.525	8	1,910	57.442
2	3	1	2	29	14,248	56.814	31	15,216	56.986
2	3	1	3	91	65,085	56.394	90	65,170	56.503
2	3	1	4	1	931	56.464	3	3,002	56.235
2	3	1	5	1	1,254	53.738	0	0	-
2	3	2	1	55	8,470	54.630	64	10,981	54.855
2	3	2	2	44	18,760	54.826	40	17,332	54.815
2	3	2	3	3	1,996	53.917	8	5,390	54.622

Day:
1 Weekday
2 Weekend

Lane:
1 Median
2 Center
3 Shoulder

Light:
1 Daylight
2 Darkness

Volume (vplph):
1 < 300
2 300-599
3 600-899
4 900-1,200
5 > 1,200

TABLE C2. COMPARISON OF PERCENTAGE OF VEHICLES EXCEEDING 65 MPH (AUTOMATIC DATA AT FT. WRIGHT)

				RADAR OFF			RADAR ON		
DAY	LANE	LIGHT	VOLUME	NO. OF HOURS	NO. OF VEHICLES	PERCENT EXCEED 65 MPH	NO. OF HOURS	NO. OF VEHICLES	PERCENT EXCEED 65 MPH
1	1	1	1	0	0	-	2	355	55.211
1	1	1	2	2	1,180	32.119	4	2,090	37.751
1	1	1	3	74	59,669	39.444	100	78,738	38.307
1	1	1	4	98	102,910	34.095	164	172,126	31.689
1	1	1	5	70	114,908	16.111	123	196,679	15.900
1	1	2	1	108	8,792	32.803	165	14,286	30.470
1	1	2	2	64	28,274	30.961	93	39,943	29.222
1	1	2	3	28	19,922	25.891	46	32,202	24.377
1	1	2	4	5	5,221	19.556	4	4,094	19.248
1	1	2	5	15	22,765	16.253	19	28,027	14.725
1	2	1	2	0	0	-	2	911	15.258
1	2	1	3	3	2,480	6.371	4	3,430	7.114
1	2	1	4	99	111,034	6.638	127	141,476	6.755
1	2	1	5	140	198,726	4.987	260	370,882	4.476
1	2	2	1	90	15,714	9.030	130	24,251	7.987
1	2	2	2	36	16,597	7.718	64	30,621	6.740
1	2	2	3	48	36,660	5.330	71	54,278	4.536
1	2	2	4	26	26,567	4.265	40	39,995	3.863
1	2	2	5	17	24,265	3.128	21	29,795	2.796
1	3	1	1	2	423	7.565	3	606	7.756
1	3	1	2	7	3,931	3.409	18	9,474	4.296
1	3	1	3	164	127,341	3.758	283	219,290	3.587
1	3	1	4	23	23,541	2.935	49	50,468	2.130
1	3	1	5	22	33,001	0.567	30	47,059	0.436
1	3	2	1	93	17,674	2.535	152	26,899	2.521
1	3	2	2	81	36,638	3.376	137	60,150	3.061
1	3	2	3	13	8,864	2.550	21	14,142	2.758
1	3	2	4	15	15,681	1.715	16	16,729	1.536
1	3	2	5	0	0	-	1	1,295	0.849
2	1	1	1	14	2,471	58.155	11	1,906	50.262
2	1	1	2	19	9,203	53.624	18	8,541	50.650
2	1	1	3	42	32,270	41.305	37	28,629	41.332
2	1	1	4	57	59,260	33.905	40	40,306	34.035
2	1	1	5	27	35,427	27.191	26	33,898	22.780
2	1	2	1	71	7,719	35.017	64	6,826	33.680
2	1	2	2	35	15,488	25.426	29	12,192	24.729
2	1	2	3	11	7,965	18.318	13	8,554	20.715
2	1	2	4	3	3,097	17.469	4	3,868	17.813
2	1	2	5	0	0	-	2	2,647	11.976
2	2	1	2	15	6,476	15.889	11	4,704	14.435
2	2	1	3	19	14,804	13.854	19	14,714	10.833
2	2	1	4	56	61,137	7.877	48	52,524	7.553
2	2	1	5	67	89,037	6.753	54	72,598	5.603
2	2	2	1	40	7,639	9.438	36	7,436	8.755
2	2	2	2	35	14,575	6.840	34	14,687	6.945
2	2	2	3	30	22,629	4.424	23	17,230	4.684
2	2	2	4	11	11,052	2.443	16	16,061	3.375
2	2	2	5	1	1,253	3.591	3	3,899	2.257
2	3	1	1	7	1,591	8.297	8	1,910	8.639
2	3	1	2	29	14,248	5.959	31	15,216	6.138
2	3	1	3	91	65,085	5.036	90	65,170	5.051
2	3	1	4	1	931	2.148	3	3,002	3.598
2	3	1	5	1	1,254	1.834	0	0	-
2	3	2	1	55	8,470	4.298	64	10,981	4.653
2	3	2	2	44	18,760	3.353	40	17,332	3.093
2	3	2	3	3	1,996	2.305	8	5,390	2.430

Day:
1 Weekday
2 Weekend

Lane:
1 Median
2 Center
3 Shoulder

Light:
1 Daylight
2 Darkness

Volume (vplph):
1 < 300
2 300-599
3 600-899
4 900-1,200
5 > 1,200

TABLE C3. COMPARISON OF PERCENTAGE OF VEHICLES EXCEEDING 70 MPH (AUTOMATIC DATA AT FT. WRIGHT)

				RADAR OFF			RADAR ON		
DAY	LANE	LIGHT	VOLUME	NO. OF HOURS	NO. OF VEHICLES	PERCENT EXCEED 70 MPH	NO. OF HOURS	NO. OF VEHICLES	PERCENT EXCEED 70 MPH
1	1	1	1	0	0	-	2	355	20.282
1	1	1	2	2	1,180	7.712	4	2,090	9.665
1	1	1	3	74	59,669	7.775	100	78,738	7.525
1	1	1	4	98	102,910	5.951	164	172,126	5.287
1	1	1	5	70	114,908	2.396	123	196,679	2.069
1	1	2	1	108	8,792	9.418	165	14,286	8.274
1	1	2	2	64	28,274	6.370	93	39,943	5.430
1	1	2	3	28	19,922	4.573	46	32,202	3.975
1	1	2	4	5	5,221	3.026	4	4,094	2.760
1	1	2	5	15	22,765	1.841	19	28,027	1.549
1	2	1	2	0	0	-	2	911	3.842
1	2	1	3	3	2,480	0.806	4	3,430	1.108
1	2	1	4	99	111,034	1.065	127	141,476	1.081
1	2	1	5	140	198,726	0.850	260	370,882	0.701
1	2	2	1	90	15,714	1.992	130	24,251	1.621
1	2	2	2	36	16,597	1.440	64	30,621	1.238
1	2	2	3	48	36,660	0.854	71	54,278	0.755
1	2	2	4	26	26,567	0.662	40	39,995	0.613
1	2	2	5	17	24,265	0.482	21	29,795	0.359
1	3	1	1	2	423	1.418	3	606	1.155
1	3	1	2	7	3,931	0.763	18	9,474	0.982
1	3	1	3	164	127,341	0.806	283	219,290	0.670
1	3	1	4	23	23,541	0.582	49	50,468	0.365
1	3	1	5	22	33,001	0.082	30	47,059	0.085
1	3	2	1	93	17,674	0.583	152	26,899	0.424
1	3	2	2	81	36,638	0.756	137	60,150	0.572
1	3	2	3	13	8,864	0.553	21	14,142	0.566
1	3	2	4	15	15,681	0.293	16	16,729	0.203
1	3	2	5	0	0	-	1	1,295	-
2	1	1	1	14	2,471	21.489	11	1,906	17.471
2	1	1	2	19	9,203	16.234	18	8,541	13.628
2	1	1	3	42	32,270	9.191	37	28,629	8.589
2	1	1	4	57	59,260	6.277	40	40,306	5.930
2	1	1	5	27	35,427	4.604	26	33,898	3.065
2	1	2	1	71	7,719	10.364	64	6,826	9.903
2	1	2	2	35	15,488	5.107	29	12,192	4.823
2	1	2	3	11	7,965	3.277	13	8,554	3.718
2	1	2	4	3	3,097	2.196	4	3,868	2.559
2	1	2	5	0	0	-	2	2,647	1.322
2	2	1	2	15	6,476	3.567	11	4,704	2.636
2	2	1	3	19	14,804	2.797	19	14,714	2.005
2	2	1	4	56	61,137	1.268	48	52,524	1.199
2	2	1	5	67	89,037	1.153	54	72,598	0.849
2	2	2	1	40	7,639	2.173	36	7,436	1.910
2	2	2	2	35	14,575	1.413	34	14,687	1.273
2	2	2	3	30	22,629	0.787	23	17,230	0.789
2	2	2	4	11	11,052	0.461	16	16,061	0.567
2	2	2	5	1	1,253	0.399	3	3,899	0.231
2	3	1	1	7	1,591	1.823	8	1,910	1.990
2	3	1	2	29	14,248	1.235	31	15,216	1.104
2	3	1	3	91	65,085	0.976	90	65,170	0.956
2	3	1	4	1	931	0.430	3	3,002	0.966
2	3	1	5	1	1,254	0.319	0	0	-
2	3	2	1	55	8,470	0.980	64	10,981	0.984
2	3	2	2	44	18,760	0.709	40	17,332	0.645
2	3	2	3	3	1,996	0.601	8	5,390	0.445

Day:
1 Weekday
2 Weekend

Lane:
1 Median
2 Center
3 Shoulder

Light:
1 Daylight
2 Darkness

Volume (vplph):
1 < 300
2 300-599
3 600-899
4 900-1,200
5 > 1,200

TABLE C4. COMPARISON OF PERCENTAGE OF VEHICLES EXCEEDING 75 MPH (AUTOMATIC DATA AT FT. WRIGHT)

				RADAR OFF			RADAR ON		
DAY	LANE	LIGHT	VOLUME	NO. OF HOURS	NO. OF VEHICLES	PERCENT EXCEED 75 MPH	NO. OF HOURS	NO. OF VEHICLES	PERCENT EXCEED 75 MPH
1	1	1	1	0	0	-	2	355	2.535
1	1	1	2	2	1,180	0.678	4	2,090	1.435
1	1	1	3	74	59,669	0.833	100	78,738	0.705
1	1	1	4	98	102,910	0.585	164	172,126	0.465
1	1	1	5	70	114,908	0.216	123	196,679	0.179
1	1	2	1	108	8,792	2.172	165	14,286	1.505
1	1	2	2	64	28,274	0.902	93	39,943	0.701
1	1	2	3	28	19,922	0.527	46	32,202	0.413
1	1	2	4	5	5,221	0.326	4	4,094	0.391
1	1	2	5	15	22,765	0.119	19	28,027	0.107
1	2	1	2	0	0	-	2	911	0.659
1	2	1	3	3	2,480	0.121	4	3,430	0.117
1	2	1	4	99	111,034	0.142	127	141,476	0.128
1	2	1	5	140	198,726	0.098	260	370,882	0.079
1	2	2	1	90	15,714	0.369	130	24,251	0.326
1	2	2	2	36	16,597	0.217	64	30,621	0.163
1	2	2	3	48	36,660	0.125	71	54,278	0.116
1	2	2	4	26	26,567	0.094	40	39,995	0.090
1	2	2	5	17	24,265	0.041	21	29,795	0.017
1	3	1	1	2	423	0.473	3	606	0.165
1	3	1	2	7	3,931	0.229	18	9,474	0.179
1	3	1	3	164	127,341	0.158	283	219,290	0.109
1	3	1	4	23	23,541	0.085	49	50,468	0.052
1	3	1	5	22	33,001	0.009	30	47,059	0.015
1	3	2	1	93	17,674	0.170	152	26,899	0.093
1	3	2	2	81	36,638	0.145	137	60,150	0.098
1	3	2	3	13	8,864	0.056	21	14,142	0.078
1	3	2	4	15	15,681	0.026	16	16,729	0.030
1	3	2	5	0	0	-	1	1,295	-
2	1	1	1	14	2,471	4.775	11	1,906	3.095
2	1	1	2	19	9,203	2.238	18	8,541	1.932
2	1	1	3	42	32,270	1.016	37	28,629	0.870
2	1	1	4	57	59,260	0.660	40	40,306	0.486
2	1	1	5	27	35,427	0.353	26	33,898	0.260
2	1	2	1	71	7,719	2.125	64	6,826	2.197
2	1	2	2	35	15,488	0.710	29	12,192	0.615
2	1	2	3	11	7,965	0.339	13	8,554	0.351
2	1	2	4	3	3,097	0.161	4	3,868	0.310
2	1	2	5	0	0	0	2	2,647	0.113
2	2	1	2	15	6,476	0.463	11	4,704	0.340
2	2	1	3	19	14,804	0.399	19	14,714	0.306
2	2	1	4	56	61,137	0.134	48	52,524	0.131
2	2	1	5	67	89,037	0.162	54	72,598	0.098
2	2	2	1	40	7,639	0.537	36	7,436	0.309
2	2	2	2	35	14,575	0.274	34	14,687	0.191
2	2	2	3	30	22,629	0.146	23	17,230	0.110
2	2	2	4	11	11,052	0.054	16	16,061	0.100
2	2	2	5	1	1,253	-	3	3,899	0.051
2	3	1	1	7	1,591	0.126	8	1,910	0.209
2	3	1	2	29	14,248	0.232	31	15,216	0.184
2	3	1	3	91	65,085	0.194	90	65,170	0.183
2	3	1	4	1	931	0.215	3	3,002	0.033
2	3	1	5	1	1,254	-	0	0	-
2	3	2	1	55	8,470	0.272	64	10,981	0.219
2	3	2	2	44	18,760	0.133	40	17,332	0.075
2	3	2	3	3	1,996	0.050	8	5,390	0.056

Day:
1 Weekday
2 Weekend

Lane:
1 Median
2 Center
3 Shoulder

Light:
1 Daylight
2 Darkness

Volume (vplph):
1 < 300
2 300-599
3 600-899
4 900-1,200
5 > 1,200

TABLE C5. COMPARISON OF PERCENTAGE OF VEHICLES EXCEEDING 80 MPH (AUTOMATIC DATA AT FT. WRIGHT)

				RADAR OFF			RADAR ON		
DAY	LANE	LIGHT	VOLUME	NO. OF HOURS	NO. OF VEHICLES	PERCENT EXCEED 80 MPH	NO. OF HOURS	NO. OF VEHICLES	PERCENT EXCEED 80 MPH
1	1	1	1	0	0	-	2	355	0.000
1	1	1	2	2	1,180	0.085	4	2,090	0.431
1	1	1	3	74	59,669	0.146	100	78,738	0.135
1	1	1	4	98	102,910	0.102	164	172,126	0.079
1	1	1	5	70	114,908	0.032	123	196,679	0.025
1	1	2	1	108	8,792	0.523	165	14,286	0.420
1	1	2	2	64	28,274	0.170	93	39,943	0.170
1	1	2	3	28	19,922	0.115	46	32,202	0.109
1	1	2	4	5	5,221	0.057	4	4,094	0.049
1	1	2	5	15	22,765	0.013	19	28,027	0.014
1	2	1	2	0	0	-	2	911	0.110
1	2	1	3	3	2,480	-	4	3,430	0.029
1	2	1	4	99	111,034	0.030	127	141,476	0.025
1	2	1	5	140	198,726	0.018	260	370,882	0.013
1	2	2	1	90	15,714	0.095	130	24,251	0.087
1	2	2	2	36	16,597	0.054	64	30,621	0.039
1	2	2	3	48	36,660	0.030	71	54,278	0.020
1	2	2	4	26	26,567	0.004	40	39,995	0.033
1	2	2	5	17	24,265	0.008	21	29,795	0.003
1	3	1	1	2	423	0.236	3	606	-
1	3	1	2	7	3,931	0.025	18	9,474	0.032
1	3	1	3	164	127,341	0.043	283	219,290	0.021
1	3	1	4	23	23,541	0.025	49	50,468	0.012
1	3	1	5	22	33,001	-	30	47,059	0.002
1	3	2	1	93	17,674	0.034	152	26,899	0.022
1	3	2	2	81	36,638	0.052	137	60,150	0.018
1	3	2	3	13	8,864	0.011	21	14,142	0.007
1	3	2	4	15	15,681	-	16	16,729	0.006
1	3	2	5	0	0	-	1	1,295	-
2	1	1	1	14	2,471	0.931	11	1,906	0.735
2	1	1	2	19	9,203	0.478	18	8,541	0.375
2	1	1	3	42	32,270	0.149	37	28,629	0.126
2	1	1	4	57	59,260	0.093	40	40,306	0.092
2	1	1	5	27	35,427	0.045	26	33,898	0.030
2	1	2	1	71	7,719	0.570	64	6,826	0.513
2	1	2	2	35	15,488	0.149	29	12,192	0.131
2	1	2	3	11	7,965	0.050	13	8,554	0.012
2	1	2	4	3	3,097	0.032	4	3,868	0.052
2	1	2	5	0	0	-	2	2,647	-
2	2	1	2	15	6,476	0.124	11	4,704	0.085
2	2	1	3	19	14,804	0.074	19	14,714	0.048
2	2	1	4	56	61,137	0.029	48	52,524	0.027
2	2	1	5	67	89,037	0.027	54	72,598	0.011
2	2	2	1	40	7,639	0.209	36	7,436	0.121
2	2	2	2	35	14,575	0.082	34	14,687	0.068
2	2	2	3	30	22,629	0.049	23	17,230	0.023
2	2	2	4	11	11,052	0.009	16	16,061	0.012
2	2	2	5	1	1,253	-	3	3,899	0.051
2	3	1	1	7	1,591	-	8	1,910	0.052
2	3	1	2	29	14,248	0.077	31	15,216	0.059
2	3	1	3	91	65,085	0.061	90	65,170	0.048
2	3	1	4	1	931	0.107	3	3,002	-
2	3	1	5	1	1,254	-	0	0	-
2	3	2	1	55	8,470	0.106	64	10,981	0.073
2	3	2	2	44	18,760	0.032	40	17,332	0.012
2	3	2	3	3	1,996	-	8	5,390	-

Day:
1 Weekday
2 Weekend

Lane:
1 Median
2 Center
3 Shoulder

Light:
1 Daylight
2 Darkness

Volume (vplph):
1 < 300
2 300-599
3 600-899
4 900-1,200
5 > 1,200

TABLE C6. COMPARISON OF 85TH PERCENTILE SPEEDS
(AUTOMATIC DATA AT FT. WRIGHT)

				RADAR OFF			RADAR ON		
DAY	LANE	LIGHT	VOLUME	NO. OF HOURS	NO. OF VEHICLES	85TH %TILE SPEED	NO. OF HOURS	NO. OF VEHICLES	85TH %TILE SPEED
1	1	1	1	0	0	-	2	355	74.524
1	1	1	2	2	1,180	71.433	4	2,090	71.593
1	1	1	3	74	59,669	71.224	100	78,738	71.219
1	1	1	4	98	102,910	71.056	164	172,126	71.000
1	1	1	5	70	114,908	70.871	123	196,679	70.745
1	1	2	1	108	8,792	71.991	165	14,286	71.840
1	1	2	2	64	28,274	71.287	93	39,943	71.133
1	1	2	3	28	19,922	71.062	46	32,202	70.963
1	1	2	4	5	5,221	70.805	4	4,094	70.726
1	1	2	5	15	22,765	70.620	19	28,027	66.837
1	2	1	2	0	0	-	2	911	70.962
1	2	1	3	3	2,480	66.477	4	3,430	66.786
1	2	1	4	99	111,034	66.600	127	141,476	66.565
1	2	1	5	140	198,726	66.605	260	370,882	66.486
1	2	2	1	90	15,714	67.455	130	24,251	67.140
1	2	2	2	36	16,597	66.858	64	30,621	66.715
1	2	2	3	48	36,660	66.625	71	54,278	66.481
1	2	2	4	26	26,567	66.527	40	39,995	66.358
1	2	2	5	17	24,265	61.504	21	29,795	61.456
1	3	1	1	2	423	66.957	3	606	67.000
1	3	1	2	7	3,931	61.992	18	9,474	66.867
1	3	1	3	164	127,341	62.164	283	219,290	62.095
1	3	1	4	23	23,541	61.933	49	50,468	61.638
1	3	1	5	22	33,001	57.659	30	47,059	57.476
1	3	2	1	93	17,674	62.220	152	26,899	62.067
1	3	2	2	81	36,638	62.049	137	60,150	61.953
1	3	2	3	13	8,864	61.609	21	14,142	61.736
1	3	2	4	15	15,681	61.486	16	16,729	61.299
1	3	2	5	0	0	-	1	1,295	60.588
2	1	1	1	14	2,471	76.193	11	1,906	75.803
2	1	1	2	19	9,203	75.737	18	8,541	71.817
2	1	1	3	42	32,270	71.423	37	28,629	71.304
2	1	1	4	57	59,260	71.129	40	40,306	71.048
2	1	1	5	27	35,427	71.009	26	33,898	70.766
2	1	2	1	71	7,719	72.057	64	6,826	72.036
2	1	2	2	35	15,488	71.226	29	12,192	71.180
2	1	2	3	11	7,965	71.031	13	8,554	71.042
2	1	2	4	3	3,097	70.592	4	3,868	70.712
2	1	2	5	0	0	-	2	2,647	66.647
2	2	1	2	15	6,476	71.318	11	4,704	67.600
2	2	1	3	19	14,804	67.309	19	14,714	66.986
2	2	1	4	56	61,137	66.719	48	52,524	66.677
2	2	1	5	67	89,037	66.684	54	72,598	66.472
2	2	2	1	40	7,639	67.447	36	7,436	67.147
2	2	2	2	35	14,575	66.852	34	14,687	66.812
2	2	2	3	30	22,629	66.590	23	17,230	66.583
2	2	2	4	11	11,052	61.590	16	16,061	61.712
2	2	2	5	1	1,253	61.418	3	3,899	61.305
2	3	1	1	7	1,591	67.053	8	1,910	67.294
2	3	1	2	29	14,248	66.946	31	15,216	66.880
2	3	1	3	91	65,085	66.841	90	65,170	66.817
2	3	1	4	1	931	65.640	3	3,002	66.336
2	3	1	5	1	1,254	-	0	0	-
2	3	2	1	55	8,470	62.372	64	10,981	67.158
2	3	2	2	44	18,760	61.911	40	17,332	61.881
2	3	2	3	3	1,996	61.373	8	5,390	61.613

Day:
1 Weekday
2 Weekend

Lane:
1 Median
2 Center
3 Shoulder

Light:
1 Daylight
2 Darkness

Volume (vplph):
1 < 300
2 300-599
3 600-899
4 900-1,200
5 > 1,200

TABLE C7. COMPARISON OF STANDARD DEVIATION OF SPEEDS
(AUTOMATIC DATA AT FT. WRIGHT)

				RADAR OFF			RADAR ON		
DAY	LANE	LIGHT	VOLUME	NO. OF HOURS	NO. OF VEHICLES	STD DEV	NO. OF HOURS	NO. OF VEHICLES	STD DEV
1	1	1	1	0	0	-	2	355	5.219
1	1	1	2	2	1,180	4.735	4	2,090	5.120
1	1	1	3	74	59,669	4.733	100	78,738	4.742
1	1	1	4	98	102,910	4.736	164	172,126	4.752
1	1	1	5	70	114,908	6.666	123	196,679	6.237
1	1	2	1	108	8,792	5.773	165	14,286	5.513
1	1	2	2	64	28,274	4.840	93	39,943	4.865
1	1	2	3	28	19,922	4.772	46	32,202	4.700
1	1	2	4	5	5,221	4.676	4	4,094	4.489
1	1	2	5	15	22,765	4.562	19	28,027	4.338
1	2	1	2	0	0	-	2	911	5.106
1	2	1	3	3	2,480	4.641	4	3,430	5.183
1	2	1	4	99	111,034	4.557	127	141,476	4.588
1	2	1	5	140	198,726	5.715	260	370,882	5.536
1	2	2	1	90	15,714	5.535	130	24,251	5.187
1	2	2	2	36	16,597	4.751	64	30,621	4.654
1	2	2	3	48	36,660	4.562	71	54,278	4.571
1	2	2	4	26	26,567	4.516	40	39,995	4.482
1	2	2	5	17	24,265	4.481	21	29,795	4.298
1	3	1	1	2	423	6.814	3	606	5.995
1	3	1	2	7	3,931	6.186	18	9,474	6.506
1	3	1	3	164	127,341	6.246	283	219,290	6.150
1	3	1	4	23	23,541	6.197	49	50,468	5.798
1	3	1	5	22	33,001	6.482	30	47,059	6.151
1	3	2	1	93	17,674	7.105	152	26,899	7.036
1	3	2	2	81	36,638	6.246	137	60,150	6.317
1	3	2	3	13	8,864	5.887	21	14,142	5.988
1	3	2	4	15	15,681	5.851	16	16,729	5.731
1	3	2	5	0	0	-	1	1,295	5.674
2	1	1	1	14	2,471	5.514	11	1,906	5.500
2	1	1	2	19	9,203	4.927	18	8,541	4.926
2	1	1	3	42	32,270	4.821	37	28,629	4.713
2	1	1	4	57	59,260	4.969	40	40,306	4.718
2	1	1	5	27	35,427	4.969	26	33,898	4.523
2	1	2	1	71	7,719	5.720	64	6,826	5.686
2	1	2	2	35	15,488	4.953	29	12,192	5.046
2	1	2	3	11	7,965	4.890	13	8,554	4.815
2	1	2	4	3	3,097	4.493	4	3,868	4.867
2	1	2	5	0	0	-	2	2,647	4.530
2	2	1	2	15	6,476	5.512	11	4,704	5.024
2	2	1	3	19	14,804	4.770	19	14,714	4.679
2	2	1	4	56	61,137	4.597	48	52,524	4.579
2	2	1	5	67	89,037	4.767	54	72,598	4.474
2	2	2	1	40	7,639	5.541	36	7,436	5.170
2	2	2	2	35	14,575	4.874	34	14,687	4.800
2	2	2	3	30	22,629	4.638	23	17,230	4.674
2	2	2	4	11	11,052	4.654	16	16,061	4.657
2	2	2	5	1	1,253	4.529	3	3,899	4.468
2	3	1	1	7	1,591	5.928	8	1,910	5.959
2	3	1	2	29	14,248	5.723	31	15,216	5.644
2	3	1	3	91	65,085	5.676	90	65,170	5.553
2	3	1	4	1	931	4.903	3	3,002	5.059
2	3	1	5	1	1,254	5.477	0	0	-
2	3	2	1	55	8,470	6.543	64	10,981	6.563
2	3	2	2	44	18,760	5.931	40	17,332	5.867
2	3	2	3	3	1,996	5.746	8	5,390	5.632

Day:
1 Weekday
2 Weekend

Lane:
1 Median
2 Center
3 Shoulder

Light:
1 Daylight
2 Darkness

Volume (vplph):
1 < 300
2 300-599
3 600-899
4 900-1,200
5 > 1,200

TABLE C8. COMPARISON OF MEAN SPEEDS (AUTOMATIC DATA AT FLORENCE)

				RADAR OFF			RADAR ON		
DAY	LANE	LIGHT	VOLUME	NO. OF HOURS	NO. OF VEHICLES	MEAN SPEED	NO. OF HOURS	NO. OF VEHICLES	MEAN SPEED
1	1	1	1	39	8,611	67.274	37	8,613	65.789
1	1	1	2	30	12,077	67.037	43	16,933	65.488
1	1	1	3	0	0	-	1	617	65.600
1	1	2	1	67	4,408	65.715	82	6,355	64.533
1	1	2	2	5	1,672	66.500	2	659	65.000
1	2	1	2	16	9,073	63.987	12	6,952	63.475
1	2	1	3	50	35,073	64.480	66	48,199	63.217
1	2	1	4	3	2,773	65.067	3	2,915	63.433
1	2	2	1	42	7,438	63.188	47	8,374	61.474
1	2	2	2	23	9,146	63.335	31	12,996	62.168
1	2	2	3	7	4,705	63.057	6	3,870	62.117
1	3	1	2	65	32,793	59.032	78	39,409	58.171
1	3	1	3	4	2,458	59.975	3	1,962	59.267
1	3	2	1	50	10,726	57.818	53	11,776	56.102
1	3	2	2	22	8,771	58.691	31	11,637	57.532
2	1	1	1	16	2,124	68.212	8	1,065	65.875
2	1	1	2	21	8,727	66.605	9	3,480	64.000
2	1	1	3	7	5,088	66.771	5	3,832	65.140
2	1	1	4	2	1,883	65.650	2	1,916	64.850
2	1	2	1	41	2,741	65.366	22	1,880	62.709
2	1	2	2	5	2,076	65.160	1	472	63.900
2	1	2	3	2	1,407	65.400	1	636	64.400
2	2	1	1	3	608	64.500	2	459	64.000
2	2	1	2	10	4,458	65.060	4	1,785	63.925
2	2	1	3	20	15,253	64.100	11	8,172	61.809
2	2	1	4	13	13,685	63.715	4	4,489	63.050
2	2	1	5	0	0	-	3	3,731	62.433
2	2	2	1	30	5,111	63.520	13	2,079	60.877
2	2	2	2	9	3,760	62.178	7	2,948	59.586
2	2	2	3	6	4,023	62.200	3	2,135	60.700
2	2	2	4	3	2,996	62.333	1	1,004	61.700
2	3	1	1	5	1,068	59.460	3	689	58.300
2	3	1	2	27	13,574	59.296	14	7,294	57.536
2	3	1	3	14	9,615	58.757	7	5,187	58.114
2	3	2	1	34	6,017	58.379	16	2,770	56.075
2	3	2	2	12	5,039	57.450	7	2,864	55.771
2	3	2	3	2	1,290	57.950	1	665	57.300

Day:
1 Weekday
2 Weekend

Lane:
1 Median
2 Center
3 Shoulder

Light:
1 Daylight
2 Darkness

Volume (vplph):
1 < 300
2 300-599
3 600-899
4 900-1,200
5 > 1,200

TABLE C9. COMPARISON OF PERCENTAGE OF VEHICLES EXCEEDING 65 MPH (AUTOMATIC DATA AT FLORENCE)

				RADAR OFF			RADAR ON		
DAY	LANE	LIGHT	VOLUME	NO. OF HOURS	NO. OF VEHICLES	PERCENT EXCEED 65 MPH	NO. OF HOURS	NO. OF VEHICLES	PERCENT EXCEED 65 MPH
1	1	1	1	39	8,611	64.696	37	8,613	52.363
1	1	1	2	30	12,077	63.385	43	16,933	49.572
1	1	1	3	0	0	-	1	617	
1	1	2	1	67	4,408	50.794	82	6,355	43.100
1	1	2	2	5	1,672	56.699	2	659	44.461
1	2	1	2	16	9,073	36.724	12	6,952	31.818
1	2	1	3	50	35,073	40.025	66	48,199	30.123
1	2	1	4	3	2,773	44.501	3	2,915	31.355
1	2	2	1	42	7,438	31.689	47	8,374	21.543
1	2	2	2	23	9,146	31.992	31	12,996	24.138
1	2	2	3	7	4,705	28.778	6	3,870	22.506
1	3	1	2	65	32,793	10.954	78	39,409	8.018
1	3	1	3	4	2,458	14.036	3	1,962	11.009
1	3	2	1	50	10,726	7.281	53	11,776	3.974
1	3	2	2	22	8,771	9.577	31	11,637	6.591
2	1	1	1	16	2,124	71.610	8	1,065	54.554
2	1	1	2	21	8,727	59.883	9	3,480	34.971
2	1	1	3	7	5,088	63.463	5	3,832	46.477
2	1	1	4	2	1,883	52.788	2	1,916	43.894
2	1	2	1	41	2,741	45.677	22	1,880	22.979
2	1	2	2	5	2,076	48.218	1	472	38.771
2	1	2	3	2	1,407	48.685	1	636	38.836
2	2	1	1	3	608	39.145	2	459	37.473
2	2	1	2	10	4,458	45.626	4	1,785	35.854
2	2	1	3	20	15,253	36.596	11	8,172	20.631
2	2	1	4	13	13,685	33.592	4	4,489	28.358
2	2	1	5	0	0	-	3	3,731	
2	2	2	1	30	5,111	34.142	13	2,079	21.260
2	2	2	2	9	3,760	26.197	7	2,948	10.787
2	2	2	3	6	4,023	25.379	3	2,135	16.253
2	2	2	4	3	2,996	23.832	1	1,004	21.514
2	3	1	1	5	1,068	16.199	3	689	10.450
2	3	1	2	27	13,574	11.890	14	7,294	6.828
2	3	1	3	14	9,615	9.641	7	5,187	7.654
2	3	2	1	34	6,017	10.686	16	2,770	5.271
2	3	2	2	12	5,039	7.759	7	2,864	3.806
2	3	2	3	2	1,290	6.977	1	665	4.361

Day:
1 Weekday
2 Weekend

Lane:
1 Median
2 Center
3 Shoulder

Light:
1 Daylight
2 Darkness

Volume (vplph):
1 < 300
2 300-599
3 600-899
4 900-1,200
5 > 1,200

TABLE C10. COMPARISON OF PERCENTAGE OF VEHICLES EXCEEDING 70 MPH (AUTOMATIC DATA AT FLORENCE)

				RADAR OFF			RADAR ON		
DAY	LANE	LIGHT	VOLUME	NO. OF HOURS	NO. OF VEHICLES	PERCENT EXCEED 70 MPH	NO. OF HOURS	NO. OF VEHICLES	PERCENT EXCEED 70 MPH
1	1	1	1	39	8,611	21.461	37	8,613	13.932
1	1	1	2	30	12,077	20.378	43	16,933	11.658
1	1	1	3	0	0	-	1	617	
1	1	2	1	67	4,408	16.742	82	6,355	12.195
1	1	2	2	5	1,672	15.849	2	659	10.470
1	2	1	2	16	9,073	8.365	12	6,952	7.365
1	2	1	3	50	35,073	9.802	66	48,199	6.096
1	2	1	4	3	2,773	10.746	3	2,915	5.489
1	2	2	1	42	7,438	9.344	47	8,374	5.266
1	2	2	2	23	9,146	8.266	31	12,996	5.186
1	2	2	3	7	4,705	6.291	6	3,870	3.902
1	3	1	2	65	32,793	2.110	78	39,409	1.467
1	3	1	3	4	2,458	3.824	3	1,962	2.090
1	3	2	1	50	10,726	1.510	53	11,776	.807
1	3	2	2	22	8,771	1.870	31	11,637	1.169
2	1	1	1	16	2,124	27.966	8	1,065	14.836
2	1	1	2	21	8,727	17.303	9	3,480	6.609
2	1	1	3	7	5,088	15.586	5	3,832	8.612
2	1	1	4	2	1,883	9.772	2	1,916	7.307
2	1	2	1	41	2,741	14.995	22	1,880	4.521
2	1	2	2	5	2,076	11.802	1	472	6.992
2	1	2	3	2	1,407	11.087	1	636	8.648
2	2	1	1	3	608	12.007	2	459	9.150
2	2	1	2	10	4,458	12.808	4	1,785	8.011
2	2	1	3	20	15,253	8.215	11	8,172	3.647
2	2	1	4	13	13,685	6.686	4	4,489	4.812
2	2	1	5	0	0	-	3	3,731	
2	2	2	1	30	5,111	10.272	13	2,079	5.051
2	2	2	2	9	3,760	6.702	7	2,948	1.967
2	2	2	3	6	4,023	5.518	3	2,135	3.185
2	2	2	4	3	2,996	5.007	1	1,004	3.586
2	3	1	1	5	1,068	2.903	3	689	2.032
2	3	1	2	27	13,574	2.416	14	7,294	1.097
2	3	1	3	14	9,615	1.706	7	5,187	1.484
2	3	2	1	34	6,017	2.476	16	2,770	1.119
2	3	2	2	12	5,039	1.766	7	2,864	.314
2	3	2	3	2	1,290	1.240	1	665	.301

Day:
1 Weekday
2 Weekend

Lane:
1 Median
2 Center
3 Shoulder

Light:
1 Daylight
2 Darkness

Volume (vplph):
1 < 300
2 300-599
3 600-899
4 900-1,200
5 > 1,200

TABLE C11. COMPARISON OF PERCENTAGE OF VEHICLES EXCEEDING 75 MPH (AUTOMATIC DATA AT FLORENCE)

				RADAR OFF			RADAR ON		
DAY	LANE	LIGHT	VOLUME	NO. OF HOURS	NO. OF VEHICLES	PERCENT EXCEED 75 MPH	NO. OF HOURS	NO. OF VEHICLES	PERCENT EXCEED 75 MPH
1	1	1	1	39	8,611	5.028	37	8,613	2.868
1	1	1	2	30	12,077	4.372	43	16,933	1.990
1	1	1	3	0	0	-	1	617	
1	1	2	1	67	4,408	4.741	82	6,355	3.021
1	1	2	2	5	1,672	3.768	2	659	1.973
1	2	1	2	16	9,073	1.841	12	6,952	1.266
1	2	1	3	50	35,073	2.130	66	48,199	1.137
1	2	1	4	3	2,773	2.164	3	2,915	.755
1	2	2	1	42	7,438	2.514	47	8,374	1.230
1	2	2	2	23	9,146	1.848	31	12,996	1.062
1	2	2	3	7	4,705	1.063	6	3,870	.775
1	3	1	2	65	32,793	.467	78	39,409	.335
1	3	1	3	4	2,458	.936	3	1,962	.510
1	3	2	1	50	10,726	.392	53	11,776	.144
1	3	2	2	22	8,771	.319	31	11,637	.275
2	1	1	1	16	2,124	7.062	8	1,065	4.695
2	1	1	2	21	8,727	3.231	9	3,480	1.092
2	1	1	3	7	5,088	2.437	5	3,832	1.331
2	1	1	4	2	1,883	1.434	2	1,916	.992
2	1	2	1	41	2,741	4.524	22	1,880	.904
2	1	2	2	5	2,076	2.601	1	472	.636
2	1	2	3	2	1,407	1.990	1	636	1.258
2	2	1	1	3	608	4.441	2	459	1.961
2	2	1	2	10	4,458	2.759	4	1,785	1.681
2	2	1	3	20	15,253	1.632	11	8,172	.661
2	2	1	4	13	13,685	1.242	4	4,489	1.025
2	2	1	5	0	0	-	3	3,731	
2	2	2	1	30	5,111	2.544	13	2,079	1.058
2	2	2	2	9	3,760	1.543	7	2,948	.475
2	2	2	3	6	4,023	1.143	3	2,135	.375
2	2	2	4	3	2,996	.868	1	1,004	.398
2	3	1	1	5	1,068	.468	3	689	.581
2	3	1	2	27	13,574	.479	14	7,294	.288
2	3	1	3	14	9,615	.468	7	5,187	.366
2	3	2	1	34	6,017	.565	16	2,770	.217
2	3	2	2	12	5,039	.437	7	2,864	.105
2	3	2	3	2	1,290	.310	1	665	.150

Day:
1 Weekday
2 Weekend

Lane:
1 Median
2 Center
3 Shoulder

Light:
1 Daylight
2 Darkness

Volume (vplph):
1 < 300
2 300-599
3 600-899
4 900-1,200
5 > 1,200

TABLE C12. COMPARISON OF PERCENTAGE OF VEHICLES EXCEEDING 80 MPH (AUTOMATIC DATA AT FLORENCE)

				RADAR OFF			RADAR ON		
DAY	LANE	LIGHT	VOLUME	NO. OF HOURS	NO. OF VEHICLES	PERCENT EXCEED 80 MPH	NO. OF HOURS	NO. OF VEHICLES	PERCENT EXCEED 80 MPH
1	1	1	1	39	8,611	1.243	37	8,613	.720
1	1	1	2	30	12,077	1.068	43	16,933	.567
1	1	1	3	0	0	-	1	617	
1	1	2	1	67	4,408	1.838	82	6,355	1.117
1	1	2	2	5	1,672	1.196	2	659	1.062
1	2	1	2	16	9,073	.408	12	6,952	.360
1	2	1	3	50	35,073	.570	66	48,199	.367
1	2	1	4	3	2,773	.721	3	2,915	.480
1	2	2	1	42	7,438	.820	47	8,374	.322
1	2	2	2	23	9,146	.601	31	12,996	.369
1	2	2	3	7	4,705	.298	6	3,870	.181
1	3	1	2	65	32,793	.174	78	39,409	.127
1	3	1	3	4	2,458	.407	3	1,962	.102
1	3	2	1	50	10,726	.177	53	11,776	.093
1	3	2	2	22	8,771	.080	31	11,637	.112
2	1	1	1	16	2,124	1.789	8	1,065	1.315
2	1	1	2	21	8,727	.768	9	3,480	.489
2	1	1	3	7	5,088	.649	5	3,832	.339
2	1	1	4	2	1,883	.637	2	1,916	.209
2	1	2	1	41	2,741	1.459	22	1,880	.160
2	1	2	2	5	2,076	.434	1	472	.212
2	1	2	3	2	1,407	.426	1	636	.314
2	2	1	1	3	608	1.316	2	459	.654
2	2	1	2	10	4,458	.763	4	1,785	.392
2	2	1	3	20	15,253	.492	11	8,172	.257
2	2	1	4	13	13,685	.329	4	4,489	.356
2	2	1	5	0	0	-	3	3,731	
2	2	2	1	30	5,111	.998	13	2,079	.337
2	2	2	2	9	3,760	.479	7	2,948	.237
2	2	2	3	6	4,023	.199	3	2,135	.141
2	2	2	4	3	2,996	.267	1	1,004	.000
2	3	1	1	5	1,068	.094	3	689	.145
2	3	1	2	27	13,574	.177	14	7,294	.110
2	3	1	3	14	9,615	.135	7	5,187	.154
2	3	2	1	34	6,017	.199	16	2,770	.108
2	3	2	2	12	5,039	.198	7	2,864	.070
2	3	2	3	2	1,290	.078	1	665	.150

Day:
1 Weekday
2 Weekend

Lane:
1 Median
2 Center
3 Shoulder

Light:
1 Daylight
2 Darkness

Volume (vplph):
1 < 300
2 300-599
3 600-899
4 900-1,200
5 > 1,200

TABLE C13. COMPARISON OF 85TH PERCENTILE SPEEDS
(AUTOMATIC DATA AT FLORENCE)

				RADAR OFF			RADAR ON		
DAY	LANE	LIGHT	VOLUME	NO. OF HOURS	NO. OF VEHICLES	85TH %TILE SPEED	NO. OF HOURS	NO. OF VEHICLES	85TH %TILE SPEED
1	1	1	1	39	8,611	76.477	37	8,613	71.790
1	1	1	2	30	12,077	76.338	43	16,933	71.526
1	1	1	3	0	0	-	1	617	
1	1	2	1	67	4,408	76.877	82	6,355	71.935
1	1	2	2	5	1,672	75.617	2	659	71.205
1	2	1	2	16	9,073	71.437	12	6,952	71.462
1	2	1	3	50	35,073	71.617	66	48,199	71.262
1	2	1	4	3	2,773	71.516	3	2,915	70.962
1	2	2	1	42	7,438	72.051	47	8,374	71.563
1	2	2	2	23	9,146	71.718	31	12,996	71.338
1	2	2	3	7	4,705	71.313	6	3,870	70.944
1	3	1	2	65	32,793	67.069	78	39,409	66.776
1	3	1	3	4	2,458	67.278	3	1,962	66.933
1	3	2	1	50	10,726	66.671	53	11,776	66.382
1	3	2	2	22	8,771	66.949	31	11,637	66.704
2	1	1	1	16	2,124	76.352	8	1,065	71.690
2	1	1	2	21	8,727	75.995	9	3,480	71.089
2	1	1	3	7	5,088	75.778	5	3,832	71.085
2	1	1	4	2	1,883	71.045	2	1,916	70.892
2	1	2	1	41	2,741	72.313	22	1,880	71.009
2	1	2	2	5	2,076	71.184	1	472	70.600
2	1	2	3	2	1,407	71.161	1	636	71.042
2	2	1	1	3	608	71.610	2	459	71.038
2	2	1	2	10	4,458	71.823	4	1,785	71.288
2	2	1	3	20	15,253	71.415	11	8,172	71.019
2	2	1	4	13	13,685	71.180	4	4,489	70.951
2	2	1	5	0	0	-	3	3,731	
2	2	2	1	30	5,111	72.001	13	2,079	71.355
2	2	2	2	9	3,760	71.588	7	2,948	66.712
2	2	2	3	6	4,023	71.212	3	2,135	70.950
2	2	2	4	3	2,996	70.933	1	1,004	70.583
2	3	1	1	5	1,068	70.273	3	689	66.887
2	3	1	2	27	13,574	67.200	14	7,294	66.669
2	3	1	3	14	9,615	66.880	7	5,187	66.608
2	3	2	1	34	6,017	67.233	16	2,770	66.534
2	3	2	2	12	5,039	66.812	7	2,864	66.103
2	3	2	3	2	1,290	66.005	1	665	65.515

Day:
1 Weekday
2 Weekend

Lane:
1 Median
2 Center
3 Shoulder

Light:
1 Daylight
2 Darkness

Volume (vplph):
1 < 300
2 300-599
3 600-899
4 900-1,200
5 > 1,200

TABLE C14. COMPARISON OF STANDARD DEVIATIONS OF SPEED (AUTOMATIC DATA AT FLORENCE)

				RADAR OFF			RADAR ON		
DAY	LANE	LIGHT	VOLUME	NO. OF HOURS	NO. OF VEHICLES	STD DEV	NO. OF HOURS	NO. OF VEHICLES	STD DEV
1	1	1	1	39	8,611	5.041	37	8,613	5.121
1	1	1	2	30	12,077	5.043	43	16,933	4.851
1	1	1	3	0	0	-	1	617	
1	1	2	1	67	4,408	5.957	82	6,355	5.761
1	1	2	2	5	1,672	4.896	2	659	5.067
1	2	1	2	16	9,073	5.272	12	6,952	5.172
1	2	1	3	50	35,073	5.251	66	48,199	5.148
1	2	1	4	3	2,773	5.041	3	2,915	4.888
1	2	2	1	42	7,438	6.173	47	8,374	5.697
1	2	2	2	23	9,146	5.630	31	12,996	5.384
1	2	2	3	7	4,705	5.116	6	3,870	5.109
1	3	1	2	65	32,793	5.578	78	39,409	5.440
1	3	1	3	4	2,458	5.738	3	1,962	5.377
1	3	2	1	50	10,726	5.524	53	11,776	5.227
1	3	2	2	22	8,771	5.406	31	11,637	5.328
2	1	1	1	16	2,124	5.293	8	1,065	5.192
2	1	1	2	21	8,727	4.975	9	3,480	4.819
2	1	1	3	7	5,088	4.556	5	3,832	4.549
2	1	1	4	2	1,883	4.556	2	1,916	4.446
2	1	2	1	41	2,741	6.244	22	1,880	5.233
2	1	2	2	5	2,076	5.265	1	472	4.936
2	1	2	3	2	1,407	4.955	1	636	4.876
2	2	1	1	3	608	6.210	2	459	5.422
2	2	1	2	10	4,458	5.485	4	1,785	5.282
2	2	1	3	20	15,253	5.205	11	8,172	5.182
2	2	1	4	13	13,685	4.997	4	4,489	4.985
2	2	1	5	0	0	-	3	3,731	
2	2	2	1	30	5,111	6.049	13	2,079	5.919
2	2	2	2	9	3,760	5.951	7	2,948	5.363
2	2	2	3	6	4,023	5.556	3	2,135	5.293
2	2	2	4	3	2,996	5.190	1	1,004	5.042
2	3	1	1	5	1,068	6.097	3	689	5.776
2	3	1	2	27	13,574	5.611	14	7,294	5.546
2	3	1	3	14	9,615	5.446	7	5,187	5.465
2	3	2	1	34	6,017	5.884	16	2,770	5.720
2	3	2	2	12	5,039	5.941	7	2,864	5.475
2	3	2	3	2	1,290	5.490	1	665	4.924

Day:
1 Weekday
2 Weekend

Lane:
1 Median
2 Center
3 Shoulder

Light:
1 Daylight
2 Darkness

Volume (vplph):
1 < 300
2 300-599
3 600-899
4 900-1,200
5 > 1,200